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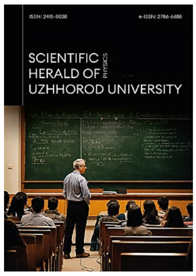

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Methodology of interdisciplinary connections of physics and mathematics in primary school when solving physical problems

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Abstract

Relevance. The relevance of the research is due to the need to develop a methodology for implementing interdisciplinary connections of physics and mathematics in primary school when solving physical problems, as well as a detailed study of various aspects of interdisciplinary connections.

Purpose. This article is aimed at conducting an analysis to identify the implementation factors of interdisciplinary connections of physics and mathematics in primary school when solving physical problems, as well as drawing up methodological recommendations aimed at implementing the methodology of interdisciplinary education among schoolchildren and students.

Methodology. The methods include system analysis, logical analysis, comparative method, synthesis and deduction methods, and classification method.

Results. The study of interdisciplinary connections of physics and mathematics in primary school when solving physical problems, as well practical methods, require a number of research methods that allow studying the implementation of interdisciplinary connections in the most thorough way. The article presents the analysis results, reveals the implementation of interdisciplinary connections of physics and mathematics in the primary school when solving physical problems, and compiles methodological recommendations aimed at implementing the methodology of interdisciplinary education of schoolchildren and students.

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Conclusions. The materials of the article are of practical value for teachers and students of pedagogical universities, school teachers of physics and mathematics, authors of physics textbooks for secondary school students.

Keywords: using the interdisciplinary potential; improving the level of academic performance of schoolchildren; topical issues of school education.

Introduction

The last century has brought many achievements in the science of learning, from the expansion of the theoretical framework underlying research in education to cultural and contextual innovations in educational practice [1]. Currently, the goal of the school is to develop students' ability to learn throughout their lives, to think and act in difficult situations, to live in a diverse world as an active and responsible member of society. The key to the success of a school graduate is not the amount of its knowledge, but what it can do with this knowledge. Thus, the main attention should be paid to the development of students' competencies, the basis of which is interdisciplinary education. Competencies provide for the application of knowledge in various situations, which are included in integrated programs, because they are, in fact, interdisciplinary and prepare students for lifelong learning [2].

Interdisciplinary education is a term that refers to the principle of learning, which aims to approach school knowledge through global study and solving problems. First, interdisciplinarity begins at the level of scientific research, and then extends to the field of education [3]. Interdisciplinarity is important not only for students when studying a particular discipline or synthesizing a solution to a problem, but also enriches their lifelong learning habits, academic skills and personal growth. Such education is aimed at developing border-crossing skills. For example, the ability to change the point of view, synthesize knowledge from different disciplines and cope with difficulties are the skills of overcoming boundaries. To implement interdisciplinary education, firs, it is necessary to develop transversal skills, as they help to see the further synthesis of knowledge and skills in various school subjects in the pedagogical process.

The priority that is given to the consideration of important issues for students and the research processing of questions makes the interdisciplinary approach student-oriented, both from the point of view of the concept and from the point of view of the methodological approach. An interdisciplinary approach allows students to participate more actively in learning, and teachers can pay more attention to lagging students. Students can become independent and confident in their knowledge, who "learn to learn" and develop lifelong learning skills. Interdisciplinary education is characterized as a process in which students combine information, methods, tools, perspectives, opportunities, ideas, concepts and theories from two or more fields to create "products", explain phenomena or solve problems [4].

In the interdisciplinary pedagogical process, problematic issues are highlighted, the most appropriate ways of solving problems are applied, the results obtained are tested, and the process of solving problematic issues leads to the formulation and analysis of what new knowledge and skills have been obtained, what skills and knowledge have been improved, what is the contribution to the development of students. Such an educational process, through which the student integrates his views and ways of thinking from various fields, facilitating thematic understanding of a specific area, determines the formation of an understanding of interdisciplinary teaching /learning content. The benefits of interdisciplinary teaching and learning are well known. The interdisciplinary approach has many advantages, such as expanding students' understanding and academic performance in all disciplines and improving their communication skills [5].

Materials and Methods

The study of interdisciplinary connections of physics and mathematics in primary school when solving physical problems, as well practical methods, require a number of research methods that allow studying the implementation of interdisciplinary connections in the most thorough way. Such methods include system analysis, logical analysis, comparative method, synthesis and deduction methods, and classification method.

System analysis is the main method, which is used to study and construct complex objects. It was used to study the idea of implementing interdisciplinary connections of physics and mathematics in primary school when solving physical problems as a tool to improve the quality of education in the context of a complex composite structure of exact and natural sciences. Logical analysis is based on the principles of logic: the laws of thinking, judgments and conclusions, the definition and use of concepts, facts. Logical analysis was used to reproduce the process of implementing interdisciplinary connections of physics and mathematics in the basic school when solving physical problems. The comparative method is used to compare various indicators, characteristics and patterns. It can be used to compare two or more objects, helping to determine the common and excellent qualities of these objects. In this study, the comparison method was used to compare factors related to the implementation of interdisciplinary connections of physics and mathematics in primary school students of different age groups. The synthesis method is characterized by the collection of all data and results into a single whole, thus allowing you to create a unified system and get an idea of previously unknown connections between the elements of the study. The synthesis method was used to systematize information about the connections between various methods of implementing interdisciplinary connections of physics and mathematics, as well as to assess their impact on each other, on the general level of knowledge and on the academic performance of students.

Deduction is a method of cognition, which is based on the transition from the general to the particular; conclusions when using the method of deduction are based on well-known and proven facts. In this work, the deduction method was used to detail the constituent elements of interdisciplinary learning. Classification is a research method in which a given set of objects is divided into independent subsets according to various classification criteria. Both physical objects and various ideas, theories or data can act as classified objects. In this study, the classification method was used to distinguish the constituent elements of interdisciplinary learning in the category.

In addition, a theoretical analysis of scientific publications of recent years was carried out during this study. Pedagogical theorists and practitioners often consider and study issues related to the implementation of interdisciplinary connections of physics and mathematics in the process of obtaining secondary and higher education. In recent years, foreign scientists and scientists from the Republic of Kazakhstan have been exploring problems and ways to improve the situation in the development and support of the implementation of interdisciplinary teaching methods.

Results

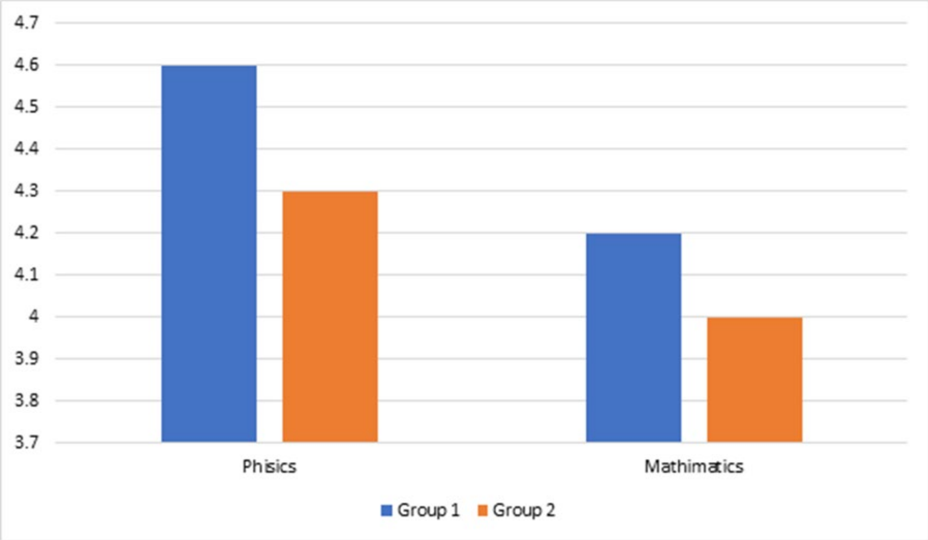
Interdisciplinary training is carried out through research activities and solving problems in the current individual training programs. Knowledge and skills acquired in several school subjects, as well as cross-cutting skills that are becoming increasingly relevant, are used in the study and solution of problem situations, if we are talking about the integrated use of knowledge and skills acquired during school.

An interdisciplinary approach in education combines various subjects and disciplines in teaching. Regardless of the level of education, an interdisciplinary approach helps to recognize the acquired knowledge, connections and their application in various disciplines and situations. When natural and exact sciences are combined, solving physics problems is a very good way to bring students closer to physics using mathematical content.

The solution of a physical problem begins in education and in science with a real problem, where the solution of the problem is built in stages. When studying the task itself, the learning process is aimed at other disciplines, as well as at achieving the desired results [6]. Many studies concerned the problem of joint teaching of mathematical and natural science content. In addition, the language of mathematics explains a wide range of natural phenomena, which helps implement interdisciplinary connections of physics and mathematics.

Numerous national initiatives call for interdisciplinary mathematical and natural science education, but only a few empirical studies examine the practical aspects of integrated learning in secondary schools. Weinberg A. and McMicking L. conducted a study aimed at studying two aspects of interdisciplinary education. First, the study was aimed at describing how and to what extent teachers integrate math and science curricula in their classrooms after participating in an event to promote and support the integration of mathematics and science. The results showed that measures to promote and support the integration of mathematics and natural sciences had a positive impact on the effectiveness of interdisciplinary education, and the method of interdisciplinary connections according to the educational content is most often used. Second, the study was aimed at expanding the understanding of the obstacles and factors that allow the use of integrated approaches in high school classrooms. It was shown that the main deterrent was an overly saturated subject program, which did not allow teachers to implement meaningful integration of mathematics and natural sciences. The theoretical component was based on previous models of integration of science and mathematics and adapted them to present interdisciplinary structures for identifying and defining integration strategies in the classroom. Finally, the authors proposed the conceptualization of the "interdisciplinary pedagogical content of knowledge" in mathematics and natural sciences as an area of attention that will allow teachers to move successfully from classical to interdisciplinary learning [7].

A study was also conducted to determine whether students from groups where students of physics and mathematics classes studied mathematics and physics subjects in interdisciplinary classes passed tests better than students of physics and mathematics classes who attended physics and mathematics classes separately. There were two types of groups; in the first (Group 1, test), connections were established between subjects through math lessons, which also included topics in physics, as well as practices for creating interdisciplinary group presentations by students. In the other group (Group 2, control), interdisciplinary connections were not implemented. The results showed that students from the first group had higher average scores in both physics and mathematics than students from the second group (Figure 1). Thus, it can be argued that students do better on tests when they make efforts to consolidate information through interdisciplinary connections.



Today, education is largely based on disciplinary approaches and programs in schools and universities, although there has been a big shift towards interdisciplinary teamwork over the past 20 years. This shift is visible on the websites of many innovative and integrated research institutes, where interdisciplinary research automatically becomes part of the research program. Interdisciplinary trends are also found in these publications, where more than one third of the references in scientific articles relate to other disciplines. Despite the development of interdisciplinary research, innovation centers and interdisciplinary teamwork, the side effects of interdisciplinary working methods are very slowly being integrated into academic education. This may be due to the lack of information about what interdisciplinary research and education specifically mean, as well as what can be learned from interdisciplinary research if applied to educational design [8].

The essence of interdisciplinary learning consists of its vision (ideas and intentions), the learning process and integrated methods to facilitate the learning process (Table 1).

Table 1. Constituent elements of interdisciplinary learning

Interdisciplinary education		
Vision	**Training**	**Simplification**
curriculum development; educational policy; cooperation; knowledge exchange.	pedagogy; innovation; practice; evaluation; student and teacher characteristics; learning objectives; indicators; phasing.	infrastructure; tools and methods; coordination; teacher skills development;

Note: compiled by the author.

The process of implementing the interdisciplinary educational approach of physics and mathematics in solving physical problems should consist of the following sequential stages: analysis; design; development; introduction.

The first stage is the starting one, its essence is to determine possible areas of intersection between disciplines that would meet the tasks set (in a particular case, they would be applicable to solving physical problems for secondary school students). At the design stage of the interdisciplinary methodology, the process of analyzing the selected areas of intersection occurs, those that for some reason cannot be correctly implemented in any of the topics in the process of teaching physics when solving problems are cut off. The third stage is development. It is characterized by full-fledged work on the description of the methodology for implementing interdisciplinary connections between physics and mathematics in solving physical problems, methodological manuals for teachers, school textbooks containing developed materials, etc. are being developed. At the final stage, all developments are implemented in the school physics course.

It is also necessary to check the mathematical record of the solution of this problem, that is, the teacher should pay attention to the correspondence of the course of reasoning to the notes on the blackboard and in notebooks. As an example, we can consider such a problem with a solution in the sources [9]: "Over a 5 km^2 area of the Earth's surface, a 1 km thick layer of air has a temperature of 20^{0}C at a relative humidity of 73%. The air cooled to 10^{0}C. It is necessary to find the mass of the fallen rain and the thickness of the precipitation layer on the Earth's surface".

Solution. To answer the first question of the problem, students need to know that the mass of rain that has fallen depends on the mass of precipitation that has fallen from each 1 m^2 of air and the volume of airspace from which it falls. In addition, for the critical thinking of students, you can ask the following question: in what case will precipitation fall? According to the materials passed, students can expect the following answer: if the vapor density (p_v) at a given temperature is less than or equal to the saturation vapor density ($_{sv}$) at the same temperature, then there will be no precipitation. Therefore, in this problem p_v at 20^0C will be greater than p_{sv} at 10^0 C With that precipitation will fall. To find out, students find the amount of water vapor contained in 1 m^3 of air at 20^0 C With a relative humidity of 73%, then determine the amount of water vapor saturating this volume of air at 10^0C.

Students formalize all these arguments mathematically and this record should be in this form (Table 2).

Table 2. Students mathematically formalized arguments

Given	**SI**	**Solution**
S=5 km ^{2} h=1 km t_1=20 ^{0} S t_2=10 ^{0} S φ=73%. m_{rain}- ? $h_{precipitation}$-?	5*10 ^{6} m^2 10 ^{3} m 0,73 kg -? m -?	m= VΔρ , where V=Sh $\Delta\rho = p_v - p_{sv}$ = (12.63 г/m^3 - 9,4 г/m^3)= 3.23 г/m^3 $p_v = \rho^{/}_{нп}\varphi$ $\rho^{/}_{нп} = 17.3 g/m^3$ So, p_v= 17.3g/m^3 *0.73 =12.63 g/m^3 According to the table, at 10^0C p_v=9.4 g/m^3 $p_v > p_{sv}$; 12.63 g/m ^{3}> 9.4 г/m ^{3} that is, precipitation will fall. Now it remains to find the value of the mass of rain that fell on the entire area: m= VΔρ= ΔρSh =(p_v - p_{sv}) Sh m=3.23 *10^{-3} kg/m^3 * 5*10^6 ^{m2}*10^3 m=16.15*10^6 kg or 16.15*10^3 t. To find the thickness of the water layer from precipitation, you can use the following formula: m = ρSh $_{precipitation}$, from there, $h_{precipitation} = \frac{m}{\rho S}$ $h_{precipitation} = \frac{16,15*10^6\ kg}{5*10^6\ м^2*10^3 kg/м^3}$ ≈3.2 mm Answer: 16.15*10^3 t; 3.2 mm.

Because only the course of reasoning, its correctness, and logic can be checked when a student solves a problem at the blackboard. The question of how the answer to the problem will change if the condition is changed in a certain way is of great importance for checking the understanding of the phenomena considered during the solution of the problem, the interrelation of phenomena, the understanding of the applied laws. That is, the student correctly explains the change in the answer, and then you can be sure that they will always cope with such types of tasks. In all other cases, the teacher is forced to confine himself to a brief record of the solution of the problem. The verification of the solution of the problem consists of checking the analysis of the problem condition, checking the mathematical record of the solution and checking the result and its analysis [9].

The analysis of the application results of the interdisciplinary approach to school education should be based on an assessment of each of the stages to identify the weaknesses of the process in the place of their origin. Despite mathematical skills are of great importance in research fields, mathematical education today rarely maintains interdisciplinary and educational links with physics. In fact, sometimes, mathematics, physics and biology seem to be separate subjects and little interrelated with mathematics from the point of view of students. This separation generates many theoretical misunderstandings in the process of studying some important concepts. For example, students who demonstrate good computing skills still do not have the opportunity to apply these skills in a meaningful way. This means that students focus their attention more on basic understanding and memorizing concepts and formulas than on critical thinking. In this sense, the promotion of creative and flexible frameworks is a key aspect of educational innovation for integrating productive ideas from different disciplines [10].

Discussion

Despite the fact that many studies of interdisciplinary education are currently being conducted, it remains a difficult task to formulate general strategies for the implementation of interdisciplinary education in such a way that students in the future become qualified specialists in the field of joint solution of problems. The ability to cross borders is considered fundamental for all scientists, engineers and other specialists if the goal is to solve the problems of the modern world. At the University of Twente, there is currently an opportunity to study the various responses of teachers to this problem through the implementation of a program that offers secondary courses to achieve the goals of interdisciplinary learning. A comparison was made between 10 additional courses to identify similarities and differences, as well as related problems regarding how the teachers of each course coped with their interdisciplinary task. To make this comparison, students' point of view was taken into account through interviews and assessments, in addition to classroom research and semi-structured interviews with teachers. There is little information in the modern literature about how students perceive interdisciplinary education, but such information can help to understand the complexity that needs to be overcome for interdisciplinary pedagogy. As a result, a number of different interdisciplinary educational projects were identified, with different problems for each, beyond the canonical model of design based on collaboration [11-13].

As a result of the study of students' interest and motivation in interdisciplinary education in the form of additional courses implementing interdisciplinary connections of physics and mathematics, with the help of preliminary and subsequent surveys (n = 5271 and n = 1323), it was revealed that students who were not previously interested in these subjects became more motivated and interested in studying exact and natural sciences, which indicates the impact of the program on participating students [14].

Problem-based learning is often characterized as an approach encompassing interdisciplinary learning; however, little attention is paid to what the statement of interdisciplinary problem-based learning means practically. Even less attention is paid to the consequences of interdisciplinary problem-based learning for students, teachers and educational institutions [15; 16]. To investigate these issues, an analysis was carried out of the intentions and principles of interdisciplinary learning and problem-based learning, respectively. Scientists have revealed a significant overlap between the two points of view, which, it is claimed, makes problem-oriented teaching a potentially convincing pedagogical practice that promotes the study of different disciplines by students. The study also examined various obstacles to be eliminated to realize the potential of interdisciplinary learning in problematic conditions. These obstacles are related to the organization of the curriculum, the development of students' competencies to solve interdisciplinary problems and the development of teachers' competencies to meet the needs of students. The conclusion is that interdisciplinary learning cannot be taken for granted in problematic conditions and only if the issues of interdisciplinary learning are specifically addressed, problem-based learning can be considered as a pedagogical approach that adequately supports interdisciplinary learning in education [17-19].

Interdisciplinary training programs are not uncommon in modern educational institutions, and both the advantages and disadvantages of interdisciplinary education are discussed in the literature. Interdisciplinary education allows you to synthesize ideas and characteristics of several disciplines. At the same time, it takes into account the individual differences of students and helps to develop important and transferable skills. The interdisciplinary approach involves students in so-called deep learning: cognitive scientists talk about deep learning – or what they might call "learning for understanding" - as the ability to organize individual pieces of knowledge into a larger scheme of understanding another aspect [20; 21]. There is deep understanding that it requires both a significant set of factual knowledge and the ability to use this factual knowledge to develop interpretations, arguments and conclusions. Indeed, traditional teaching was practiced in accordance with the paradigm or assumption that it consisted in the transfer of knowledge from the authority - the teacher - to the students. However, modern realities show that education consists in acts of cognition, and not in the transmission of information. This is a learning situation in which the cognizable object (and not the end of the cognitive act) is an intermediate link between cognitive participants - teachers on the one hand and students on the other. Training should be aimed at developing students' independent analytical thinking and even at creating their original activities [22-24].

Teaching and learning is a system consisting of many components, including goals, results, teaching methods, curricula, etc. To achieve general and specific educational goals, it is assumed that in practice it is necessary to actively use interdisciplinary connections. The teaching method based on practical exercises plays a crucial role in achieving all kinds of goals and objectives. It ensures the involvement of cognitive, affective and psychomotor functions of the brain, thereby showing promising results. The practical method of training, based on interdisciplinary connections, prepares students for the upcoming life tasks and meets their future professional goals. Practical classes play a huge role in the pedagogical, andragogical and eutagogic aspects of education. The practical approach based on interdisciplinary connections is a full-fledged means to expand the possibilities of the interdisciplinary aspect of teaching [25; 26].

Analyzing the issues of curriculum reform, reform of teaching methods and innovations, context-based learning, as well as the assessment system in interdisciplinary education, scientists Yao Yao, Pan Qi and Yiming Zhu came to the conclusion that the curriculum should include courses in different disciplines, contain more hours of practical classes and emphasize the interaction between different subjects. The teaching method should subject to critical thinking and higher-level thinking to develop students' problem-solving abilities. In interdisciplinary education, an innovative approach should be applied to improve the quality of education. Context-based education requires accelerating information updating in textbooks, adaptation to the labor market and entrepreneurship training. In addition, an assessment standard should be developed and implemented for interdisciplinary education to balance theoretical research and practical application of knowledge to guarantee the effectiveness of learning outcomes [27].

Although interdisciplinary education is necessary and unavoidable, many current interdisciplinary efforts in secondary education are underdeveloped. It is equally important that most educational institutions still provide education as a "product", following the models of the XIX and XX centuries. However, modern interdisciplinary education should be considered and provided to students as a "process", fully integrating theoretical thinking and practical application of the subjects studied. Modern interdisciplinary education does not consider the components of STEM and humanities as a dichotomy, as it used to be. The success of applying this new educational model in real conditions depends on all relevant disciplines and ways of thinking. Its dynamic and modular curriculum development process should be based on the theory of system design and information technology to create a unique infrastructure and knowledge-based structure - fully integrated, decentralized and extremely flexible - capable of quickly adapting to global and technological changes [28; 29].

Today, school teachers must teach students to go beyond their discipline and find innovative solutions to problems. Many teachers would like to pay more attention to teaching students how to integrate different forms of knowledge, work together in teams, think critically and become self-regulating students [30; 31].

Interdisciplinary initiatives are encouraged in educational curricula, especially in the field of exact and natural sciences, because of the fact that this industry requires trained specialists with multidisciplinary competence to solve complex real-world problems. However, distance due to disciplinary differences creates big problems for interdisciplinary teaching and learning. How can interdisciplinary teachers effectively cooperate in teaching, and how can students with different levels of training gain important knowledge? Collaboration for interdisciplinary learning is challenging for teachers, as they are usually in different learning contexts, and tend to speak different disciplinary languages and appreciate different disciplinary cultures [32-34].

The construction of an interdisciplinary educational program is a multi-stage process, since it reflects the dynamics of student learning and should allow for timely adjustment of the educational process [35].

When planning the curriculum and classroom instruction, it is important to apply an interdisciplinary approach. Interdisciplinary connections or connections related to several fields of knowledge are welcomed as the latest best practices in the field of school education. There are many types of students. To meet the needs of each student, it is necessary to use different teaching methods combining different areas of development [36; 37].

Interdisciplinary learning allows teachers and students to make connections in the learning process by exploring clear and relevant connections in the curriculum [38; 39]. It supports the use and application of what has been taught and learned in new and different ways. Interdisciplinary learning provides opportunities to deepen learning, for example, by answering important questions, studying a problem, solving problems, or completing a project. Effective interdisciplinary training:

- it can take the form of individual one-time projects or longer training courses;
- planned with clear goals;
- based on experience and results obtained from various areas of the curriculum or subjects;
- provides progress in skills, knowledge and understanding;
- can provide opportunities for blended learning based on interests.

Two broad types of interdisciplinary learning often overlap in practice:

1. Training planning is aimed at developing awareness and understanding of the interrelationships and differences between subject areas and disciplines. This may be the content of knowledge and skills, ways of working, thinking and arguing, or a specific point of view on a subject or discipline;
2. The use of training in various subjects and disciplines to study a topic or problem, solve a problem, solve a problem, or complete a project. This can be achieved by creating a context that is real and relevant to students, the school and its community.

To be truly interdisciplinary, learning must support students in using knowledge and skills from different disciplines, as well as in applying and deepening their learning in appropriate contexts, as well as helping them to establish real connections between subjects and disciplines, where appropriate [40; 41].

Conclusions

Mathematics has played a vital role throughout human history. Everyone uses mathematics in his or her daily lives, most of the time without even realizing it. Without mathematics, the world would lack the main component of its structure, an integral part and the language necessary to express its physical manifestations. The world has accepted the point of view of the Italian physicist and astronomer Galileo Galilei that mathematics is the language of science. Her abstract equations are our most effective tools for interpreting the results of empirical research, and she has been successfully predicting new scientific research, phenomena and theories for a long time. Thus, the strength of mathematics is that it is at least an "amazing language".

The methodology of implementing interdisciplinary connections of physics and mathematics is determined by the process of integrating the skills and knowledge that students receive from studying one subject into another. When implementing this integration approach in solving physical problems and setting a goal in the form of using the knowledge gained in mathematics lessons, it is necessary to understand that the interdisciplinary connection between physics and mathematics is quite explicit and stable, therefore, it can be confidently stated that the practice of implementing interdisciplinary connections of physics and mathematics has already been introduced into the modern education system. To deepen this connection, in this theoretical study, a methodology was proposed using a step-by-step system for implementing interdisciplinary connections of physics and mathematics. In addition, in addition to this methodology, it is necessary to pay attention to the constituent elements of interdisciplinary training. The poor quality or absence of one of the elements (vision, teaching or facilitating the educational process) can have an extremely negative impact on the results of the implementation of interdisciplinary connections of physics and mathematics. Thus, the evaluation of the results of the introduction of the methodology of interdisciplinary teaching should be evaluated by analyzing the progress of students at equal time intervals, but scientists should not lose sight of other factors affecting the effectiveness of this practice.

Interdisciplinary education today is a frequently requested educational format, both from schoolchildren and students, and from employers. Every year, there is a growing demand for specialists of a wide profile who possess knowledge and skills from related disciplines. Practice shows that it is easier for such specialists to master new practices.

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Conflict of Interest

None.

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Методика міжпредметних зв'язків фізики і математики в початковій школі при розв'язуванні фізичних задач

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Анотація

Актуальність. Актуальність дослідження обумовлена необхідністю розробки методики реалізації міжпредметних зв'язків фізики і математики в основній школі при розв'язуванні фізичних задач, а також детальним вивченням різних аспектів міжпредметних зв'язків.

Мета. Метою статті є проведення аналізу для виявлення чинників реалізації міжпредметних зв'язків фізики і математики в основній школі під час розв'язування фізичних задач, а також розробка методичних рекомендацій, спрямованих на впровадження методики міжпредметної освіти серед школярів та студентів.

Методологія. Використано методи системного аналізу, логічного аналізу, порівняльний метод, методи синтезу та дедукції, метод класифікації.

Результати. Дослідження міжпредметних зв'язків фізики і математики в основній школі під час розв'язування фізичних задач, а також практичні методи, потребують застосування низки методів дослідження, які дозволяють найбільш ґрунтовно вивчити реалізацію міжпредметних зв'язків. У статті представлено результати аналізу, розкрито реалізацію міжпредметних зв'язків фізики і математики в основній школі під час розв'язування фізичних задач, а також складено методичні рекомендації, спрямовані на реалізацію методики міжпредметної освіти школярів і студентів.

Висновки. Матеріали статті мають практичну цінність для викладачів і студентів педагогічних університетів, шкільних учителів фізики і математики, авторів підручників з фізики для учнів загальноосвітніх шкіл.

Ключові слова: використання міжпредметного потенціалу; підвищення рівня навчальних досягнень школярів; актуальні питання шкільної освіти.