Development of Technological Educational Products for teaching environmental sciences

Desenvolvimento de Produtos Educacionais Tecnológicos para ensino das ciências ambientais

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A B S T R A C T

Technological educational products have gained prominence and have become strong allies in the teaching of environmental sciences, mainly due to the pandemic context and the environmental degradation we are experiencing. In face of this ecological, social and political problematic, this article was part of a research of the Post-graduation Course in National Network for the Teaching of Environmental Sciences of the Federal University of Pernambuco (*Universidade Federal de Pernambuco* - PROFCIAMB/UFPE) that has as a prerequisite for its conclusion the production of an educational product. This work aims to present three technological educational products that were produced in order to develop social and environmental awareness in students, they are: an application, a blog and a digital booklet, which were applied in elementary school in three public and private schools, based on the BNCC and the SDGs, with the main theoretical references: Ausubel et al. (1980) and Braga et al. (2012). The methodology used was a quali-quantitative research with participatory nature and the products were developed in a multidisciplinary perspective. Based on the research and observations of the applications of educational technology products in different contexts and methodologies it was possible to verify that the products were well evaluated in the communities where they were applied, bringing positive experiences in the teaching and learning process.

R E S U M O

Os produtos educacionais tecnológicos ganharam destaque e se tornaram fortes aliados no ensino das ciências ambientais, principalmente pelo contexto pandêmico e pela degradação ambiental que estamos vivenciando. À face dessa problemática ecológica, social e política, este artigo fez parte de uma pesquisa do Curso de Pós-graduação em Rede Nacional para o Ensino das Ciências Ambientais da Universidade Federal de Pernambuco (PROFCIAMB/UFPE), que tem como pré-requisito para sua conclusão a produção de um produto educacional. Este trabalho tem como objetivo apresentar três produtos educacionais tecnológicos que foram produzidos com a finalidade de desenvolver a consciência socioambiental nos estudantes, são eles: um aplicativo; um blog e uma cartilha digital, que foram aplicados no ensino fundamental em três escolas das esferas pública e particular, fundamentados na BNCC e nas ODS, tendo como principais referenciais teóricos: Ausubel et al. (1980) e Braga et al. (2012). A metodologia utilizada foi uma pesquisa quali-quantitativa com cunho participativo e os produtos foram desenvolvidos em uma perspectiva multidisciplinar. Partindo das pesquisas e observações das aplicações dos produtos tecnológicos educacionais em diferentes contextos e metodologias, foi possível verificar que os produtos foram bem avaliados nas comunidades que foram aplicados, trazendo experiências positivas no processo de ensino e aprendizagem.
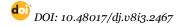
Introduction

Technological educational products have gained prominence and become strong allies in environmental science teaching, mainly because of the pandemic context and environmental degradation we are experiencing. Thus, the objective of this work is to present three educational technological products that were produced with the purpose of developing socio-environmental awareness in the students, are: An application; a blog and a digital primer, which were applied in elementary education in three schools of the public and private spheres. The skills and competences of the Common National Curriculum Base (BNCC) and the Sustainable Development Goals (SDGs) were used as the theoretical basis for the products, aiming to emphasize meaningful learning (AUSUBEL ET AL., 1980) and to achieve success in the study of the learning objects addressed in the products.

Educational products are teaching tools that collaborate with educational practice, facilitating learning and therefore the didactic proposal must be presented clearly and objectively so as to contribute to the acquisition of knowledge. Is it important that in the construction of an educational product, what to do is prioritized? To what audience? And how can this public interact in its construction? Thus, fleeing from a technicalist vision to meet a critical and reflective vision, being mediated in the whole process of elaboration of the product by dialog with the students, leading him to explore the "intimacy of the movement of his thought" (Freire, 1996, p. 86).

Nowadays, in the social context impacted by the Covid-19 pandemic, technological educational products have gained prominence due to remote and/or hybrid classes, being indispensable for the maintenance and dynamism of classes. When it comes to the teaching of environmental sciences, they have become strong allies, not only for the variety of resources, but also for being playful instruments in the teaching-learning process, mainly for seeking to sensitize students and lead them to reflections, since "it´s a dynamizing instrument between theory and practice" (Freire, 1996, p. 39), mainly in the face of the environmental crisis that we are experiencing in Brazil, which among them we can punctuate: the lack of interest and investments on the part of public managers and the lack of environmental education of people.

Faced with this ecological, social and political problem, this article was part of a survey by the Graduate Course in National Network for the Teaching of Environmental Sciences of the Federal University of Pernambuco (PROFCIAMB/UFPE) that has as a prerequisite for its conclusion the production of an educational product. According to CAPES:

> Requirement of presentation of final work demonstrating mastery of the object of study, (in the form of dissertation, design, case analysis, performance, artistic production, development of instruments, equipment, prototypes, among

others, according to the nature of the area and the purposes of the course) and ability to express themselves lucidly about it (CAPES, 1998, p. 2).

Thus, the objective of this work is to present three technological educational products that were produced with the purpose of developing socio-environmental awareness in the students, are: an application; a blog and a digital primer, which were applied in elementary schools being from the public and private spheres.

Based on the BNCC, when it establishes and encourages digital culture and strengthens autonomy in students (BNCC, 2017), and the SDGs (2012) for 2030 of the United Nations Organizations, the technical and technological products were developed from the socio-environmental demands identified in the localities where the educational institutions are located and from the dialog with students, which contributed directly or indirectly with the whole construction process, demonstrating how technology can be a concrete alternative for the teaching of environmental sciences and consequently for the formation of ecological subjects (Carvalho, 2012).

Theoretical reference

The textbook and the whiteboard are still the main resources used by the teachers in their classes, whether for the lack of investment in technological tools or for the lack of ability of the teachers to handle them. However, these traditional resources are essential in the construction of knowledge, but adding other resources that bring other possibilities of understanding on the part of students and diversifying the methodologies used by the professor helps to expand the cognitive field of students.

It´s then realized that, in general, the plastering of the didactic practice and the restriction along with the traditional materials that limit the possibilities of representation and construction of knowledge. "Furthermore, it does not commit to meaningful learning, which can result in students becoming unmotivated" (Lara e Sousa, 2020). "In a meaningful learning, not only does the retention of the structure of knowledge happen, but the capacity to transfer this knowledge to its possible use in a different context from that in which it was realized is developed" (Tavares, 2008, p. 95).

Currently the teacher has autonomy and the possibility to reflect, decide and create his own pedagogical practice, a significant learning occurs when the student participates actively in the whole educational process, ie the student will be the protagonist of its academic development, considering his previous knowledge, using technological resources relating to the cognitive structure of the learner.

In the perspective of a dynamic and creative teaching, the products created could make the environmental theme an engaging theme and develop in the participants a real and

significant learning, leading them to be critical and reflective, especially in the light of the increase of environmental impacts experienced in recent years in Brazil. In this context, technological educational products used for teaching have been classified as Learning Objects (AOs). "Despite being a challenge, it´s expected that the same AO can be reused in different educational contexts" (Braga et al., 2012).

The creation of Learning Objects should count on the participation of the teachers, since they who hold the curriculum and the reality of each class, however, are few teachers who have sufficient technical knowledge for the production of OA with high quality, thus needing the support of multidisciplinary teams for its production.

The BNCC (2017) brings in its skills objectives that develop in students a science and technology teaching in an integrative way, being able to establish commitment to development in scientific literacy, which involves the ability to understand and interpret the world (natural, social and technological). Thus, allowing students to have a new perspective on the world around them, as well as making choices, conscious interventions and guided by the principles of sustainability and the common good. Since the early years, children have been involved with a number of objects, materials and phenomena in their daily living and in the relationship with their surroundings. Combining this with technology is possible to organize learning situations starting from issues that are challenging and recognizing cultural diversity, stimulating the interest and scientific curiosity of students, making it possible to define problems, raise, analyze and represent results, communicate conclusions and propose interventions.

Educational products also make it possible to include students with disabilities or disorders in the curriculum, through adaptations of the tools already used in the school, acting on the transformation and usefulness for the student.

> Assistive technology is a multidisciplinary area of knowledge that aims to eliminate barriers to full participation and functional life for people with disabilities, disabilities and reduced mobility, aiming at greater autonomy and quality of life. And its application gains importance in the teaching and learning processes to which children are submitted in the school phase (CONTE et al., 2017).

Tools that increase accessibility for people with some kind of disability are of utmost importance. According to Mello and Sganzerla (2013), there is an increasing need for applications and software designed for inclusion, not only in the digital environment, but also to allow and assist in the greater independence of these individuals in life. However, environmental science education is supported by technology as a means of propagating sustainable ideals in order to promote environmental education.

Methods

The methodology used was a participatory qualitative-quantitative research, "in a scientific research, the quantitative and qualitative treatments of the results can be complementary, enriching the analysis and the final discussions" (Minayo, 1997). Initially there was the choice of the theme and the verification of the demand for technological educational products aimed at the chosen area, based on the bibliographic survey and application of a survey with the target audience.

After this stage, the construction phase of the educational product began, in which different technological resources were used, relying on the direct or indirect participation of students' knowledge about the theme addressed. The products presented in this work have as their target audience, students of elementary education, having as their central theme the teaching of environmental sciences in a multidisciplinary perspective (Table 1).

With the finalization of the product, there was its application with the students and teachers of Elementary School for the verification and validation of the product and the analysis of the impact caused in the teaching-learning process.

Table 1.

Technology Educational Products.

Product educational technology	Target Audience	Curriculum Component	Theme	Application site
Digital Dipstick	Early Primary Years	Math Arts Science Languages	The Importance of Statistics in Covid-19 Studies and Combating	Recife - Pernambuco Private School
Application	Early Primary Years	Science Languages Math Arts	Application as assistive technology: an inclusive perspective in environmental science education	School of the public network of Gravatá - PE
Blog	Final years of Elementary Education	Science Chemistry Languages Math Arts	"ECOMAR", a blog as an Interdisciplinary Pedagogical Resource for the Formation of the Ecological Subject	School of the public network of the municipality of Paulista - PE

Source: *Authors, 2022.*

Analysis of results

Starting from the research and observations of the applications of educational technological products in different contexts and methodologies, it was possible to verify that students showed participation and engagement in the development of the product through suggestions, drawings, activities, podcasts, tables, graphs and sustainable actions, as well as, curious to handle and explore them as a source of research, interaction with colleagues and integration with the environment, awakening the formation of an ecological awareness.

In relation to teachers, educational products were well accepted and evaluated according to the criteria of CAPES, being seen as innovative products for the locus of research and facilitators in the process of teaching environmental sciences, since the digital primer, the application and the blog are multidisciplinary.

Presentation of technological educational products

The importance of statistics in the study and fight against Covid-19: application to elementary education

Statistical education is necessary in several areas of knowledge, allowing a better interpretation of data presented in various contexts and instigating critical thinking in the foundation of judgments and decision making. The BNCC establishes guidelines for teaching the content of Statistics, inserted in the area of Mathematics, since the beginning of elementary schooling, so that, from a young age, students become apt to develop strategies and skills by means of critical reasoning in the face of day to day problems. At the end of 2019, the first case of Covid-19 appeared in China, and shortly afterwards, in 2020, the pandemic situation was decreed.

Since then, we have been faced with data laid out in tables and graphs on the level of contamination, death and recovery from Covid-19. This information also reaches children through the media, making it important to discuss with them the causes and consequences of the pandemic, including the importance of social isolation and vaccination campaigns. The product focus of this work is an educational booklet entitled Learning Statistics in Covid-19 Times, which highlights the importance of Statistics in combating a pandemic situation in math classes in the early years of elementary school, working on this topic through tables and graphs, containing real information about the rate of Covid-19 contamination and data about the vaccination campaign in Brazil. All this is based on the objects of knowledge and skills present at the BNCC destined to the fourth and fifth year of elementary schooling.

The validation of the educational product was succeeded by students and teachers, through a form containing questions based on the validation criteria of CAPES (Coordination for the Improvement of Higher Level Personnel). Through the responses obtained, it was observed that the primer had an excellent evaluation in the criteria of CAPES, being evaluated in all the questions, in their majority, as excellent. We concluded that the primer met the

proposed objective of contributing to the teaching of statistical content, providing an awareness on the subject of combating a pandemic situation.

Link to product access:

https://drive.google.com/file/d/1nnI9OQWFuj28iGt8w4TbYAmfB_CFzrd_/view?usp=sharin.

Application as assistive technology: an inclusive perspective in environmental science education

Educational inclusion has been overcoming barriers in the face of the challenge of achieving an education of equality for all. Children with disabilities must, from an early age, live with other typical children, this brings benefits not only for themselves, but similarly for other children in school.

With the aim of developing an application as a tool of assistive technology in the teaching of Environmental Sciences, this research finds in its way various ways of reflection on education, especially in the Teaching of Environmental Sciences, passing through some themes to achieve the utopia that is the inclusion of students of inclusive education in school in a cooperative way, having the management of natural resources involved in a garden, with activities aimed at sustainable actions to improve the environment in which they live and their well being and in line with the SDG2 - Zero Hunger and Sustainable Agriculture, SDG3 - Health and Well Being, SDG4 - Quality Education and SDG6 - Drinking Water and Sanitation, the 2030 Agenda.

From an exploratory applied research with a qualitative approach developed at the Cônego Eugênio Vilanova School, Gravatá - PE, the application "*Minha hortinha*" developed in the Factory of Applications platform provides content and interactivity on vegetable gardens, recycling, water saving, literacy and inclusion.

Inclusive education in schools has been a challenge for teachers, who mostly have difficulties working with students with global developmental disorders, high skills and disabilities, with a limitation of digital tools, the developed application brings in an interdisciplinary way several activities adapted to elementary school students - Initial years that are part of inclusion, focusing on the teaching of Environmental Sciences, however, can work other curricular components, promoting a teaching in an integrated way.

Link to product access:

https://pwa4.app.vc/minha_hortinha_2431804/home

"ECOMAR" a blog as an interdisciplinary pedagogical resource for training the ecological subject

Life in water is one of the United Nations (UN) Sustainable Development Goals for 2030, with conservation and sustainable use of oceans, seas and marine resources as one of its goals, especially because the marine environment is increasingly threatened by anthropic actions. Aiming to achieve this goal, this project of action had as general objective, to produce a blog as an interdisciplinary pedagogical resource for the formation of ecological subjects, grounded in online learning in the constructivist perspective and the general competences of the Common National Curricular Base.

The methodological approach adopted was qualitative and quantitative of the type of participant research and consisted of three stages: situational diagnosis and choice of sample group; prototype development; probing the student's knowledge of the blog. The research was developed at the Governador Miguel Arraes de Alencar Municipal School, located in the municipality of Paulista - PE. The validation of the educational product took place through remote classes and online questionnaires applied with final grade II students, teachers and specialists in the field of environmental education and educational technology.

The results indicated that the blog ECOMAR como ambiente virtual [ECOMAR as a virtual environment] is a source of research, information and interactivity of great importance for the conservation of marine ecosystems, as it can also be a technological resource used in all curricular components.

Therefore, we consider the ECOMAR blog as a collaborative learning platform that allows teachers to interact with their students and other readers, promoting dialog, publication and authorship of texts, photos, music, podcasts, activities, among other educational actions that contribute to the formation of the ecological subject.

Link to product access:

https://estelasouza13.wixsite.com/ecomar

Final Considerations

With the Covid-19 pandemic, the educational and technological resources produced to enable learning for students, brings a sense of methodological innovation to teachers. In order to adapt to the new format of lessons (remote and/or hybrid), they had to learn, even with all difficulty, how to handle the technological resources, adapting themselves to a new reality.

The educational products presented in this paper bring Learning Objects that can be used in an integrative way with several areas of knowledge, each with its approach: Conservation of the marine environment; home garden and Statistical Analysis of Covid-19 data, which join in a multidisciplinary way skills of the current curriculum, thus enabling the teacher to apply these tools in his class, highlighting that can use the products continuously, bringing innovation to the classrooms.

The products were well evaluated by the communities participating in their application, contributing with positive experiences in the teaching and learning process. However, the need to expand the investments of the government regarding technological resources, such as access to the Internet, for there to be a true digital inclusion, became evident.

From the production of educational products in a collaborative way, students began to perceive the environment with criticality, developing the feeling of belonging that contributed to the formation of ecological awareness.

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