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GAMIFICATION IN ENVIRONMENTAL EDUCATION: ACTIVE STRATEGIES FOR NATURE CONSERVATION IN ELEMENTARY EDUCATION

GAMIFICAÇÃO NA EDUCAÇÃO AMBIENTAL: ESTRATÉGIAS ATIVAS PARA A CONSERVAÇÃO DA NATUREZA NO ENSINO FUNDAMENTAL

GAMIFICACIÓN EN EDUCACIÓN AMBIENTAL: ESTRATEGIAS ACTIVAS PARA LA CONSERVACIÓN DE LA NATURALEZA EN EDUCACIÓN PRIMARIA

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Abstract: The growing demand for sustainable practices and the urgency of concrete actions for the environment make environmental education an essential pillar in the training of young citizens aware of nature conservation. In this perspective, this work aims to investigate the use of gamification as an active methodological strategy to promote nature conservation among students in middle school. The National Energy Efficiency Olympics (ONEE) was implemented in 8th and 9th grade classes, aiming to develop conceptual, procedural, and attitudinal skills related to the understanding, reflection, and appreciation of environmental practices. It was divided into stages, including the approach of the three student modules, the application of content reinforcement questionnaires, and a final application of the questionnaire and

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gamification. The results indicate that the application of gamification stimulated students' awareness of the importance of sustainability, as well as the adoption of attitudes geared towards environmental preservation. Furthermore, the study highlights the need for further investigations into the effectiveness of gamification in educational contexts, suggesting that this approach can be replicated in different realities to foster the development of environmentally conscious citizens prepared for future challenges.

Keywords: Nature conservation, Gamification, Active methodologies, National Energy Efficiency Olympiad.

Resumo: A crescente demanda por práticas sustentáveis e a urgência de ações concretas em prol do meio ambiente tornam a educação ambiental um pilar essencial na formação de jovens cidadãos conscientes sobre a conservação da natureza. Nessa perspectiva, este trabalho tem como objetivo investigar o uso da gamificação como uma estratégia metodológica ativa para promover a conservação da natureza entre estudantes do ensino fundamental II. A Olimpíada Nacional de Eficiência Energética (ONEE) foi empregada nas turmas de 8º e 9º anos, visando desenvolver habilidades conceituais, procedimentais e atitudinais relacionadas à compreensão, reflexão e valorização de práticas ambientais. Tendo sido dividida em etapas: a abordagem dos três módulos do estudante, a aplicação dos questionários de fixação dos conteúdos abordados e a terceira a aplicação do questionário e gamificação. Os resultados indicam que a aplicação da gamificação estimulou a conscientização dos alunos sobre a importância da sustentabilidade, bem como a adoção de atitudes voltadas para a preservação do meio ambiente. Além disso, o estudo aponta a necessidade de novas investigações sobre a eficácia da gamificação em contextos educacionais, sugerindo que essa abordagem pode ser replicada em diferentes realidades para fomentar a formação de cidadãos ambientalmente conscientes e preparados para os desafios futuros.

Palavras-chave: Conservação da natureza, Gamificação, Metodologias ativas, Olimpíada nacional de eficiência energética.

Resumen: La creciente demanda de prácticas sostenibles y la urgencia de acciones concretas para el medio ambiente convierten a la educación ambiental en un pilar esencial para el desarrollo de jóvenes ciudadanos conscientes de la conservación de la naturaleza. Desde esta perspectiva, este estudio busca investigar el uso de la gamificación como estrategia metodológica activa para promover la conservación de la naturaleza en estudiantes de primaria.

La Olimpiada Nacional de Eficiencia Energética (ONEE) se utilizó en clases de 8.º y 9.º grado, con el objetivo de desarrollar habilidades conceptuales, procedimentales y actitudinales relacionadas con la comprensión, la reflexión y la valoración de las prácticas ambientales. El proceso se dividió en etapas: la aproximación a los tres módulos estudiantiles, la aplicación de cuestionarios para reforzar el contenido abordado, y la tercera, la aplicación del cuestionario y la gamificación. Los resultados indican que la aplicación de la gamificación estimuló la concienciación del alumnado sobre la importancia de la sostenibilidad, así como la adopción de actitudes hacia la preservación del medio ambiente. Además, el estudio destaca la necesidad de seguir investigando la eficacia de la gamificación en contextos educativos, sugiriendo que este enfoque puede replicarse en diferentes contextos para fomentar el desarrollo de ciudadanos con conciencia ambiental y preparados para los retos del futuro.

Palabras clave: Conservación de la naturaleza, Gamificación, Metodologías activas, Olimpiada Nacional de Eficiencia Energética.

1. INTRODUCTION

Promoting environmental education is one of the responsibilities of public authorities, as established in articles 205 and 225 of the 1988 Federal Constitution. Article 205 emphasizes that education must be "promoted and encouraged with the collaboration of society," while article 225 defines the responsibility to "protect and preserve the environment" as a duty of all, including environmental education at all levels of education (Brazil, 1988). These guidelines reflect the importance of integrating environmental education into the education of citizens from the earliest years of school.

In the current educational landscape, there is a growing effort to adopt pedagogical practices that integrate environmental education in an interdisciplinary manner. This aims to enrich the teaching and learning process, providing students with a more comprehensive understanding of environmental issues. Environmental education is essential for developing students' critical awareness and sensitivity to the consequences of human actions on the environment**.** Its goal is to impart knowledge, share ideas, and mobilize the population to face environmental challenges by promoting innovative and accessible solutions.

An effective approach to environmental education is the use of educational tools that act as knowledge mediators. Gamification, for example, has proven to be a promising strategy for engaging students and fostering attitudes toward environmental education. Games, for

example, foster a sense of appreciation for environmental preservation, building a bridge between dynamic learning and everyday practices. Including playful and interactive elements in pedagogical practices can transform the learning experience, making it more engaging and meaningful.

Gamification is not necessarily constituted by the use of games, but uses the techniques applied in them to construct knowledge, such as the use of reasoning, narrative, feedback and reward systems, conflicts, cooperation, competition, questions and answers, objectives that presuppose stimulus and motivation in the construction of knowledge, in the same way that occurs when playing something.

In other words, gamification in education can be understood as a teaching methodology that establishes the resolution of challenges, a victory condition, and the definition of points systems and rewards. This strategy allows students to see education not only as an obligation to be fulfilled, which makes the process burdensome, but also streamlines the educational context and makes it more relaxed, encouraging the promotion of education and the development of an appreciation for learning.

The National Energy Efficiency Olympiad (ONEE) [2]is an example of how gamification can be applied to teach and encourage conscious energy consumption, demonstrating the effectiveness of this approach in educational contexts (Santos et al., 2023). Gamification is provided by ONEE through games that promote the importance of energy efficiency. For example, it highlights challenges for completing the proposed games. This encourages students to exercise creativity and remain focused on achieving objectives while becoming aware of the need for environmental preservation and sustainability.

Along these lines, the objective of this study is to investigate student engagement in promoting nature conservation through gamified educational strategies. The research focused on the experience of using gamification to encourage environmental education, employing games tailored to students' educational context.

2. LITERATURE REVIEW

The classroom environment is comprised of multiple realities and experiences, which generally requires the implementation of dynamic approaches that play a fundamental role in the teaching-learning process. This is no different in the context of environmental education.

[2] National Energy Efficiency Olympiad (ONEE) : https://onee.org.br/

Research indicates the need to include, in addition to dynamic teaching practices, the principles of Critical Environmental Education in ongoing teacher training.

Acquiring a critical environmental education involves understanding the relationship between humans and nature, and is an essential tool for promoting the construction of relationships and concepts, encouraging the assimilation of attitudes that guide the sustainability process.

Over the years, the environment has been impacted by the advancement of civilizations. In response to this exploitation, concerns about environmental problems have also grown, with the aim of minimizing their catastrophic effects. One strategy for nature conservation is the creation of conservation units and areas of permanent environmental protection. These areas, often marked by extensive deforestation and climate degradation, are directly affected by human actions, which are at the heart of these phenomena.

The environment calls for intervention and strategies that facilitate and raise awareness not only in current society but also in future generations. The school environment is a great ally in mediating this process, with educational mechanisms that encourage students to seek ways to contribute to nature conservation, critically learning about their role as participatory citizens.

The growing population also raises concerns about the fate of the waste products produced and their potential improper disposal. From this perspective, it is essential to disseminate topics such as the aforementioned in schools so that students understand the real situation and thus contribute to sustainability.

The way topics are approached in a school environment determines the interest in that subject. One method considered attractive and that has been explored to aid learning with conceptual, attitudinal, and procedural approaches is the use of gamification.

3. GUIDING PRINCIPLES FOR NATURE CONSERVATION

To guide nature conservation actions and strategies in the educational context, it is essential to adopt guiding principles that ensure the effectiveness and relevance of these efforts. Here are some essential principles:

- **Principle of Sustainability:** This principle emphasizes the importance of promoting practices that meet current needs without compromising the ability of future generations to meet their own needs. In environmental education, this means teaching about the balance between economic development and environmental conservation (Brundtland, 1987).

- **Principle of Integration:** Nature conservation should be integrated into all areas of knowledge and educational practices. Rather than treating conservation as a stand-alone subject, it should be incorporated into disciplines such as science, geography, history, and even mathematics, to provide a holistic and contextualized view (Tilbury, 1995).
- **Principle of Participation:** Involving students and the community in conservation initiatives is crucial. Active participation helps foster a sense of responsibility and commitment. This can include school gardening projects, cleanup campaigns, and monitoring local flora and fauna, among others (Stapp, 1969).
- **Principle of Experiential Education:** Learning through hands-on experience is fundamental to environmental education. Experiments, visits to natural areas, field projects, and other hands-on activities help students connect theory and practice and understand the importance of conservation in concrete ways (Dewey, 1938).
- **Principle of Local Relevance:** Adapting educational content to the specific environmental issues and contexts of the region where students live increases the effectiveness of environmental education. This helps students understand how global conservation issues relate to their local communities (Stapp, 1969).
- **Principle of Interdisciplinarity:** Nature conservation and environmental education benefit from an interdisciplinary approach. Connecting different disciplines, such as biology, chemistry, sociology, and economics, helps students see the interconnectedness of natural and human systems and the complexity of environmental problems (Tilbury, 1995).
- **Principle of Inclusion and Equity:** Ensuring that all students, regardless of their socioeconomic, cultural, or ability backgrounds, have access to quality environmental education is essential. Inclusion and equity ensure that conservation strategies are fair and comprehensive (UNESCO, 2017).
- **Precautionary Principle:** In the context of conservation, the precautionary principle recommends adopting preventive measures to avoid damage to the environment, even when there is scientific uncertainty. In education, this can involve promoting behaviors and practices that minimize environmental risks and impacts (Rio Declaration, 1992).
- **Principle of Innovation and Adaptability:** The ability to adapt and innovate is crucial to meeting new environmental challenges. Teaching students about the importance of innovation in sustainable technologies and practices prepares them to contribute creative and adaptive solutions to future environmental problems (Chouinard, 2014).
- **Principle of Cooperation:** Collaboration between different sectors of society—such as schools, non-governmental organizations, businesses, and governments—is essential to

the effectiveness of conservation strategies. Environmental education should promote cooperation and teamwork to achieve common goals (UNESCO, 2017).

- **Principle of Continuous Assessment:** It is important to continually evaluate environmental education actions and strategies to ensure their effectiveness. Assessment allows for adjustments in approaches and content, ensuring that conservation goals are being met and that students are learning effectively (Tilbury, 1995).
- **Principle of Global Citizenship Education:** Environmental education should also prepare students to be responsible global citizens, aware of global environmental issues and how their actions can have a global impact. This includes teaching about problems such as climate change, pollution, and biodiversity loss, and encouraging actions that contribute to global solutions (UNESCO, 2017).

These guiding principles help ensure that conservation actions and strategies in the educational context are effective, relevant, and inclusive. They promote a comprehensive and practical approach that engages students and communities in environmental protection and preservation, preparing them to address environmental challenges in an informed and responsible manner.

4. EDUCATIONAL STRATEGIES FOR NATURE CONSERVATION IN ELEMENTARY SCHOOL II

Nature conservation in schools, especially in middle school, plays an important role in developing environmentally conscious and responsible individuals. Therefore, implementing practical activities, interdisciplinary projects, and community initiatives in schools can make environmental education more effective and engaging.

The school environment is a privileged space for the dissemination of sustainable knowledge and practices, integrating activities that go beyond theoretical content, such as field classes and school gardens, which encourage direct student engagement.

Furthermore, the interdisciplinary approach proposed by the National Curricular Plans (PCNs), as well as the National Common Curricular Base (BNCC), promotes a broader vision of environmental education, enabling integration across different disciplines. Finally, connecting with the local community through projects that discuss issues such as waste management and responsible consumption strengthens the relationship between school and society, contributing to the development of a culture of sustainability.

In this context, educational strategies for nature conservation in elementary school II are listed:

● **Practical actions in daily school life:** The school environment is a source of knowledge, experiences, and the exchange of knowledge, and teaching nature conservation is no exception. However, it is worth highlighting the importance of field trips as a source of new knowledge, increasingly stimulating interest in teaching and nature conservation. Working on environmental education and its concepts can become more attractive when experiences and school activities are proposed that involve students, such as the implementation of school gardens as a proposal for the democratization of healthy eating and its benefits in the environment (Santos et al., 2023).

● **Interdisciplinary Projects:** Environmental education should not be treated as a discipline, as recommended by the (PCNs), where this educational approach directs its work in an interdisciplinary manner to achieve maximum efficiency. Involving different disciplines to broaden the field of knowledge about environmental education is very important and is already a widespread practice of excellence (Coimbra, 2012).

● **Community Initiatives:** The globalization process, in addition to bringing many positive aspects to society, also brought several environmental challenges that needed to be addressed, one of which was the amount of waste generated by society. Therefore, it is essential to promote projects that extend beyond the school environment to involve the local community in topics concerning a consumer society and its ethical values. One way to minimize the negative effects of excess solid waste in a community is to encourage selective collection.

● **Active Methodologies:** Teachers are challenged daily to find new teaching strategies to encourage students both inside and outside the school environment. One way to facilitate learning about nature conservation is through the use of educational games as a playful tool, proving to be an excellent teaching method. Another way to encourage learning is through the use of gamification as an active methodology for problem-solving (Japiassu; Rached, 2020). A good example is The National Energy Efficiency Olympiad (ONEE) seeks to promote the dissemination of conscious energy consumption.

● **Use of Digital Technologies:** Digital media has become a powerful tool for conservation and environmental monitoring. One example is the ONEE website, which aims to promote the responsible use of energy. Various electronic media can be used as environmentally relevant search resources, such as the Ecoar Institute, which implements and develops projects for the construction and development of more sustainable societies.

● **Evaluation and Feedback:** evaluating the concepts developed on environmental education can be a task considered difficult to resolve.

However, student participation in class itself can be considered a form of assessment. Another alternative would be to use extracurricular projects that seek to solve everyday problems in order to encourage active participation in the community.

6. CASE STUDY

The ONEE was held at the Padre Joaquim Félix Municipal School, in the 8th and 9th grades of elementary school II, located in the municipality of São João do Sabugi, 297 km from the state capital, Natal. The National Energy Efficiency Olympiad is aimed at this age group. It was initially held in 2022 to encourage students to be aware of the rational use of electricity both inside and outside the school environment, while also motivating society.

Methodologically speaking, during class mediation, gamified olympiads were used to stimulate students with nature conservation themes, aiming to reduce electricity consumption, since low consumption results in a decrease in the use of natural resources in energy production.

To carry out the Olympiad, the teacher was prepared through a course and the students, through the student module applied in the classroom, which was carried out through work with question-and-answer games, consolidation activities, exchange of exercises between students, cutting and pasting activities and teaching about calculations related to energy consumption, to identify which tariff flag was active, thereby helping students assimilate the concepts.

The Olympiad is divided into two stages, with the second involving the development of gamified challenges on the topic of conscious consumption. Solving this challenge required advanced internet access, and the challenge was conducted online. This created difficulties during the challenge due to the internet's fluctuations when it needed to support the number of students during the challenge.

The following strategies for the preservation and conservation of nature were proposed to students:

● Reduce electricity consumption inside and outside the school environment, expanding to the community;

● Promote awareness through fun classes about the conscious use of electricity;

● Provide knowledge about the main expenses during a month specified on your electricity bill.

Thus, in relation to the results achieved, the development of conceptual, procedural and attitudinal skills was observed in relation to the practices of conservation of natural resources with activities that were initially acquired in the classroom and later applied in their daily lives, such as, for example, the choice of electronic equipment considering their efficient consumption using the National Electric Energy Conservation Program - PROCEL and the National Energy Conservation Label - ENCE, students applied these concepts in their daily lives. Examples include choosing efficient electronics, using well-lit environments, and exchanging fluorescent lamps for LEDs. (Light Emitting Diode).

The results indicate that the use of the active methodology applied, in this case, the National Energy Efficiency Olympiad (ONEE) is a tool with great potential for dissemination and learning for the more conscious use of electricity, since the students who were public in the Olympiad had the opportunity to learn and pass on the knowledge acquired in their social circles.

7. CONCLUSION AND FUTURE PERSPECTIVES

Based on the above, it is clear that implementing nature conservation strategies in schools plays a crucial role in raising students' awareness of the importance of sustainability. Thus, by promoting awareness in an interdisciplinary and playful way, environmental education fosters not only students' cognitive development but also a significant change in attitudes and behaviors within their families and communities. In this way, schools become allies in developing environmentally conscious citizens, contributing to a more sustainable future.

Future work aims to expand the application of active methodologies, such as gamified Olympiads and playful games focused on sustainability, to other educational institutions in the municipality and neighboring cities. Furthermore, we aim to further investigate the effectiveness of these strategies, assessing their concrete impact on student behavior and their role as multipliers of environmental practices. This will enable the development of a sustainable educational model that can be replicated in different contexts, promoting increasingly broad environmental awareness, given that the research has contributed to a reduction in daily energy use, raising

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