FROM ENVIRONMENTAL EDUCATION TO THE MOST DYNAMIC AND ENGAGING ENVIRONMENT IN MATHEMATICS

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ABSTRACT

The present study recommends the integration of environmental education with the teaching of mathematics in basic education institutions. This learning methodology allows students to experience and experiment with the concepts learned in the classroom, making the environment more meaningful, as it contributes to the student realizing the usefulness of mathematics in the context of the real world. For this, an example of collaborative activity that stimulates self-directed learning, promoting the development of skills and competencies was presented. In addition, it was proposed that schools break with the traditional teaching model, adopting interdisciplinarity in the school environment. Literature research and website studies revealed that collaborative learning encourages students to expose their ideas and develop autonomy, especially when school activities are associated with the student's social context. It is concluded, therefore, that educational institutions should establish the relationship between mathematics and environmental and social issues, contributing to the integral formation of the student and encouraging them to adopt sustainable practices, with the aim of creating a more balanced future.

Keywords: Environmental Education. Mathematics Teaching. Interdisciplinarity. Basic Education. Active Learning Methodologies. Education 4.0.

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INTRODUCTION

Math is seen by many students as difficult and scary, but not necessarily as a 'villain'. Students face challenges and difficulties in understanding mathematical concepts when they are not well developed, or when they lack connection with everyday life. Such difficulties can negatively impact adult life, as dyscalculia persists and affects both learning in higher education and work performance.

This article aims to recommend the integration of environmental education into mathematics teaching, as it offers students new ways of thinking and learning. This reflection highlights the importance of approaching mathematical concepts within the student's reality.

Conducting learning in different contexts allows students to realize the usefulness of mathematics in the real world and its applicability in solving significant problems, from the perspective of a globalized and sustainable world.

> Environmental education, in a formal way, should not be defined as a specialized area of knowledge. It transcends the formal areas worked on in the school and [...] needs to be always present as a cross-cutting theme in each of the disciplines (FILIPPSEN, 2013, p. 2 apud PEDRINI, 1998).

Integrating environmental education with various disciplines in schools is essential, making learning more interesting, dynamic and meaningful, allowing students to experience the concepts learned in the classroom. The objective of this text is to understand the relationship between mathematics and environmental education, addressing the interdisciplinarity of mathematics in the school environment.

> Hence the great difficulty encountered by students, who are increasingly confronted with a culture that does not cease to become more complex and use limited study methods that do not keep up with the global evolution of culture and science at the same pace (SEVERINO, 2014, p. 57).

In this way, environmental education cannot be dissociated from mathematics, as it involves discussing learning practices and understanding the student's needs in relation to the world around them.

METHODS AND LITERATURE REVIEW

Methodology plays a fundamental role in conducting research in various areas of knowledge, being an essential element in the interaction between the researcher and the object of study, which can, consequently, influence the results obtained.

In the context addressed, it is essential to highlight the importance of environmental education and its impact on the formation of the social and subjective character of young people. In addition, we emphasize the relevance of mathematical concepts in basic education schools. For this, we specifically chose the literature review as a[2] methodological approach.

In addition, for the present work, we opted for bibliographic research based on the studies present in the researched texts. In this sense, Gil states that:

> The bibliographic research is developed based on material already prepared, consisting mainly of books and scientific articles. Although in almost all studies some type of work of this nature is required, there are studies developed exclusively from bibliographic sources. A good part of exploratory studies can be defined as bibliographic research (GIL, 2009, p. 44).

Based on the authors' guidelines, this work will highlight the importance of using bibliographic sources, such as books, databases of scientific articles, legislation and studies obtained from *websites*, which will be essential for understanding the subject.

MATHEMATICS GOES BEYOND MATHEMATICAL CONCEPTS

The National Curriculum Parameters for Mathematics establish that:

> Mathematics is an important component in the construction of citizenship, [because] society increasingly uses scientific knowledge and technological resources, which citizens must appropriate. Mathematics needs to be within everyone's reach and the democratization of its teaching should be a priority goal of the teaching work (BRASIL, 1997, p. 15).

Mathematical knowledge is directly linked to the understanding and apprehension of the learning process. Teachers should provide activities that develop the student's intellect, favoring the construction of a critical and logical mentality, enabling him to act socially more consciously than what happens around him.

The study of mathematics goes beyond problem solving and arithmetic arithmetic. It is present in the applications of other sciences – such as physics, economics and sociology – and also in the daily life of the individual.

> The construction of a mathematical curriculum, considering themes of social relevance, gives it an integrative perspective and, in this sense, its organization is established around situations and problems of interest that allow a reading, understanding and interaction of the social, cultural, political and natural reality. A relevant theme is, without a doubt, Environmental Education (DA SILVA; GROENWALD, 2015, p. 2).

[2] Echer (2001) emphasizes that "the literature review begins before the theme is well defined and goes until the researcher feels familiar with the texts, to the point of simplifying, criticizing and discriminating them according to the intention of his research project".

Environmental education is essential in schools and can contribute significantly to the process of learning mathematics. Teachers can develop activities that offer real, practical context, allowing students to apply mathematical concepts in a meaningful and engaging way.

INTERDISCIPLINARY TEACHING – THE MOST ATTRACTIVE ENVIRONMENT FOR LEARNING

Professor Max Damas (2024) states that interdisciplinary teaching[3]:

> [...] can inspire educators to develop curricula that transcend traditional boundaries between disciplines, promoting more holistic learning that is vital to understanding and solving the complex problems of our time (DAMAS, 2024, p. 24).

Traditional teaching methods are inadequate for Education 4.0 students. It is necessary to break with old practices and innovate, promoting more meaningful and self-directed learning. Therefore, it is urgent to change from an anachronistic educational system, still anchored in the last century, to a disruptive teaching with rapid transformations. Education in the twenty-first century is aligned with the concept of interdisciplinarity.

The National Curriculum Parameters for Secondary Education defend this idea when they describe interdisciplinarity from the school perspective:

> From the school perspective, interdisciplinarity does not intend to create new disciplines or knowledge, but to use the knowledge of various disciplines to solve a concrete problem or understand a certain phenomenon from different points of view. In short, interdisciplinarity has an instrumental function (BRASIL, 2000, p. 21).

It can be said that "interdisciplinarity is part of the boldness of new teaching approaches, in basic education and especially in teacher training courses" (Fortes, 2012, p. 2). In turn, "interdisciplinary work can help students understand mathematical content" (Góes-Silva, 2015, p. 60), allowing them to learn in a personalized way and have a unique experience.

Therefore, the new educational system requires continuous updating in the areas of knowledge. This approach makes learning more dynamic and engaging, facilitating the development of science and strengthening critical thinking.

[3] Interdisciplinary research is not content with promoting the convergence and complementarity of various disciplines to achieve a common goal. It seeks to use it to try to obtain a synthesis between the methods used, the laws formulated and the proposed applications (JAPIASSU, 2006, p. 5).

ENVIRONMENTAL EDUCATION AND MATHEMATICS TEACHING

For Niskier (2024), "the more attractive the environment in which the student is inserted, the more motivated he will be to learn", evidencing the possibility of engaging students in a more engaging learning, directly impacting their motivation.

> The combination of Mathematics with environmental issues can be presented as a promising way to arouse greater interest in students in learning Mathematics, in addition to making them more aware, critical and reflective with regard to environmental problems (PEREIRA, 2020, p. 79 apud FERREIRA; WODEWOTZKI, 2007).

This model breaks down the barriers of traditional teaching, promoting student engagement and highlighting their creativity and potential. The teacher assumes the role of mentor, helping students to apply knowledge in a meaningful way in their social context.

In this way, by involving students in understanding the environment in which they are inserted, it enables them to reflect on their role in preserving the environment, promoting a holistic view of citizenship and sustainability, and influencing positive practices in their communities.

> The environmental issue is urgently presented as a central theme of school programs. These issues can hardly be addressed without mathematics. This implies the presentation of new contents and methodologies that allow the student to be able to do mathematics, such as what modeling makes possible (D'AMBROSIO, 2001, p. 17).

Mathematics is a powerful tool in environmental education, as it provides methods and resources that allow the understanding of data, the analysis and the resolution of environmental problems in an objective and qualified way.

> We need to learn to face Mathematics in a more meaningful way, where interaction with other sciences brings a better understanding of each one of them. Thus, Mathematics transcends an idea of an isolated science to a more comprehensive idea [...] providing a more critical and much more strongly elaborated view of the survival of our environment (GÓES-SILVA, 2015, p. 61).

A rich learning environment creates an interdisciplinary space, engaging students in a more effective and practical way. It encourages interaction, application of knowledge and generates deeper learning.

In principle, "Environmental Education is represented as a set of educational practices that aim to raise awareness for the preservation of natural resources and enable the individual to develop sustainable attitudes" (Costa, 2017, p. 53). This more engaging approach integrates multiple disciplines, such as Mathematics. It makes the environment

stimulating, whether through an interesting physical space or practical activities, allowing the student to perceive the connection between what they learn and their daily lives.

MATHEMATICS APPLIED IN THE SOCIAL CONTEXT

The integration of Mathematics with Environmental Education, in the student's social context, not only makes learning more relevant, but also allows mathematics to cease to be an isolated and abstract discipline.

> Mathematics should not be seen only as a prerequisite for further studies. It is necessary that teaching be focused on the formation of citizens, who increasingly use mathematical concepts in their routine (PCN, 1998, p. 51).

By connecting mathematics with social issues, students realize that it is a powerful tool for solving social and real problems, preparing them to become more critical and proactive citizens in their community.

Teachers must be able to relate the contents of the classroom with the reality experienced by students, giving meaning to learning and contributing to the formation of conscious citizens.

Education 4.0 promotes multidisciplinary teaching, allowing students to perceive the interrelationship of mathematical concepts in various real-life situations, which favors a more effective teaching and learning process.

> Contact with real environments, with concrete problems of the community, not only to get to know them, but to try to contribute with real solutions, based on processes of empathy, approximation, listening and sharing (BACICH; MORAN, 2018, p. 47).

Another important factor is shared learning. In the new educational era, this model proves to be extremely effective, as it allows for a collaborative and continuous process among students, moving away from traditional teaching methods.

By working with collaborative learning, students develop skills and competencies that are essential for social life. This learning model tends to be inclusive and accessible, as it offers students the opportunity to learn together.

MATHEMATICS PRESENT IN EVERYDAY LIFE

Mathematics is present in all aspects of everyday life, not just limited to the classroom.

According to Bacich and Moran,

> [...] the classroom can be a privileged space for co-creation, *maker*, search for entrepreneurial solutions, at all levels, where students and teachers learn from concrete situations (2018, p. 39).

Because it is present in everyday life, mathematics, when consciously integrated into daily life, becomes a fundamental tool for problem solving and decision-making.

> The school should be a space not only for instruction, but mainly for socialization and for criticizing what is observed and felt in everyday life. This can stimulate creativity leading to a new way of thinking (D'AMBROSIO, 2018, p. 196).

To contextualize this theme, the authors Ferrete, Ferrete and Araújo (2016) present methodological proposals that start from the discussion of environmental problems present in the lives of students at the Federal Institute of Sergipe (IFS Aracaju), establishing a connection with mathematics. Below, we present one of the proposals in the table below:

Table 1. Lesson 01 - Rectangle and square area

Content	Objectives
Environmental Education: land use and occupation of the IFS campus - Aracaju	Discuss the use and occupation of the land of the IFS campus - Aracaju
Mathematical: calculation of the area of the rectangle and square, the main characteristics of each of these plane figures	Explain the fundamental concept of calculating the area of the rectangle and square
	Discuss main geometric features of each of these plane figures

Source: Ferrete; Ferrete; Araújo (2016, p.5)

It is perceived that environmental education is essential, and mathematics can be taught in a contextualized way, close to the daily life of students, valuing the areas of knowledge and promoting interaction between students.

> Mathematical modeling is a learning environment in which students are invited to inquire and/or investigate, through mathematics, situations arising from other areas of reality [...] everyday problems are solved with the use of mathematical content learned at school, such as: geometry, percentage, rule of three, units of measurement, [...] statistical tools, tables, graphs and averages. Contents that are worked on in the daily teaching of mathematics, but rarely related to reality (BARBOSA, 2001, p. 6).

Thus, basic education teachers, both elementary and high school, must challenge their students to use mathematical content to find solutions to the challenges they face on a daily basis.

For example, teachers can provide students with the opportunity to create a garden within the school, demonstrating the practical applications of geometry, allowing them to use mathematics in a creative and practical way. The teacher challenges the student to draw geometric figures for planting trees, stimulating understanding and logical reasoning,

without the need to memorize formulas or procedures, making mathematics engaging and less intimidating, by inserting it in a practical and meaningful way.

DISCUSSION AND RESULTS

The integration of environmental education with the teaching of mathematics in schools is a current theme and frequently addressed in classrooms. The data were obtained through bibliographic research, with the objective of understanding the role of the student in their social context and promoting interdisciplinary learning in the school environment.

Students have difficulties understanding mathematical concepts and consider mathematics a difficult subject to learn. However, when the teacher develops activities related to environmental education, he contributes to the learning process by allowing students to perceive the connection between concepts and their daily lives.

Severino (2014) points out that students are increasingly challenged by a culture in constant complexification. In formal education, Bacich and Moran (2018) highlight that contact with real contexts and concrete problems of the community is important, aiming not only at knowledge, but also at contributing to practical solutions.

According to the PCN of Mathematics (1997), Góes-Silva (2015), D'Ambrosio (2018) and Damas (2024), pedagogical concepts transcend the classroom. Social relevance and interaction with other sciences are essential for the socialization and training of students: the professionals of the future.

Niskier (2024) and Pereira (2007) emphasize that the school environment must be attractive and capable of awakening the student's interest in mathematics, through collaborative learning, favoring awareness of sustainable practices. Based on the research data, it is confirmed that interdisciplinarity facilitates the understanding of mathematics and enhances the analysis of environmental and social issues. This theme is of great relevance, deserving attention from researchers, and as a method of active learning.

FINAL CONSIDERATIONS

In the context of Education 4.0, the student assumes the role of protagonist in the learning process. This pedagogical approach encourages students to expose their ideas, create and develop autonomy, and encourage freedom. Its true dimension is reached when it is integrated into the student's social context.

This allows the student to feel more connected and engaged in the learning process. Integration and recognition in the educational context are perceived when the teacher connects different areas of knowledge in a meaningful way.

In this way, mathematics and environmental education must go together, establishing a pedagogical approach that relates the importance of mathematical content with environmental and social issues.

Therefore, this interdisciplinarity not only facilitates the understanding of mathematics, but also contributes to the analysis and solution of environmental issues. It encourages students to adopt more sustainable practices and develop solutions based on mathematical analysis, with the aim of building a more balanced and sustainable future.

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