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USING MATHEMATICAL KNOWLEDGE IN PHYSICS LESSONS

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ABSTRACT:

This article highlights the role and importance of utilizing mathematical knowledge in physics lessons. It particularly provides examples of essential mathematical concepts—formulas, arithmetic operations, graphs, and units of measurement—needed for solving physics problems at the 7th-grade level. The article discusses how interdisciplinary connections can enhance students' logical thinking and improve their ability to apply knowledge in practice.

INTRODUCTION. In modern education, interdisciplinary integration plays a vital role. In particular, the close connection between the natural sciences—mathematics and physics—serves as a foundation for students to gain deep and meaningful knowledge. Although physics is an experimental science, its theoretical foundations are often expressed through mathematical formulas, calculations, and analyses. Therefore, the effective use of students' mathematical knowledge in physics lessons is not only a necessity but also an integral part of quality education. Naturally, physics and mathematics share overlapping knowledge areas, although the role of knowledge in each subject is different, and the approaches to using and applying this knowledge often vary. For this reason, a teacher must be proficient in both subjects, understand their common aspects, and be aware of the differences between them—such as epistemological differences and differing objectives [1].

When teaching mathematics, the field of physics provides effective examples and outcomes for explaining mathematical concepts. However, at times, it may be beneficial for both disciplines to operate independently—without subordinating one to the other—depending on the learning situation.

Literature Review

Professor L. Marcu from the University of Oradea emphasizes that interdisciplinary education plays a crucial role in science teaching, as it provides new resources for the development of science and technology. In his research, he highlights that applying an interdisciplinary approach in teaching physics helps demonstrate the connection between theory and practice [2].

Malaysian researchers Veloo, Nor, and Khalid, in their article *"Attitude towards Physics and Additional Mathematics Achievement towards Physics Achievement,"* state that physics teachers should not only focus on teaching the subject itself but also pay close attention to students' attitudes towards learning physics. The authors show a strong correlation between students' success in mathematics and their achievements in physics. Physics is considered a fundamental science because its laws are widely applied in other natural sciences such as chemistry, biology, and geography. This shows that the progress of physics is closely linked to advancements in mathematics and other sciences [3].

In the American book *"Interdisciplinary Research: Process and Theory"*, it is proposed that while integrative research and interdisciplinary studies may not have the same boundaries, they share important common features. Integration is considered the most vital step in the interdisciplinary research process and is necessary in all areas of life. It is emphasized that the integration skills students develop through interdisciplinary learning are more applicable in real-life situations. Such skills prepare students to solve complex real-world problems and become active participants in society.

Methods

In Finland, most physics teachers also teach mathematics, and vice versa. For example, the recent reform of the Finnish National Core Curriculum for Basic Education emphasizes the use of multidisciplinary learning modules in teaching. Similar reforms have been introduced in the national core curriculum for general

In physics, many concepts are expressed through formulas. For instance, in the 7th grade, students learn concepts such as speed, distance, and time. If distance and time are given, speed can be calculated—this is based on mathematical operations such as multiplication and division. Understanding the relationship between speed and time becomes clearer when visualized using a graph. In drawing such graphs, students rely on mathematical knowledge gained in math classes, such as coordinate axes, straight lines, points, and axis scales. Physics always involves units of measurement: meters (for distance), seconds (for time), and meters per second (for speed), among others. In order to use and convert these units correctly, a solid understanding of numerical operations—that is, mathematics—is essential. Many physical phenomena are explained using graphs. For example, velocity-time or force-deformation graphs allow students to visualize the phenomena. In such cases, skills in reading, analyzing, and constructing mathematical graphs become highly important [4].

While solving physics problems, students develop skills such as analyzing the problem, identifying relevant data, applying mathematical modeling, selecting appropriate formulas, and performing calculations. This process enhances their overall logical thinking abilities. During experimental activities, students take measurements, record results, and analyze the data. In this context, mathematical elements such as precision, approximate calculations, and statistical analysis (e.g., average values, errors) play a critical role. However, when analyzing the physics curriculum through the lens of mathematics, both advantages and certain limitations can be observed [5]

Analysis of the Integration Between Physics and Mathematics Curricula in General Education Schools

Advantages in Physics Lessons	**Mathematics**
Percentages are also needed at the beginning of the physics course	Percentages are covered in the 5th grade mathematics textbook
Proportion and ratio concepts are very important in physics lessons	Proportion, inverse proportion, and ratios are introduced in the 5th grade
Use of Archimedes and pressure topics in the 7th grade physics textbook	Surface area and volume concepts are presented in the 5th grade mathematics textbook
Can answer the question "How many ways can resistors be connected in parallel?"	The topic "Elements of combinatorics" is included in the 7th grade algebra textbook, which helps improve calculation speed and understanding in physics
Mathematics lessons are taught 5-6 hours per week, allowing deeper exploration and reinforcement	
Disadvantages in Physics Lessons	**Mathematics**
The 7th grade physics textbook does not include approximate calculations or standard form of numbers	The topic "Standard form of numbers" is covered in the 8th grade algebra textbook
In 7th grade physics, when calculating quantities	The "Modulus" topic is

Disadvantages in Physics Lessons	Mathematics
like force, speed, and distance, square roots are solved using the absolute value (modulus)	explained in the 8th grade algebra textbook
Students cannot fully solve displacement problems in the 7th grade physics	"Distance between two points" is covered in the 8th grade geometry textbook
The topic "Friction force" in 7th grade physics requires trigonometric equations which have not yet been studied	Trigonometric equations are introduced in the 9th grade geometry and algebra textbooks
Calculation of "Resultant velocity" or "Relative velocity" in 7th grade physics requires knowledge of the Cosine theorem, which is not yet studied	The "Cosine theorem" is included in the 9th grade geometry textbook

Results

The essence of the principle of continuity is as follows: during the transition from one stage or condition to another, certain elements or parts of the overall system are preserved. In the scientific knowledge process, continuity is connected with the principle of adaptation. In didactics, it means that each subsequent stage is built upon the foundation of the previous ones. Moreover, for teachers in various types of schools, it signifies organizing the content of their functional activities. In this sense, continuity implies the necessity to preserve and develop the core of physics knowledge during the transition from one educational level to another [6]. It is important to note that applying the continuity principle simultaneously demands a new approach in teaching methodology alongside the process of improving students' knowledge, skills, and competencies.

The principle of linking theoretical knowledge with practical skills is based on the philosophical teaching about the unity of theory and practice in the process of cognition. Applying this principle is one of the key objectives of physics education in general secondary schools. Physics education should not only provide students with deep scientific knowledge but also teach them to understand physical concepts and laws, and perceive the continuity among them.

Above all, it is necessary to awaken in students such curiosity and attentiveness that they can observe physics in every natural phenomenon around them. This will help form a strong

idea that "physics is everywhere." Most importantly, this idea should be nurtured from the very beginning of physics education.

Teaching physics by using interdisciplinary connections is of great importance because the development of physics as a science involves studying the true essence of natural phenomena. This is realized through linking physics with natural and other sciences. However, interdisciplinary connections do not form automatically during the learning process. This is a complex issue that can only be addressed through targeted and purposeful approaches.

Discussion

Mathematics has originated from practical human needs, and its connection with practice has become increasingly diverse and deep over time. Mathematics and physics cannot exist separately; they always develop interdependently. This interrelation has stimulated the development of both fields. The famous scientist Isaac Newton stated that “mathematical analysis serves as the foundation for understanding physics.” Mathematics provides the necessary methods and tools to express the relationships between quantities that arise from physical problems or experiments in a precise and general form. One of the key features of modern physics is that its conclusions are not only qualitative but also quantitative, requiring the use of mathematical language. Mathematical knowledge forms the basis for skills in calculation and measurement. The interdisciplinary links between physics and mathematics are evident through concepts such as vectors, coordinates, graphs, functions, equations, and inequalities, as well as through formulas, charts, tables, and the mathematical representation of relationships between quantities. This integration is not only practically important but also creates favorable conditions for the development of scientific worldview.

Conclusion

Physics and mathematics are closely related and interconnected sciences. In physics lessons, we study natural phenomena, but to calculate, analyze, draw graphs, and solve problems, we rely on mathematics. Therefore, a strong foundation in mathematics helps students better understand physics and achieve higher academic results.

Effective use of mathematical knowledge and skills in physics lessons develops students’ interdisciplinary thinking and enhances their ability to approach and solve real-life problems. Physics teachers should consider students’ mathematical preparedness and explain topics clearly, enriching lessons with practical and relatable examples. Interdisciplinary integration is a key principle of modern education, through which knowledge is absorbed more deeply and systematically [7].

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