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MAKER EDUCATION AND CREATIVE LEARNING FOSTERED BY THE SUSTAINABLE DEVELOPMENT GOALS

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Introdução
The aim of this study is to share with teachers the practice of using Sustainable Development Goals (SDG) as a pedagogical strategy to foster maker education and creative learning. The study has a descriptive nature with a study case of the lived experiences of four groups involving 12 students, conducted in a private institution of middle and elementary education in the municipality of São Paulo. The study becomes relevant through the presented results, being an important contribution to educational advancement.

Problema de Pesquisa e Objetivo
Learning is not merely the result of students' interactions with objects and people around them, but the result of students' engagement in constructing something of their interest. Another important factor is the recognition that simply providing information or assigning tasks is not sufficient for knowledge construction

Fundamentação Teórica
In this context, the "Maker Movement" is associated with sustainability, as it encourages creative solutions to everyday problems, promoting the reduction and reuse of materials in its productions, as well as proposing the observation of material conditions, new uses, and improvements. In this sense, guiding documents such as the National Common Curriculum Base (BNCC), the SDGs, and the Education for Sustainable Development (ESD) program are essential for pedagogical planning.

Metodologia
The study has a descriptive nature with a case study, conducted in a private elementary and high school institution in the city of São Paulo, from March to December 2023. Given the relevance of the topic, a case study of using the SDGs to promote maker education and creative education can provide significant contributions to teachers and educators interested in the subject, with the possibility of furthering studies already conducted.

Análise e Discussão dos Resultados
The projects developed were treated as possible solutions to real problems in which the students were directly or indirectly involved. For example, one of the students was on the north coast when the landslide with many fatalities occurred, and for him, the proposed solution held real value for society, leading the other group members to share the same perception and consequently engage in the construction of a solution.

Considerações Finais
The use of the SDGs as an initial part of activities, combined with the fact that students have personal stories reflecting societal problems, gives meaning and importance to the search for a solution and prototyping in generating knowledge for students.

Referências
Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education—A systematic literature review. Thinking skills and creativity, 8, 80-91. Valente, J. A., & Blikstein, P. (2019). Maker education: Where is the knowledge construction? Constructivist Foundations, 14(3), 252-262. Blikstein, P., Walter-Herrmann, J., & Büching, C. (2013). Digital Fabrication and ‘Making’in Education. FabLab Of Machines, Makers and Inventors, 203-222. Campos de Almeida, A. D., Wunsch, L. P., & Martins, E. B. (2022). Aprendizagem criativa e a educação mak

Palavras Chave
Maker Education, Creative Learning, SDGs

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1 INTRODUCTION

The aim of this study is to share with teachers and interested parties the practice of using sustainability concepts, and more specifically, the use of Sustainable Development Goals (SDGs) as a pedagogical strategy to promote maker education and creative learning.

The development of creative skills in children and young people, as stated by Davies et al. (2013), is supported by the flexible use of space and time, availability of appropriate materials, working outside the classroom with playful approaches and a certain degree of student autonomy, based on respectful relationships between teachers and students, generating opportunities for peer collaboration, awareness of students' needs, and planning. Students' creativity can also be closely related to increased confidence and resilience, motivation and engagement, and the development of social, emotional, and thinking skills. The competencies and attitudes of teachers, along with the use of Information Technology and assessment, are important components of teaching creativity (Davies et al., 2013).

However, learning is not merely the result of students' interactions with objects and people around them, but the result of students' engagement in constructing something of their interest. Another important factor is the recognition that simply providing information or assigning tasks is not sufficient for knowledge construction. Mediation needs to be carried out by more experienced individuals who understand the process of promoting learning and the content being studied, in other words, educators are necessary. Similarly, digital technologies play a significant role in makerspaces. Furthermore, it is crucial for makerspaces to recognize the need for teachers or more experienced individuals to act as mediators, challenging students, creating conditions that promote interaction with the objects being produced, and helping students understand the concepts and strategies being

used. Through these interactions with students, teachers can help them build new knowledge and achieve a higher level of understanding of what they are doing, like an ever-growing spiral of learning (Valente & Blikstein, 2019).

Blikstein et al. (2013) emphasize that the projects developed by students should be meaningful at a personal or community level, where students can suggest educational and empowerment solutions. Collaborative activities highlight the idea of the sum of individualized behaviors and lead to the perception that the solution to collective problems cannot occur individually, but requires forms of cooperative, equitable learning, different resources, and ways to meet different specificities, as well as a common goal. Thus, associating attitudes, skills, and well-being with scientific knowledge (Campos de Almeida et al., 2022).

It is worth noting that, according to Oliveira and De Souza (2022), digital transformation in education is achieved only through the holistic use of different types of drivers and not just digital technology alone. Thus, the pedagogical practices adopted with the implementation of information technologies in education enhance student engagement, enabling them to develop competencies in planning processes and procedures related to their own learning. This transforms the interaction between students, teachers, and the school environment through the inclusion of technological resources, creating conditions for a mutual teaching and learning process between educators and students. This process is supported using the SDGs (Sustainable Development Goals), which are part of the 2030 Agenda for Sustainable Development, created by the United Nations in 2015, comprising a set of 17 goals with 169 targets and 230 indicators (Silva et al., 2023).

In this context, the "Maker Movement" is associated with sustainability, as it encourages creative solutions to everyday problems, promoting the reduction and reuse of materials in its productions, as well as proposing the observation of material conditions, new uses, and improvements. In this sense, guiding documents such as the National Common Curriculum Base (BNCC), the SDGs, and the Education for Sustainable Development (ESD) program are essential for pedagogical planning. From this perspective, the development of school activities for Education for Sustainable Development is suggested as relevant (Silva, 2023).

Given the relevance of the topic, an account of the experience of using the SDGs to promote maker education and creative education can provide significant contributions to teachers and educators interested in the subject, with the possibility of furthering studies already conducted.

2 METHODOLOGICAL PROCEDURES

The study has a descriptive nature with a case study, conducted in a private elementary and high school institution in the city of São Paulo, from March to December 2023. Given the relevance of the topic, a case study of using the SDGs to promote maker education and creative education can provide significant contributions to teachers and

educators interested in the subject, with the possibility of furthering studies already conducted.

The case study method is considered a type of qualitative analysis (Goode & Hatt, 1969) and has been considered a means of organizing social data while preserving the unitary character of the social object studied (Goode & Hatt, 1969). On the other hand, Tull and Hawkins (1976) state that a case study is based on an in-depth analysis of a particular situation and Bonoma (1985) places the case study as a description of a specific situation (Bressan, 2000).

Case studies can be valuable instruments for educational studies, as the researcher's direct and prolonged contact with the events and situations investigated makes it possible to describe actions and behaviors, capture meanings, analyze interactions, understand and interpret languages, study representations, without detaching them from the context and the special circumstances in which they manifest themselves. Thus, they allow us to understand not only how these phenomena arise and develop, but also how they evolve in a given period. The development of case studies generally follows three phases: (a) exploratory or definition of the focus of study; (b) phase of data collection or delimitation of the study; and (c) data analysis phase. They are defined as three phases, but they are, in fact, references for conducting case studies, as research is a creative activity and as such may require the combination of two phases, the unfolding or extension of one of them, the creation of others (Marli, 2013).

The educational institution was established in 1964, during a time of great political and cultural upheaval. The institution's history is marked by an innovative pedagogical process that goes beyond working with content produced by the major areas of knowledge, also investing in the development of autonomy and critical thinking, the analysis of the social dimension constructed by students, and the linkage with knowledge. Over the years, the institution has maintained its commitment to its principles, consolidating the holistic formation of students as the foundation of the pedagogical-educational project.

The project was applied to four fronts, with a total of 12 students, comprising five students from the elective course Internet of Things, two students from the elective course Digital Projects, four students from the scientific initiation project, and one student from the institution's International Baccalaureate (IB) program, an IB Global School.

The proposal for the four fronts was to develop a solution for society using information technologies, in an innovative and low-cost way for its development, and to develop a prototype as a product resulting from the research and application of knowledge. The main objective of the proposal was the development of technological skills with the support of sustainability concepts.

Understanding the SDGs was the first step in seeking meaningful solutions for society. The students sought in their research the relationship of the SDGs to their personal stories and, more importantly, their experiences. Thus, four different projects were developed, as presented in Table 1.

Table 1: Maker Projects with SDG Fundamentals

Group	Students	Middle Ages	Project	SDG	Solution created
Internet of Things	5	15,5	Constructionism Applied to Real-World Problem Solving: Landslide Monitoring Design	(11) Sustainable cities and communities	totype IoT solution using Arduino and Bluetooth alert APP (MIT APP Inventor)
Digital projects	2	15	Smart Glove: Exploring Internet of Things (IoT) Solutions	(10) Reducing inequalities	Prototype of a smart glove with Arduino to help people with visual impairments
Scientific guidance	4	16	Smart Care: Use of Artificial Intelligence in the public health system	(3) Health and Wellness	Prototype of an APP supported by artificial intelligence to reduce queues in the SUS
IB	1	16	Healthy Meal Delivery Drone: STEM Approach to the Commuting Problem in Big Cities	(11) Sustainable cities and communities	Drone Building Project with Arduino

Source: Authors.

The projects developed were treated as possible solutions to real problems in which the students were directly or indirectly involved. For example, one of the students was on the north coast when the landslide with many fatalities occurred, and for him, the proposed solution held real value for society, leading the other group members to share the same perception and consequently engage in the construction of a solution.

3 RESULTS AND DISCUSSION

The students' accounts during the development of the projects and the perception generated among the teachers confirm the importance of the significance brought by the students' life stories and their direct or indirect involvement with a real problem, as well as the creative formulation of a solution using technology in a sustainable way.

The students' engagement was noticeable in their statements as they sought the help and guidance of the teachers when challenges seemed insurmountable, because they believed in the product as a real contribution to society. The exchange of knowledge between students and professionals or specialists outside the institution also contributed to the students' engagement, as it confirmed the path taken or provided future possibilities for solving real problems with social relevance and importance. A school project allowed to broaden the students' vision, enabling them to contribute to the construction of a better world.

The students' accounts confirmed that the knowledge acquired went far beyond the teachers' expectations. Students reported the importance of teamwork, where colleagues'

opinions must be respected, the exercise of critical thinking, and the understanding of citizenship. They learned that it is possible to practice simple actions that contribute to achieving the SDGs, as they built low-cost prototypes aimed at solving real problems. The concepts were applied in practice, they explored new tools and materials, with the possibility of creating codes and integrating STEM (Science, Technology, Engineering, and Mathematics) practices. They understood that IoT could be used to solve everyday problems. Another group of students reported the importance of learning programming and Artificial Intelligence resources as a basis for improving the public health process. Collaboration is essential for the emergence of new ideas, as well as empathy. But most importantly, they learned that, with a focus on real social problems, with much study and effort, it is possible to contribute to society. Prototyping and coding were important lessons for all students.

In the descriptive process, a considerable potential is identified to deepen the literature related to the topic and the objective of the study.

4 FINAL CONSIDERATIONS

A central aspect of the approach used is the construction of objects, using different materials combined with programming activities and the use of manufacturing tools. Students are engaged by using creativity to solve real problems that were part of their life stories, directly or indirectly, creating an important relationship with the SDGs. This project-based STEM approach allows them to gain control over their school experience and participate in activities around new topics and technologies. Thus, students were able to produce artifacts using traditional objects and materials combined with digital manufacturing technologies (Blikstein et al., 2013), directly based on the constructionist learning approach proposed by Papert (1986) to explore and build knowledge in various domains (Valente & Blikstein, 2019).

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The use of the SDGs as an initial part of activities, combined with the fact that students have personal stories reflecting societal problems, gives meaning and importance to the search for a solution and prototyping in generating knowledge for students. This holds true even if only one student in a group has a direct or indirect relationship with the problem. The importance of sharing the solutions developed with external agents to the institution, through interviews, or even after the completion of the work, with presentations at

conferences and in discussion groups, demonstrates that learning has no limits, and that the maker approach empowers students. The approach used motivated the participation of colleagues, family members, and teachers in the process, generating new ideas and new learning, boosting the construction of knowledge, the knowledge spiral.

Thus, the study becomes relevant considering the results presented, being an important contribution to the educational field, achieving the goal of sharing with teachers and interested parties the practice of using sustainability concepts and, more specifically, the use of the SDGs as a pedagogical tool to promote maker education and creative learning.

REFERENCES

Blikstein, P., Walter-Herrmann, J., & Büching, C. (2013). Digital Fabrication and 'Making'in Education. *FabLab Of Machines, Makers and Inventors*, 203-222.

Bonoma, T. V. (1985). Case Research in Marketing: Opportunities, Problems, and Process. *Journal of Marketing Research*, 22.

Bressan, F. (2000). O método do estudo de caso. *BREMAT Institute for Strategic Thinking & Leadership*. https://doi.org/10.13140/RG.2.2.31803.39207

Campos de Almeida, A. D., Wunsch, L. P., & Martins, E. B. (2022). Aprendizagem criativa e a educação maker: análise de boas práticas. *Dialogia*, (40), e21067-e21067.

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education—A systematic literature review. *Thinking skills and creativity*, 8, 80-91.

Goode, W. J., & Hatt, P. K. (1969). Métodos em Pesquisa Social (3o ed, Vol. 1). *Cia Editora Nacional*.

Marli, A. (2013). O que é um estudo de caso qualitativo em educação? *Revista da FAEEBA – Educação e Contemporaneidade*, 40, 95–103.

Oliveira, K. K. D. S., & De Souza, R. A. (2022). Digital transformation towards education 4.0. *Informatics in Education*, 21(2), 283-309.

Papert, S. (1986). Constructionism: A new opportunity for elementary science education. *Massachusetts Institute of Technology, Media Laboratory, Epistemology and Learning Group*.

Silva, J. B. D., Frasseto, L. D. S., Machado, L. S. R., Bilessimo, S. M. S., & Silva, I. N. D. (2023). A pedagogical model for integrating digital technologies in education: Workshops on sustainable development goals (SDGS). *Journal of Information Technology Education: Research*. Califórnia. Volume 22 (2023), p. 461-479.

Silva, R. A. D. S. (2023). *Cultura Maker e educação sustentável nos anos iniciais do ensino fundamental: um estudo da motivação em interface com BNCC e ODS* (Doctoral

dissertation, Sao Paulo University).

Valente, J. A., & Blikstein, P. (2019). Maker education: Where is the knowledge construction? *Constructivist Foundations*, 14(3), 252-262.