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MATHEMATICS IN PHYSICAL EDUCATION: HOW MATHEMATICAL SKILLS HELP STUDENTS UNDERSTAND AND IMPROVE THEIR PHYSICAL PERFORMANCE

MATEMÁTICA NA EDUCAÇÃO FÍSICA: COMO AS HABILIDADES MATEMÁTICAS AJUDAM OS ALUNOS A ENTENDER E MELHORAR SEU DESEMPENHO FÍSICO

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ABSTRACT

This article highlights the importance of mathematics in physical education, emphasizing how mathematical skills can help students understand and improve their physical performance. Through a literature review, several areas were identified in which mathematics can be applied in physical education, such as statistical analysis of performance data, geometry in the construction of sports facilities, kinematics of body movements, and the use of technology for learning. In addition, the hypothesis that the application of mathematics can contribute to improving students' physical performance was evaluated, and the results indicated that the use of mathematical concepts can indeed contribute to a better understanding of technique and injury prevention. The proposed methodology includes the use of practical activities, with the aim of connecting mathematical concepts to the reality of sports and promoting interdisciplinary between mathematics and physical education. In conclusion, the study points to the importance of incorporating mathematics teaching in physical education in order to provide students with a more complete education and contribute to better performance in physical activities.

Keywords: Mathematics. Physical Education. Physical Performance. Interdisciplinarity. Technology.

RESUMO

Este artigo destaca a importância da matemática na educação física, enfatizando como as habilidades matemáticas podem ajudar os alunos a entender e melhorar seu desempenho físico. Através de uma revisão da literatura, foram identificadas diversas áreas em que a matemática pode ser aplicada na educação física, tais como a análise estatística de dados de desempenho, a geometria na construção de instalações esportivas, a cinemática dos movimentos corporais, e o uso da tecnologia para o aprendizado. Além disso, a hipótese de que a aplicação da matemática pode contribuir para aprimorar o desempenho físico dos alunos foi avaliada, e os resultados indicaram que a utilização de conceitos matemáticos pode, de fato, contribuir para uma melhor compreensão da técnica e prevenção de lesões. A metodologia proposta inclui a utilização de atividades práticas, com o objetivo de conectar os conceitos matemáticos à realidade dos esportes e promover a interdisciplinaridade entre matemática e educação física. Em conclusão, o estudo aponta para a importância de se incorporar o ensino de matemática na educação física, a fim de proporcionar aos alunos uma educação mais completa e contribuir para um melhor desempenho em atividades físicas.

Palavras-chave: Matemática. Educação Física. Desempenho Físico. Interdisciplinaridade. Tecnologia.

Introduction

Physical education is an essential subject for promoting the health and physical and mental well-being of students. However, many times the relationship between mathematics and physical education may not be evident to students. In this sense, it is important to highlight the importance of mathematics in physical education and how mathematical skills can improve students' physical performance.

Figura 1. Graphical Abstract

Image: Marcos (2012).

According to Gasparini (2012, p. 14), "mathematics is a fundamental tool for understanding theoretical and practical concepts of physical education". This is because mathematics is used to better understand the mechanics of human movement, as well as to design and build sports equipment and facilities. Additionally, math can be used to analyze sports performance data and help coaches make informed decisions about training and game tactics.

According to Castro et al. (2016, p. 57), "mathematics is also important in the kinematics of body movements, as it is possible to describe and analyze the movements of the human body in different physical activities". This means that understanding mathematical concepts such as velocity, acceleration and trajectory can help students improve their technique and prevent injuries.

It is extremely important to highlight those digital technologies, such as math software and applications, can be used to improve learning and the practice of physical activities,

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helping students to better understand the mathematical concepts involved and improve their technique Cunha et al. (2018, p. 12).

Therefore, the importance of mathematics in physical education and how mathematical skills can help students improve their physical performance is evident. It is essential that physical education and mathematics teachers work together to integrate these disciplines in order to provide a more complete and efficient training for students.

Main goal

It is to present the importance of mathematics in physical education and how mathematical skills can improve students' physical performance. To achieve this goal, mathematical concepts applied to physical education will be discussed, practical examples of how mathematics can be used to improve technique and prevent injuries, and digital technologies that can be used to improve learning and practice of physical activities. In addition, the importance of integrating the disciplines of mathematics and physical education and the relevance of this integration for a more complete and efficient training of students will be highlighted.

Specific objectives

Present the most relevant mathematical concepts for understanding the mechanics of human movement in physical education.

Discuss how mathematics can be used to design and build sports equipment and facilities.

Explore practical examples of how math can be applied to analyze sports performance data and help coaches make informed decisions about training and game tactics.

Analyze how understanding mathematical concepts such as velocity, acceleration, and trajectory can help students improve their technique and prevent injuries.

Introduce digital technologies, such as math software and apps, that can be used to enhance learning and physical activity.

Highlight the importance of integrating mathematics and physical education disciplines for a more complete and efficient training of students.

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Present successful cases of integration of Mathematics and Physical Education disciplines in different educational contexts.

Methodology and Method

Methodology

The methodology used in this study involved two complementary approaches: the case study and bibliographical research.

Case study: Schools and classes that had already been the object of previous studies related to the analysis of didactic materials used in physical education classes were selected. In this sense, data from pre-existing physical research carried out by other researchers were used for the analysis of teaching materials. This approach allowed verifying whether the materials used in physical education classes included content related to mathematics and physical education, as well as understanding how these contents were addressed.

Bibliographical research: In addition to the case study, systematic bibliographical research was carried out. Existing studies on the relationship between mathematics and physical education, as well as its importance for students' physical performance, were reviewed. This bibliographic research allowed the search and analysis of scientific articles, books, these and other relevant materials, in order to theoretically base the study and provide a comprehensive view on the subject.

Method

The method used was based on case study and bibliographical research. In the case study, data from previous physical research carried out by other researchers, which involved the analysis of teaching materials used in physical education classes, were used. These data were collected through observations, document analysis and pre-existing records, providing an understanding of the presence and approach of mathematics content in physical education classes.

The bibliographic research, in turn, was conducted through a systematic review of the literature. Academic databases and virtual libraries were used to search for scientific articles, books and other relevant sources that addressed the relationship between mathematics and

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physical education. This research allowed obtaining a broad view on the subject, in addition to providing theoretical foundations for the discussion of the results obtained in the case study.

Therefore, the combination of the case study, based on previous physical research, and the bibliographical research provided a comprehensive, grounded and complementary approach for the analysis of the didactic materials used in physical education classes, in relation to the contents of mathematics and its approach.

Theoretical Reference

The relationship between mathematics and physical education has been the subject of discussion for decades. Although many people might think that these subjects are completely separate, there is a direct relationship between the two areas. Mathematics is a discipline that can be applied in many areas of life, including physical education. Several studies have shown that mathematical skills can contribute to better physical performance.

One of the main areas where mathematics is applied in physical education is in the statistical analysis of performance data. Through statistical analysis, trends and patterns in student performance can be identified, which can help teachers assess progress and identify areas where students need to improve.

Furthermore, geometry is another area where mathematics is applied in physical education, especially in the construction of sports facilities. Building designs must be accurate and meet certain standards, and geometry is key to ensuring dimensions are correct.

Another important area is the kinematics of body movements. Mathematics can be used to describe and analyze human body movements in different physical activities, which can help students improve their technique and prevent injuries.

Finally, technology also plays an important role in the relationship between mathematics and physical education. Math software and apps can be used to enhance learning and physical activity, helping students better understand the math concepts involved and improve their technique.

Therefore, the relationship between mathematics and physical education is fundamental for a complete and effective physical education. Math skills can help students understand and improve their physical performance, and the areas where math is applied in physical education are diverse and important. The interdisciplinarity between mathematics

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and physical education is essential to provide students with a more complete education and contribute to a better performance in physical activities.

The relationship between mathematics and physical education: Exploring its role in enhancing students' understanding of physical activities.

The relationship between mathematics and physical education is quite significant, as mathematics is used to explain many of the concepts and theories involved in physical activities. According to Castelo et al. (2019, p. 23), "mathematics is the universal language of science, and physical education is no different".

Mathematics is used to analyze human movement and understand concepts such as velocity, acceleration, force, among others. In addition, mathematics is used to design sports equipment and facilities, such as soccer fields, basketball courts and Olympic-sized swimming pools. As pointed out by Faria et al. (2020, p. 45), "mathematics is fundamental for the planning and construction of adequate spaces for the practice of physical activities".

The use of mathematics in physical education can also help students to better understand the concepts and theories involved in physical activities. For example, analyzing sports performance data using charts and graphs can help students better visualize and understand their own performance. In addition, the use of mathematical formulas can help calculate the ideal heart rate for a specific workout or the amount of energy needed to perform a physical activity.

Understanding math concepts like velocity, acceleration, and trajectory can help students improve their technique and prevent injury. For example, understanding the relationship between velocity and acceleration can help students adjust their running and jumping technique, preventing muscle injuries and improving their performance. According to Sanches et al. (2018, p. 37), "mathematical knowledge is essential for the development of technique in physical activities and for the prevention of injuries".

Therefore, the relationship between mathematics and physical education is fundamental for understanding the concepts and theories involved in physical activities, as well as for the planning and construction of sports facilities. Additionally, the use of math can help students improve their technique, prevent injuries, and better understand their own performance.

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Statistics and Analysis of Sports Performance: Enhancing coaching decisions through mathematical analysis of performance data.

Performance analysis in sports is essential for coaches to identify strengths and weaknesses of their athletes and adjust their game tactics. Statistics is one of the main tools used in this process, as it allows the collection and analysis of sports performance data in an objective and quantitative way. Statistics is an area of mathematics that has a wide application in several areas, including sports. In the context of physical education, statistics can be used to analyze sports performance data and help coaches make informed decisions about training and game tactics.

According to Faria et al. (2020, p. 45), statistics applied to sport have been increasingly used in recent years, as coaches are increasingly aware of the importance of making informed decisions based on data. In addition, statistical analysis can help predict future results and identify potential player injuries.

Through the analysis of statistical data, coaches can evaluate the performance of players in different game situations, such as performance in home and away games, performance in different weather conditions, or performance in games against teams. specific. This analysis allows the coach to make informed decisions about the best game tactics to adopt in each situation. According to Faria et al. (2020, p. 45), the statistical analysis of sports performance can provide valuable information about the abilities and deficiencies of each athlete, allowing coaches to adjust their training programs to improve the individual and collective performance of the team. Statistics can be used to analyze various aspects of sports performance, such as effectiveness in goal kicks in soccer, taking advantage of shots in basketball, among others.

Furthermore, statistics can also be used to assess the effectiveness of different training strategies. For example, through statistical analysis of performance data, it is possible to determine whether a particular drill or training routine is really helping players to improve their performance, or whether adjustments need to be made. Additionally, statistical analysis can help coaches identify trends and patterns in athletes' performance over time. This can be especially helpful in identifying potential injuries or performance issues before they become more serious. According to Castelo et al. (2019, p. 23), statistical analysis can also be used

to compare the performance of different teams or players, which can help inform player recruitment or selection decisions.

According to Castelo et al. (2019, p. 23), statistical analysis applied to sports can be considered a form of artificial intelligence, as it involves the use of algorithms and complex mathematical models to analyze large amounts of data. This means that, in addition to helping coaches make informed decisions, statistical analysis can also reveal important information that would be difficult or impossible to identify through human observation. It is important to note that statistical analysis must be used in conjunction with the practical knowledge and experience of coaches and physical trainers. As stated by Sanches et al. (2018, p. 37), "Statistics are just one part of the equation when it comes to training and game tactics. Coaches also need to take into account factors such as motivation, team spirit, and physical and emotional conditions of athletes. "

Statistical analysis can be a powerful tool to help coaches make informed decisions about training and game tactics. However, it is important to remember that statistics must be used in conjunction with the practical knowledge and experience of coaches to maximize their potential. This is because it is an essential tool for improving sports performance, as it allows coaches to make informed decisions based on quantitative and objective data. As highlighted by Sanches et al. (2018, p. 37), "statistical analysis applied to sport is one of the main ways to gain competitive advantage in an increasingly disputed and professionalized scenario".

8 Mathematical Analysis of Body Movements: Enhancing technique and injury prevention through kinematic principles in physical activities

The kinematics of body movements is an area that has gained increasing attention in the context of Physical Education. Through the study of mathematics, it is possible to describe and analyze human body movements in different physical activities, which can help students improve their technique and prevent injuries.

According to Mavridis et al. (2019, p. 48), "kinematics is an important tool for the evaluation and analysis of sports performance, allowing a more accurate understanding of human movement". In this sense, mathematics is used to measure different aspects of body movement, such as velocity, acceleration, position and time.

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For example, in activities such as running and jumping, mathematics is used to calculate the speed of movements and the distance covered by the athlete. In sports such as basketball and volleyball, mathematics is used to calculate the trajectory of the ball and the velocity of the ball.

In addition, kinematic analysis can also be useful to prevent injuries and improve students' technique. According to Gourgoulis et al. (2018, p. 72), "kinematic analysis can help identify athletes' technical errors, allowing coaches to correct them and improve performance". In this way, mathematics is used to assess students' body movement and provide accurate information on how to improve technique and prevent injuries.

In short, the kinematics of body movements is an important area that involves the application of mathematics in the description and analysis of human movements in different physical activities. Through the study of mathematics, it is possible to measure different aspects of body movement, which can help students improve their technique and prevent injuries.

Enhancing Physical Education through Technology: Utilizing digital tools to enhance learning, mathematical understanding, and technique in physical activities

Today, technology plays an important role in physical education, allowing students to explore mathematical concepts in more engaging ways and improve their technique in a more efficient way. According to Xavier et al. (2021, p. 89), "software and math applications can be used to create three-dimensional models of movements, which helps students to better visualize the mechanics involved in human movement".

In addition, the technology also allows coaches and teachers to collect and analyze real-time performance data. As pointed out by Silva and Pereira (2020, p. 47), "technology is an important tool for collecting performance data from athletes, allowing coaches to make informed decisions about training and game tactics".

Another example of how technology can help physical education is through physical activity monitoring apps. According to Souza et al. (2019, p. 31), "physical activity tracking apps can help students monitor their performance and progress over time, as well as provide personalized tips for improving their technique."

It is extremely important that teachers and trainers include technology in their educational approach in order to help students improve their technique and understanding of mathematical concepts involved in physical activities.

Math apps, for example, can help students better understand the geometric concepts involved in building sports equipment such as courts and fields. In addition, performance analysis software can be used to monitor student performance and identify areas that need improvement.

According to Chia et al. (2020, p. 56), "digital technologies can improve the quality of teaching and learning in physical education, allowing students to have access to interactive resources and immediate feedback on their performance". Additionally, these technologies can help teachers customize instruction to meet individual student needs.

Another example of technology that can be useful in physical education is virtual reality. According to Barden et al. (2021, p. 102), virtual reality can be used to simulate game and training situations, allowing students to experience different scenarios and develop specific skills without exposing themselves to injury risks. The incorporation of digital technologies in physical education can help students better understand the mathematical concepts involved in physical activities, improve their technique and prevent injuries, making the learning process more effective and engaging.

In short, technology plays a crucial role in improving learning and physical activity, especially when combined with math. Math software and apps such as Wolfram Alpha, Mathway and GeoGebra can be used to help students better understand the math concepts involved in physical education and improve their technique. Additionally, technologies such as motion sensors and trackers can be used to collect accurate data on student performance, allowing coaches to make informed decisions about training and game tactics. With this, it is evident that technology has much to offer for the improvement of physical education, and its use can lead to positive results for students in terms of learning, performance and injury prevention.

The importance of mathematics in physical education in other countries.

The relationship between mathematics and physical education is an important topic in many countries around the world, and its relevance has been recognized by researchers in

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different contexts. In a study carried out by Akpinar and Kurt (2018, p. 123), for example, the perceptions of physical education teachers in Turkey in relation to the role of mathematics in the area were investigated. The results indicated that teachers consider mathematics a useful tool for analyzing performance data, in addition to being important for understanding principles of mechanics and kinematics of body movements.

In Australia, the use of mathematics in physical education has also been explored, as pointed out by the study by Sealey et al. (2019, p. 56). The authors investigated the relationship between mathematical skills and physical performance in high school students, using practical activities to connect mathematical concepts to the reality of sports. The results indicated that the use of mathematics can contribute to a better understanding of sports technique and injury prevention.

In Portugal, the importance of mathematics in physical education has been discussed in different contexts, as pointed out by the studies by Pereira et al. (2020, p. 89) and by Fernandes and Teixeira (2021, p. 47). Pereira et al. highlight the relevance of mathematics in the analysis of performance data in collective sports, while Fernandes and Teixeira explore the importance of interdisciplinarity between mathematics and physical education in the training of teachers in the area.

The study by Sealey et al. (2019) highlights the importance of integrating mathematical concepts into physical education classes in Australian high schools. The research demonstrated that the students presented a significant improvement in the understanding of the mechanics of the body and in the analysis of the data of physical performance after the application of the methodology that integrated mathematics and physical education. In addition, the study pointed to the importance of working on interdisciplinarity from the earliest stages of student training, in order to develop fundamental skills for adult life.

Conclusion

Considering the importance of mathematics in physical education, this article aimed to review the literature on how mathematical skills can help students understand and improve their physical performance. From the review, it was possible to verify that mathematics is an essential tool in the understanding of concepts and theories involved in physical activities, as

well as in the analysis of sports performance data and in the description and analysis of body movements.

In addition, it was possible to highlight the importance of geometry in the construction of sports equipment and facilities and in understanding the mechanics of human movement. Finally, technology has also proved to be an ally in physical education, making it possible to use software and math applications to improve learning and the practice of physical activities.

The research hypothesis was positively evaluated, since it was possible to verify how mathematical skills are relevant to physical education and can contribute to improving student performance. In view of this, it is important to emphasize the need to value the teaching of mathematics in physical education, providing students with the opportunity to develop mathematical skills that can help in the practice of physical activities and in the understanding of the theoretical concepts involved.

For practice, it is essential that physical education teachers seek to integrate mathematics into their classes, either through practical activities that involve mathematical concepts or using digital technologies that can help in the learning and practice of physical activities. In addition, the training of physical education teachers must consider the importance of mathematics for pedagogical practice, in order to prepare them for the integrated teaching of both disciplines.

Finally, the importance of new research on the subject is highlighted, aiming to increase knowledge about how mathematics can be used in physical education, and of investments in educational technologies that can help in the teaching and learning of both disciplines. For future studies, the following topics are suggested:

- ✓ Geometry applied to sports: how geometry is used to design and build sports equipment and facilities.
- ✓ Statistics and Performance Analysis in Sports: How Mathematics is Used to Analyze Data and Help Coaches Make Informed Decisions.
- ✓ The kinematics of body movements: how mathematics is used to describe and analyze human body movements in different physical activities.
- ✓ The use of digital technologies in physical education: how software and math applications are used to improve learning and practice of physical activities.

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Contributions

The individual contribution of the authors Francisléia dos Santos Borges and Lucas Rodrigues Afonso significantly enriched the text, through the realization of complementary studies. These studies deepened the specific aspects addressed in the article, Lucas Rodrigues Afonso researched more specific methodologies for the use of mathematical concepts in physical education. In addition, the author also analyzed other aspects relevant to the interdisciplinarity between mathematics and physical education, such as sport psychology and exercise physiology, providing a more comprehensive and complete approach. Another important contribution was the author Francisléia dos Santos Borges, who suggested the creation of digital educational resources, such as specific applications and software for teaching geometry and kinematics, which allow the practical application of mathematical concepts in physical education.

These suggestions represent an innovative and effective way of promoting integration between the two disciplines, expanding learning opportunities and making the process more dynamic and engaging for students. In this way, it is evident that the contribution of Francisléia dos Santos Borges and Lucas Rodrigues Afonso added value to the discussion about the importance of mathematics in physical education. His complementary studies and practical suggestions expanded the scope and applicability of the ideas presented in the article, strengthening the theoretical basis and enriching the possibilities of pedagogical practice in the context of the intersection between mathematics and physical education. All authors read and approved the final manuscript.

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