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Lego Education and use of STEAM methodology in teaching History

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ABSTRACT : *The STEM teaching methodology (Science, Technology, Engineering, Arts and Mathematics) has stimulated the development of collaborative and transdisciplinary knowledge in Basic Education schools. Combined with the Lego Education methodology with the use of robotics to build prototypes that involve Lego blocks and electronic parts, the school becomes a fun learning laboratory. This article deals with the use of the combination of STEAM and Lego Education methodologies in the teaching of History, presenting two case studies: one referring to the democratic electoral process in the History of Brazil Republic and another on death, citizenship, and social hierarchies from the cemeteries in the History of Aracaju, Sergipe, Brazil. Both using active methodologies, Lego blocks and robotics.*

KEYWORDS *Lego Education, robotics, teaching History, STEAM, Edtechs*

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I. INTRODUCTION

The deep changes that made the use of digital technologies more intense were driven by the Covid19 pandemic, which in 2020 caused social isolation and the closing of countless social and workspaces around the world. Education, particularly affected by the initial paralysis of its activities due to the closing of universities and schools, needed to use technologies that were previously only auxiliary, elevating them to the position of protagonists with virtual teaching environments and active methodologies for a more dynamic online teaching.

Before the pandemic, the concern with Artificial Intelligence and other disruptive technologies demanded by the labor market evidenced a gap in the training processes in Brazilian Basic Education, still extremely focused on analog classes that used the blackboard and chalk and the textbook as fundamental elements of the relationship between teacher and student.

Companies that direct their activities (or part of them) to Technologies in Education are called "EdTech". Many attributes the nomenclature to startups, but not only entrepreneurship has given rise to this niche of current services, products and employability, as large companies such as Google (Google Education) and Lego (Lego Education) have developed digital platforms to offer courses, sequences didactics and materials combining the digital and virtual universe with the analog with the application of robotics [1].

Most of the so-called digital natives (born in the era of digital technologies) have greater aptitude and ease in handling technological supports, using them as the basis of their communication and social interaction most of the time. In this respect, sharing information impacts their learning [2].

Many schools approached Lego Edtech when they realized the potential of using differentiated teaching-learning methods in the 21st century and invested resources in the adoption of STEAM (Science, Technology, Engineering, Arts, and Mathematics) and its application to robotics with Lego blocks in classrooms.

This article seeks to present the Lego Education methodology and its use of STEAM as an innovative tool in teaching History.

The second section of this paper showsthe concepts and practices of Lego education and STEAM methodologies, also addressing the use of blocks from the Lego Education We Do 2.0 kit in the development of a History of Brazil Republic class on the democratic electoral process. The third section discusses the

application of the Lego Education methodology in contents of Sergipe's cemeteries, Brazil, and finally the conclusion is reviewed in the fourth section.

II. LEGO EDUCATION AND STEAM METHODOLOGIES

STEAM is a methodology created in the USA in the 1990's that provides for the integration of different areas of knowledge such as **S**cience, **T**echnology, **E**ngineering, **A**rts and **M**athematics, enabling the student to prepare for challenges as a citizen and in the job market that has been valued interdisciplinarity and multidisciplinary areas in various segments in the search for solving daily problems [3].

The step-by-step STEAM methodology can be performed as follows:

- When dealing with contents related to the History of Brazil Republic, the teacher can create a round of conversations with students about the form of Elections in Brazil to debate the use of electronic voting machines between the past of printed votes and the present of votes mediated by technologies. Problems must be raised so that they can collaboratively seek solutions.
- After dividing the class into groups, the teacher should guide students to use theCanvas Education model (inspired by the original Business Model Canvas) to paste post-it notes, organize, systematize, and visualize ideas, questions, and hypotheses (Fig.1).
- Visit to a regional Electoral Court.
- Optimize placement to maximize efficiency.The search for solutions for the picture visualized in the elaboration of the Educational Canvas involves: a) **Science**: social, political, technical and technological concepts (Historical Context); b) **Technology**: the technological functioning of electronic voting machines (Law & Security); c) **Engineering**: logical and organizational reasoning in both the use of printed and electronic voting (planning and design); d) **Art**: the construction of a rhetorical argument with the use of advertising banners and videos (drawing, collage, digital graphic art, smartphone with creative and collective participation), e) **Mathematics**: Tables and Graphs with the quantity of fraud in elections with printed and electronic voting.And with the number of days spent in counting the votes in both procedures.
- Presentation to the class of the results.

Fig.1 shows the development of the selected theme to solve the historical problem. The first module contains a brief background on the subject. The second module (over) presents the related problems. The third (under) module asks for the hypotheses about the problem. The third module shows the interests at stake. The fourth (over) module lists the participants linked to the theme. The fifth module (under) brings the channels for disseminating information produced by the event related to the theme. The sixth module presents the Laws and Safety that address the topic in focus. In the modules below are the benefits and disadvantages.

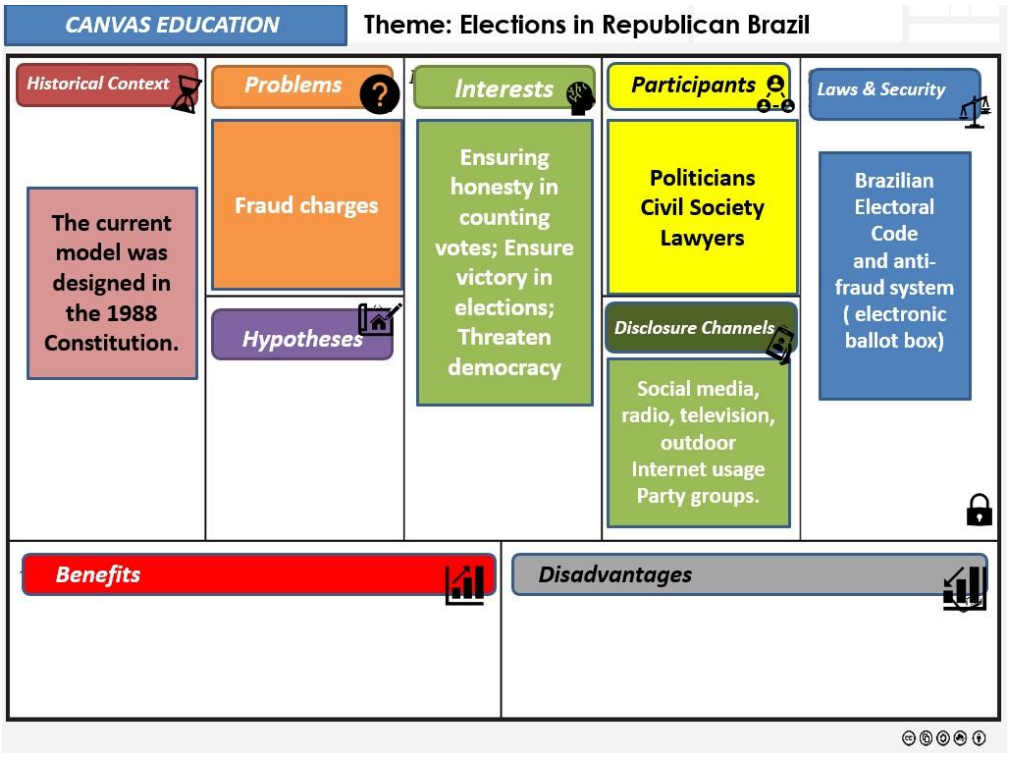

Fig.1. Canvas Education model (own authorship, 2021)

In the case of the Lego Education methodology, it follows the parameters of student engagement, exploration of the theme/subject/problem, explanation of contexts and analyses, elaboration of prototyping in Lego blocks and evaluation of the results achieved.

Lego was invented in 1934 by Danish carpenter Ole Kirk Christiansen. Initially made as wooden toys, but due to the scarcity of raw material after the war, it changed its base to injected plastic (Acrylonitrile butadiene styrene). From then onwards, a toy was configured with several modules of different sizes for fitting, originating several combinations, and reaching international success in the late 1950s.It brought immense possibilities for fun, because with six eight-pin pieces there are many different combinations, allowing creativity and play at the same time[4].

Teachers Natália Lucas Dutra Bortoluzzi and Daniele Maestri Battisti Archer, from São Luiz School, in Brusque (SC, Brazil), developed the LEGAL VOTE project with their elementary school classes and explored the robotics class to teach about the functioning of the electoral process. The STEAM and Lego Education methodologies were associated with the use of robotics. For this, an electronic ballot box was built with a Lego's Kit, under the guidance of teacher Natália's husband, who is a robotics teacher [5]. After it was built, the ballot box was made available for voting by the students who also built the entire process of assembling electoral sheets, advertisements, votes and counting.Some results are shown in Fig. 2.

Fig. 2. LEGAL VOTE project (Robo Mind, 2021)

Lego Education works with Maker Culture (where teachers mediate learning through prototyping projects, when students build their knowledge in a tangible way), with programming (computational thinking, involving creativity, autonomy, logical reasoning, abstraction and resolution of problems), STEAM method, with attention to the development of socio-emotional skills (in cooperative work and encouragement of responsible leadership), culminating in the presentation of solutions through robotics using kits such as "WeDo 2.0".

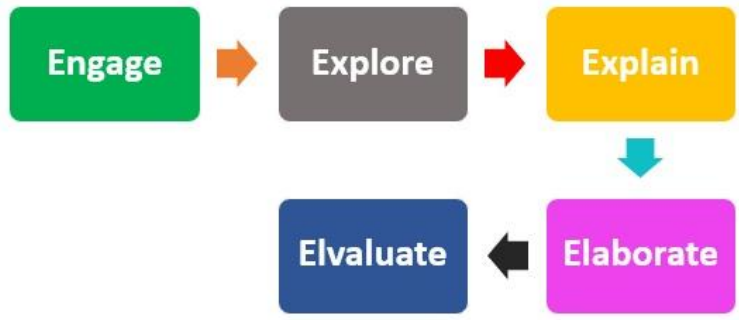

Fig. 3.Lego Educationmethodology – Five E's (own authorship, 2021)

The Lego Education methodology, in a more detailed way, in its subdivisions seeks: **Engage** – use games, short stories and debates to arouse curiosity, recover the knowledge already acquired and prepare students for a new stage of learning); **Explore** – carry out practical construction activities. As students create diverse shapes, their minds organize and store new information related to these structures; **Explain** – provide opportunities to reflect on what they did, to speak and share ideas they had in the Explore phase; **Elaborate** - developing complementary activities allow students to apply their newly acquired knowledge, thus reinforcing what they learned in the previous phases and **Evaluate** - sharing with students feedback from the teacher, other colleagues and the self-assessment of their own growth during the activity, stimulating the process of self-knowledge and continuous improvement[6]. Fig. 3 shows a diagram with the five steps of the Lego Education methodology.

The Lego Education WeDo 2.0 robotics kit is designed to provide opportunities for students to sketch, build, and test prototypes and representations of objects, animals, and vehicles that have a real-world focus. It encourages the investigative approach (hands-on) and encourages students to be fully involved in the process of designing and building knowledge[7].

Educational robotics emerged in the 1960s, when pioneering researcher Seymour Papert was developing his theory on constructionism and defending the use of computers in schools as a resource that would appeal to children. It is understood as a set of technological concepts applied to education, in which the learner accesses computers and software, electromechanical components such as motors, gears, sensors, wheels and a programming environment so that the above components can work. In addition to basic knowledge of mechanics, kinematics, automation, hydraulics, computers, and artificial intelligence involved in the operation of a robot, pedagogical resources are used for a pleasant schoolwork environment[8].

Fig. 4. Lego Education We Do robotics kit

Fig. 5.Lego Education We Do - Electronic Parts (smarthub, battery, engine, and sensors)

Through resistant plastic materials elaborated in the form of pluggable blocks, Lego brings together transistors, electronic motors and movement and inclination sensors, in addition to an intelligent hub for connecting the parts with its own battery.The electronic parts coated with plastic blocks are displayed in the in Fig. 5.

In this regard, there is a complex materials engineering behind these parts. The kind of tough plastic that will not melt in contact with electronic parts has been extensively tested. There are many studies and mathematical calculations in manufacturing. The measurement of an eight-pin block (brick) (2 x 4) is calculated by the 8mm multiples rule, so this block has a 2-fold measure8mm by 4 times 8mm, and resultin 16x32mm (precisely 31.8mm). The height of the blocks is 9.6mm.

III. USE OF LEGO EDUCATION + STEAM METHODOLOGY IN HISTORY TEACHING

In her Professional Master's thesis in History Teaching, since 2019, Cleones Gomes dos Santos has been conducting research on the Cruz Vermelha and Santa Isabel urban cemeteries located in Aracaju, capital of Sergipe, Brazil. The studies have supported the development of an authorial History teaching methodology called **ConText**, which uses Lego blocks in a card game with goals to be achieved and scores from the contact with local history through newspapers from the past.

The ConText methodologyevoking historical context and playing with the T in the layout of a visual identity that can refer to a cross or tombstone, typical of cemetery spaces. The aim is to make situations more familiar and surmountable, situations that a priori may be uncomfortable when related to the symbology of death and the memories linked to it.

The oldest tomb records of the Santa Isabel Cemetery date back to 1885 and, probably, in its first phase, that holy field contained individual shallow graves in the ground and marked by crosses that did not survive the passage of time. Obituaries started to be controlled in organized books only from 1885, when their management was transferred to theAracajuana Charitable Association.

Throughout the 20th century, the Santa Isabel cemetery was practically exclusively used by traditional families of the political-economic elite, liberal professionals, and intellectuals from Sergipe. This is what Rafael Santa Rosa Cerqueira (2014) attests to when he makes a brief comparison between the burials carried out in the Santa Isabel and Cruz Vermelha (Cambuys) cemeteries [9].As shown in Fig.6 showing a luxurious family tomb.

Fig. 6.Leite Franco family's tomb in the Santa Isabel Cemetery (Photo Marcos Aurélio, 09/24/2019)

It was only in 1902, according to a document of the time, that the Cruz Vermelha cemetery (Fig.7), also known as Cambuys, was inaugurated, destined to perform burials in shallow graves, that is, to serve the poor population, destitute of all sorts, residing in the capital. Located in the former Expedicionários Square in the Siqueira Campos neighborhood (formerly known asAribé), now RanulfoPrata Square.

The inclusion of cemeteries in the social landscape as a specific place destined for burials, separating the dead from the living, was not just a mere sanitary issue, that is, a practical and scientific attitude of society. The attitude is also the result of the privileged desire for distinction to eternalize themselves through a status symbol, a permanent mark of consecration: the tomb. And here death serves as a mechanism for us to understand the differences between social classes.

Fig.7. Shallow graves at the Cruz Vermelha Cemetery (Photo Marcos Aurélio, 09/24/2019)

The Cruz Vermelha and Santa Isabel cemeteries are currently under the administration of the Aracajuana Charitable Association, and even in the 21st century the traces that marked their trajectories continue to populate the landscape of both, whether the sumptuous mausoleums located in Santa Isabel, or the poor shallow graves of the Red Cross. They are rich in history, but also in abandonment, especially regarding the Cruz Vermelha cemetery, and yet full of possibilities when we use their respective funerary spaces to bring out new possibilities for teaching History.

Fig. 8. Lego Harry Potter Cemetery and Cemetery prototyped in 3D

A model of a Lego cemetery inspired by the Harry Potter movie was acquired in a toy store and from it experiments have been carried out to fit pieces according to the dynamics of a game where questions about citizenship of the dead and the living throughout the Aracaju history are content for historical reflection. A quiz with a set of questions about the social, economic, and political role of the living and the dead in society guides the movement through the cemetery, the construction or deconstruction of tombs in the Lego blocks.

In addition to the Harry Potter Lego Cemetery, it is possible to prototype in a 3D printer tombstones and other objects that would configure the Santa Isabel and Cruz Vermelha cemeteries,as indicated in the Fig.8.

IV. CONCLUSION

The use of the use of students' everyday reality in teaching History for the development of meaningful learning combines the demands of the physical world with cognitive abstractions. By adopting didactic procedures that encourage investigation, creativity, hypotheses, and tests, seeking solutions to the demands of life in time and space, learning constitutes a historical vision for life, where the struggle for full citizenship can be an effective achievement.

The evolution of Materials Engineering in the integration of different objects such as plastic (Acrylonitrile butadiene styrene) to electronic parts allows to give movement to historical paths built with Lego blocks for educational activities. Thus, robotics streamlines learning even on sensitive topics such as elections, democracy,death, cemeteries, and social hierarchies in life.

In this aspect, the ConText methodology with Lego blocks for the teaching of History of Aracaju, can encompass critical reflection on other formative particularities about:

Engineering and Architecture - the construction project of cemeteries, cartography, space and time relationship and the use of different materials in tombs.

Environment - the ecological relationship of cemeteries, reflecting on soil contamination and territorial occupation in cities.The extraction of geological materials for the construction of the tombs and the impact on nature.

Economic/Financial - the costs of a burial in shallow graves and luxurious graves, the costs of maintaining bones in cemeteries.

Art/History of Art - the analysis of tomb sculptures, their artisans, the form of artistic production from the work of sculptures in different materials such as marble, granite, concrete etc.

Technology - identification of technologies for extracting geological and construction materials from tombs. Use of computer graphics, sensory digital mapping, etc.

Learning elements also included in the STEAM methodology.

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