Macrothink Institute™

Journal of Studies in Education
ISSN 2162-6952
2023, Vol. 13, No. 4

Creation of Sustainable Cities through Digital Game: A Proposal for the Teaching of Geography

Janaína Iara Alves Pereira do Nascimento, Ana Silvia D'Alessandro, Janaína Aparecida Pereira Paiva, & Estaner Claro Romão

Escola de Engenharia de Lorena, Universidade de São Paulo, Brasil

E-mail: jana-jose@usp.br, anasilviadalessandro@usp.br, janainapaiva@usp.br, estaner23@usp.br

Received: Oct. 5, 2023 Accepted: Nov. 1, 2023 Published: November 10, 2023

doi:10.5296/jse.v13i4.21424 URL: https://doi.org/10.5296/jse.v13i4.21424

Abstract

The use of methodologies that approach the daily lives of students, generating greater engagement and meaningful learning, can become the key to education today. The current generation, the so-called Digital Natives, are attracted to activities that involve technologies, such as the use of digital games. The present research was carried out with 28 students, from the 7th year of Middle School, in a private school in the interior of the state of São Paulo, and it is qualitative-quantitative research, having the case study as an approach. Initially, the students answered a pre-test that sought to find out which concepts on the subject the students had already acquired before the application of the project. The chosen theme, within the Geography discipline, was the 2030 Agenda – Sustainable Development Goals, specifically SDG number 11 which deals with Sustainable Cities and Communities. After the pre-test, a sensitization class was held about the topic and proposed to them a research activity. After the socialization of the research, the proposal involving the Minecraft game was presented so that, through it, the students in teams could create a sustainable city, demonstrating the acquired knowledge. To measure the learning gains, the metric used was the rubric, established by the class teacher. As a result, the game contributed to stimulating creativity, solving problems, and overcoming challenges proposed through the criteria previously established. In the end, they presented their developed cities using video creation and editing. The results show a gain in learning since 80% of the students reached levels between intermediate and advanced.

Keywords: Game Based Learning; digital native; Minecraft.

Introduction

Teaching that privileges students to become the protagonists of their learning, actively participating in their knowledge construction process, while the teacher only occupies the role of mediator, has its scope in the so-called Active Methodologies (MORAN, 2015). Through these methodologies, it is possible to obtain greater student engagement, since, once the work proposal is presented, they start research, discussions about the topic or problem to be solved, conclusions, decision-making, and even the so-called "*Hands-On*", in which they present some product, resulting from this process, having greater possibilities of obtaining significant learning gains than a merely expository class.

However, it is important to reflect that for each new activity or topic addressed in the classroom, in order for the topics to be understood, it is always necessary to consider the students' prior knowledge (AUSEBEL, 2002). Based on this prior knowledge, it is possible to establish a better connection between what the student knows and what he will learn, thus contributing to effective learning.

Due to these mentioned possibilities, the adoption of one of the Active Methodologies, such as Digital Game-Based Learning (DGBL) (ECK, 2006; HUSSEIN *et. al.*, 2019), is present in this study. Digital games are present in students' daily lives, and they are part of the generation called Digital Natives (PRENSKY, 2000). Bringing this daily life closer to classes is an indicator of possibly promising results because our students are born in this context and it is up to us to bring them to Education, understanding that digital technologies occupy a place in the lives of these students (ARRUDA, 2011).

The culture of digital games has been incorporated into Education in several places around the world, including Brazil (JOHNSON *et. al.*, 2012) and, according to Itacarambi (2013), the games used in education already present a challenge since, with it, it is possible to present content in order to make teaching attractive, providing creativity and the search for resolutions and conclusions of the proposed challenges. However, it is necessary to adopt a methodology for the use of digital games in the classroom (PRENSKY, 2005).

Assuming that the use of DGBL is favorable for teaching, we will present in this work a proposal for the use of the Minecraft game to assist in the teaching of concepts about sustainable development, and for that, we will first make a brief discussion about the objectives of sustainable development in the light of the 2030 Agenda, then we will present the methodology of application of this project, and finally the results found and their analyses.

The Sustainable Development Goals (SFG) - Agenda 2030

Currently, discussions about environmental and urban problems have been constant on political and economic agendas. The UN (United Nations), since 2013, has discussed issues related to sustainability and, with the 195 Member States, in 2015, it approved the 2030 Agenda. For the elaboration of this Agenda, several groups, from civil society, through governments and research institutions, organized a document whose structure is based on 17

objectives and 169 goals. This Agenda 2030 contemplates ambitious and very important goals for the maintenance of life on our planet.

These objectives can only be achieved through a global effort that can generate a culture of collaboration between peoples, as the UN assures in its document for the implementation of the 2030 Agenda, saying that

We are determined to mobilize the necessary means to implement this Agenda through a revitalized Global Partnership for Sustainable Development, based on a spirit of reinforced global solidarity, focused in particular on the needs of the poorest and most vulnerable and with the participation of all countries, all stakeholders and all people (ONU, 2021, s/p, our translation).

The goals contained in the SDGs are considered ambitious, transformative, and extremely necessary for us to be able to overcome the problems faced by the society that inhabits this planet. Knowing how to live in a way that the current generation does not deplete natural resources, and learn to organize a society that is more balanced, conscious and fraternal for future generations is extremely important.

Thus, the school, as an institution that also has the function of assisting social development, according to UNESCO (United Nations Educational, Scientific and Cultural Organization) (UNESCO, 2020), has an important role in approaching the SDG theme, as well as promoting actions for its understanding, thus becoming an important collaborating agent for the goals become achievable.

In a more focused way, the present work is based on the discussion and development of ideas that are related to the "SGD 11 - Mobilize Sustainable Cities and Communities" which, among other goals, seeks to make cities more inclusive places, providing transport systems more safe and sustainable, reducing environmental impacts related to waste generation, aspects that are related to sustainability.

Methodology

For the present research, a qualitative-quantitative approach was carried out in a private school in the interior of São Paulo, involving 28 students from the 7th year of Middle School. This is a Case Study that sought to analyze how the use of a digital tool, the Minecraft game, can contribute to the better development of geographic skills within the theme of urbanization in Brazil and sustainability.

At first, a survey was carried out on the students' previous knowledge about sustainability, which for this, two question was applicated. After answering this form, which was carried out through Google Forms, the research professor and class teacher raised awareness on the topic: Sustainable Cities and the 2030 Agenda of the SDGs, along with the topic of urbanization in Brazil. Students were able to learn about SDG 11 - Sustainable Cities and Communities.

After this first stage, the students were encouraged to carry out a research whose theme was: “Sustainable cities: characteristics and innovations”. On the stipulated date, when bringing

the researched data to the class, a dialogic class was held, raising questions that made a parallel between the local (referring to the city where they live) and the global (related to the cities of the world).

In the next class, as a third stage, the students formed 7 teams, which would carry out, using the Minecraft game, the creation of a sustainable city for the application of the acquired knowledge. The expectation was that students should create a city showing how it was before the insertion of sustainable elements such as selective garbage collection, use of clean and renewable energy, and encouraging the use of public transport, among other elements. The evaluation criteria of the works were previously presented through a rubric, as shown in Table 1. The students had 15 days to this task to perform it. On the appointed day, the students presented the videos to their classmates and to the teacher. After the presentations, discussions were held about the innovations presented, and, as a last stage, the students answered a final questionnaire.

Results and Discussion

To start the proposal it was important to investigate what the students knew about sustainability since the theme was the motivator for the application of the project involving the game Minecraft. Thus, a form using the Google Forms tool, the two was sent through the Microsoft Teams platform, used by the school. 25 participants answered this pre-test. Figure 1 shows the marked responses.

Observing the results, it is clear that, a priori, the students associate sustainability with resolutions related to the disposal of garbage, since it was the one that obtained an index of 96%. The “Reduction of plastic packaging” and “Energy savings” also received good votes, with 88% and 84% respectively. A fact that draws attention is that 40% of the students indicated “Reduction in the use of public transport”, this shows a knowledge that has not yet been assimilated, regarding the need to reduce the emission of greenhouse gases through the widespread use of transport by the population, thus reducing the volume of cars on the streets.

Table 1. *Rubrica presented to students.*

Levels	Creating a sustainable city	Possible points	Final presentation of the game	Possible points
Advanced	Create a sustainable city using elements such as: • Parks • Bike paths and efficient public transport • Use of clean energy • Accessible places • Green roofs • Selective collect	4	The video must attract the viewer to notice the characteristics of the city created, using the participation of all the components of the team and include an introductory cover.	2
	Make a comparison between before and after sustainable changes in your city.	2		
	INNOVATIVE IDEA Create at least one innovative idea for your city, an idea that solves a problem run into cities today.	2		
Intermediate	Create a city with basic elements, but also inserted other elements: • Parks • Bike paths and efficient public transport • Use of clean energy • Accessible places • Green roofs • Selective collect	4	The video must attract the viewer to notice the characteristics of the city created, using the participation of all the components of the team and include an introductory cover.	2
	Make a comparison between before and after sustainable changes in your city.	2		
Basic	Create the city with basic elements of a sustainable city: • Parks • Bike paths and efficient public transport • Use of clean energy	2	Presented video with narration or explanatory text.	2
	Make a comparison between before and after sustainable changes in your city.	2		
Below Basic	Create the city with basic elements of a sustainable city: • Parks • Bike paths and efficient public transport • Use of clean energy	2	Presented video with narration or explanatory text.	2

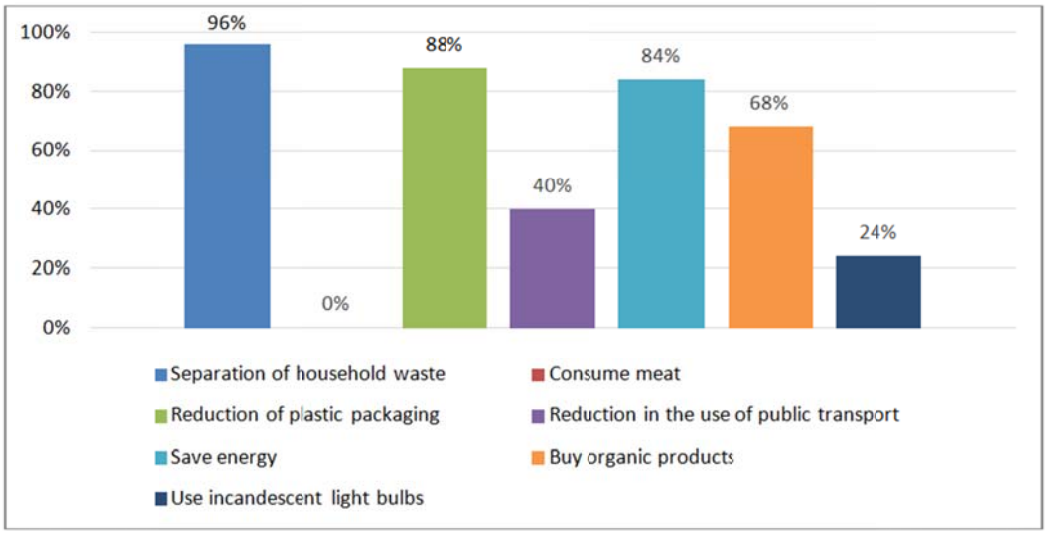

Figure 1. Question 1 (open): Mark alternatives that are related to sustainable attitudes.

Regarding the use of incandescent light bulbs, 24% indicated that this is something sustainable, when in fact it would be correct for them not to indicate this item. None of the students indicated "consuming meat". Meat consumption is associated with methane gas generation and deforestation. It is something to consider that they are aware of this issue as they studied the topic "Rural Brazil" a few weeks ago, where this subject was addressed. Incandescent lamps should be replaced by fluorescent or LED, as these are more economical. This data can demonstrate that they do not know the term "incandescent" properly, since they were born in a historical moment in which this type of lamp is not used frequently in homes in our region. Based on this data, there was a need for an explanation to students about this subject.

Another important question was to know what these students knew about sustainable cities, or what it meant for them. For this, Figure 2 contains the results of the questioning about the characteristics that a sustainable city must-have.

Through these results (Figure 2), some data presented in Figure 1 are confirmed when related to what they consider to be something that a sustainable city should be concerned about. For example, 92% marked "Collection and correct disposal of waste", demonstrating that the issue of waste disposal is something they always relate to sustainability. A fact that stands out is that 80% indicated that sustainability in a city is also associated with quality education. This data may be linked to the idea that a society without education is hardly able to make projects that promote sustainability viable.

It is likely that students have associated education with environmental issues. As for the issue of transport, once again it is clear that 44% of students still do not understand that public transport should be encouraged to the detriment of the use of private vehicles when we think

about sustainable cities. Regarding energy use, 28% indicated that a system that uses non-renewable energy sources should be implemented.

Therefore, the concept of renewable and non-renewable energies needed to be worked on with the students. Only 4% of the students indicated that a sustainable city should keep away socially vulnerable people. Even though it is a little mentioned topic, the issue of social vulnerability associated with sustainability must be worked on with students, as sustainability cannot be associated only with environmental issues, but in a broad aspect that involves economic and social issues.

After analyzing the answers to the two applied questions, it was confirmed the need to raise awareness on the subject was carried out in class, where, associated with the theme of the Brazilian population, a subject that the (BRASIL, 2018, p. 387) brings for the series in question in the skill "EF07GE06 (Discuss the extent to which the production, circulation and consumption of goods cause environmental impacts, as well as influence the distribution of wealth, in different places)". Students got to know the 2030 Agenda – SDG, more specifically SDG 11 (Sustainable Cities and Communities).

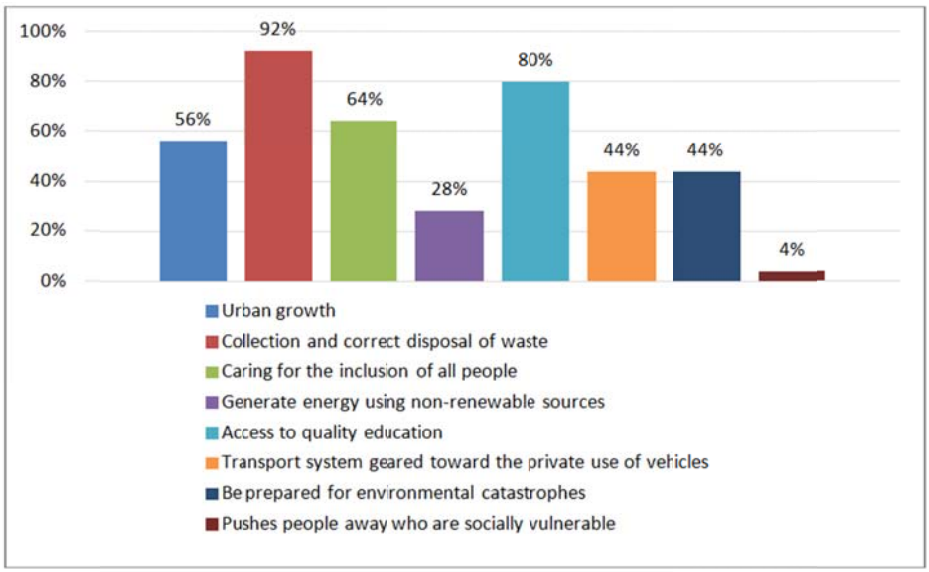

Figure 2. Question 2: Cities that are considered sustainable are concerned with the following aspects: (Check all that you think is correct).

After this moment, in which there was effective participation of students with questions relevant to the theme, students were encouraged to carry out their research individually, having as a theme the characteristics of sustainable cities. After these surveys, the students shared the knowledge obtained and were instructed to form teams.

It was made clear what would be the evaluation criteria were included in a rubric created especially for the activity of producing a sustainable city using the Minecraft game. Table 1, previously presented, presents the rubric sent to students.

After the stipulated period, the students made their presentations through the videos made using the Minecraft game. They created sustainable cities, showing viewers what a city should look like after modifications that made it more sustainable.

Figure 3 shows elements of one of the cities presented by a team of students. During the teams' presentation of the cities, everyone should highlight the characteristics and explain the reason why they chose to implement them in their city. One of the criteria for the evaluation of the final product of the game was that the students presented a before and after of the city and were encouraged to create an innovative idea to implement and solve a problem faced by the residents.

This team (work in Figure 3), during the presentation, demonstrated that in their sustainable city, they sought to implement important characteristics, such as (a) green roofs, a technique that contributes to rainwater harvesting and improvement of the thermal sensation inside the residences; (b) leisure parks, which would provide an environment that would provide residents with better air quality and leisure; (c) use of clean and renewable energy, an important concern in the face of greenhouse gas emissions and global warming, (d) selective garbage collection, demonstrating concern related to waste disposal. This team created the city with important elements to characterize it as sustainable, however, it did not present any innovative idea for the solution of some problem that affects today's cities.

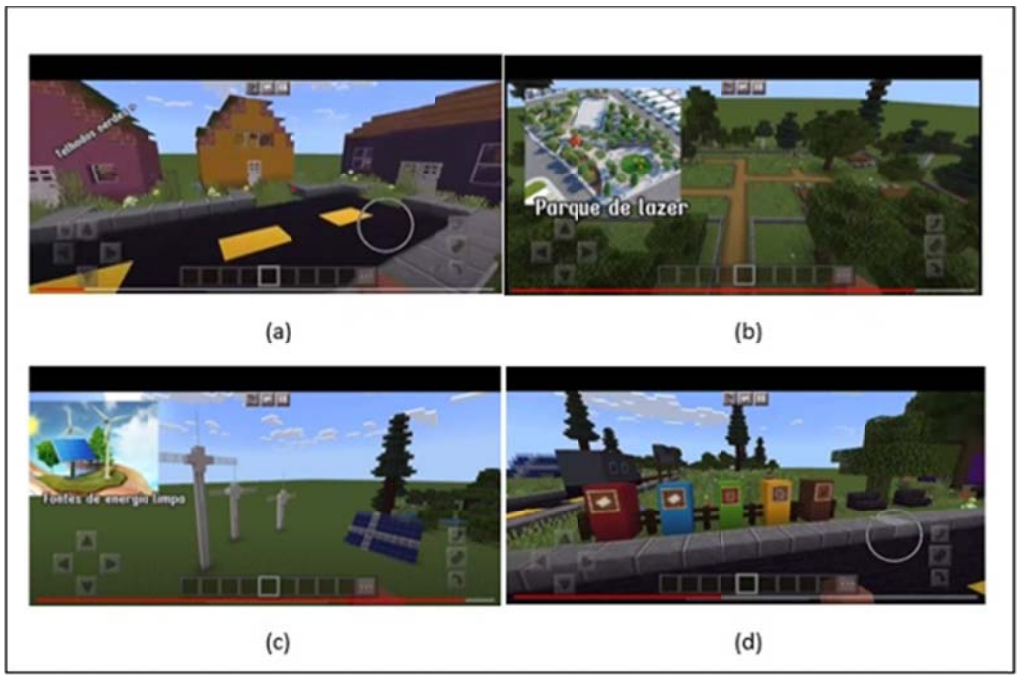

Figure 3. Images of the activity using the Minecraft game to present sustainable cities.

Figure 4 shows some of the innovative ideas designed to solve a problem faced by cities today.

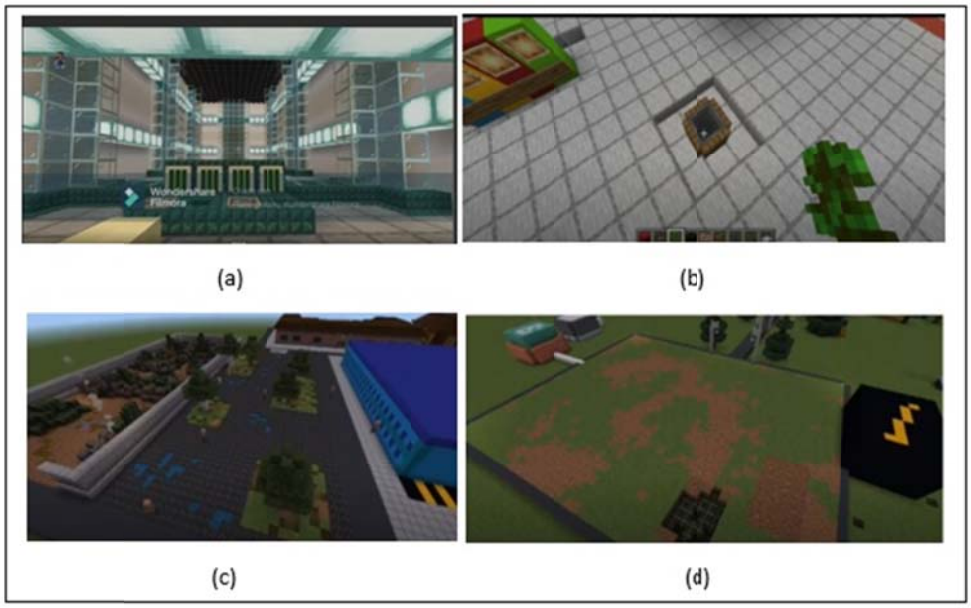

Figure 4. Presentation of an innovative idea to solve current urban problems.

One of the teams presented an innovative idea the creation of a rainwater plant to transform rainwater into electrical energy, thus complementing the energy used in the city (a). Another team presented an intelligent recycling system that would mechanically separate the waste, directing it to the plant that will recycle it (b). The issue of garbage was also addressed by another team that presented an open-air dump that, after the city's transformations, became a park. From this waste, they created a biodigester to transform organic waste into energy to be used in the city (c) and (d).

Sustainability is not only related to aspects of nature but also to social elements. In their research, students were able to realize that a sustainable city is also an inclusive city that cares about the most vulnerable. Figure 5 shows some of the works that took this item into consideration.

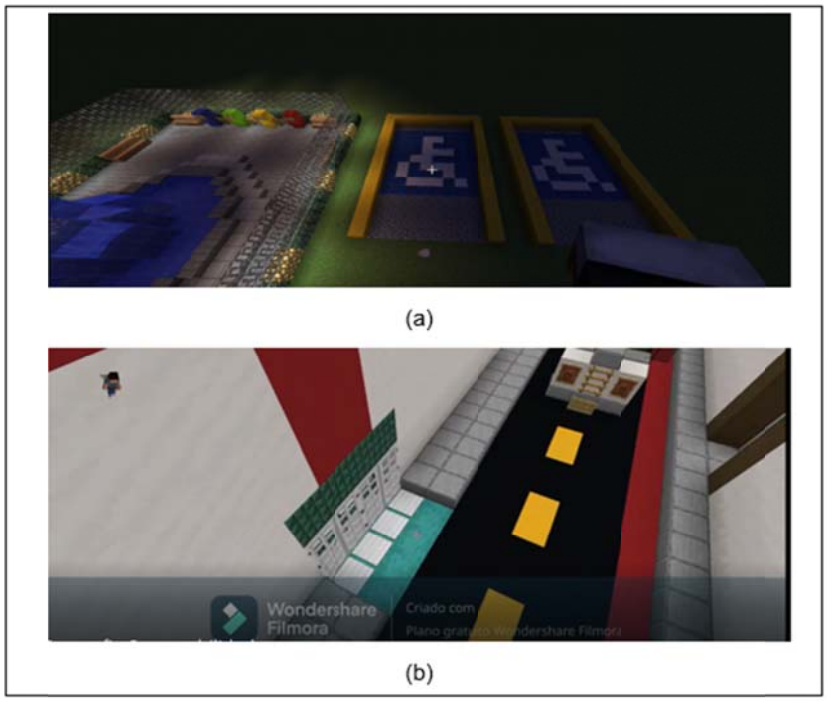

Figure 5. Elements of a sustainable city in terms of sustainability.

We can see that accessibility for people with mobility problems was not forgotten. Exclusive parking for people with reduced mobility (a) and access ramps for entrances to public buildings (b), were two examples of student concerns to show that cities should be concerned with social issues when they think about becoming sustainable.

After the presentations, the students were evaluated according to criteria that had already been presented in the rubric offered to them. Therefore, the results are shown in Figure 6.

Observing the results presented in Figure 6, we can verify that the use of the game allied to the theme "Sustainable Cities" aroused significant participation from the students. Students who have reached the advanced and intermediate levels exceed 80% of the participants in the game proposal. This demonstrates engagement, commitment, and assimilation of the proposed knowledge relevant to the activity. Four students were classified in the basic level for partially fulfilling the requested requirements, only highlighting the characteristics and not explaining their importance for the improvement of the environment and society.

When asked, in the final form, about what they learned through the activity using the Minecraft game, some of the answers allow us to understand how much their use contributed to the development of the proposal. Some answers are shown in Table 2.

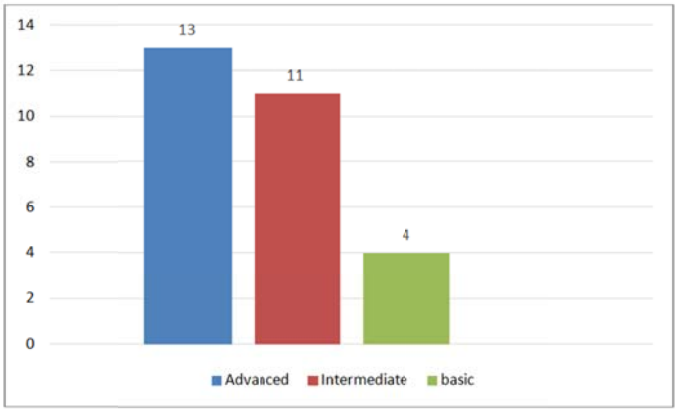

Figure 6. Results obtained after evaluating the games presented by the students.

Students report that they learned to work better as a team, and this allows us to make an inference when understanding the dynamics of the Minecraft game, which generates interaction between players and articulation of ideas together for the realization of a final product. There were reports that they needed to research and learn more about energy sources to comply with the proposal's requirements.

Table 2. Learning acquired through the theme and the game used (our translation).

Regarding the theme "sustainable cities", what was the main learning acquired during the execution of the work through the game "Minecraft"?
“I learned several things such as ways to avoid floods, use of green roofs that, in addition to helping the environment, contribute to making the house, the building more beautiful, etc.”;
“In addition to learning how to work better as a team, I learned what a sustainable city should be, I learned the 17 SDG goals and many other things”;
“It was that we can have good learning just by playing and having fun, we can learn from a common game that we always used to play”;
“That we can create amazing things”;
“I learned to use the game's blocks better”;
"Because of this work, I had to study, but about the types of energies so consecutively I learned a lot about the energies".

Creativity was also stimulated as they needed to attract the attention of spectators to the demonstration of their city. As one of the students reported: “that we can create amazing things”, they realized how creative and dynamic they were in the proposed activity. Therefore, in addition to creating their city through the game, they needed to look for ways to propagate the idea through an organized, clear presentation with attractive elements.

Conclusion

At the moment when the United Nations meets with world leaders in order to establish guidelines so that countries can practice more sustainable standards, so that future generations can adopt better practices, it is necessary for the school to diversify the presentation of the theme about sustainability combining a learning model in which students can identify, and one option for this is the use of the Digital game-based learning methodology.

The project adopted the use of the digital game Minecraft to produce Sustainable Cities, linking the theme to the Sustainable Development Goals, more specifically goal number 11. The 7 teams produced cities using the game, comparing and reporting, through videos, models that are sustainable and those that are not. The assessments were made using the established rubrics and previously informed to the students who, after the explanations on the subject, understood that the criteria addressed in class were mandatory, challenging them to create innovative ideas for their Sustainable Cities.

In the meantime, it is observed that most teams met the basic criteria, but it is noteworthy that the innovative ideas presented, such as: rainwater plant that helps in the production of electric energy, intelligent recycling that helps in the separation of garbage that is discarded in garbage dumps and biodigesters that transform organic waste into energy, showed that this generation, the so-called Digital Natives, is attentive to current environmental problems.

In the evaluations, it was noticed that many teams understood that the concept of sustainable cities goes beyond concern for the environment and that they must serve all individuals who live in it, thus being of form inclusive for elderly and deficient people, such as production access ramps and parking for these groups, showing the concern with this social issue.

The proposal to conduct the theme Sustainable City associated with a game known by the students, showed how much the school contributes to lead them to a more significant learning and we know that, by the observed results, we hope that this generation, known as Digital Natives, can contribute to ideas and innovations towards a more sustainable planet.

References

ARRUDA, E. P. (2011). Aprendizagens e jogos digitais. 1. ed. Campinas, SP: Alínea.

AUSUBEL, David P. (2003). Aquisição e retenção de conhecimentos: uma perspectiva cognitiva. Lisboa: Plátano, v. 1.

BRASIL. Ministério da Educação. (2018). Base Nacional Comum Curricular. Brasília. Access in 11/08/2023: http://basenacionalcomum.mec.gov.br/images/BNCC_EI_EF_110518_versaofinal_site.pdf

ECK, R. V. (2006). Digital Game-Based Learning: It's Not Just the Digital Natives Who Are Restless….. EDUCAUSE Review, vol. 41, no. 2 (March/April). Access in 11/08/2023: https://er.educause.edu/-/media/files/article-downloads/erm0620.pdf

HUSSEIN, M. H., OW, S. H., CHEONG, L. S., THONG, M. K., EBRAHIM, N. A. (2019). *Effects of Digital Game-Based Learning on Elementary Science Learning: A Systematic Review. IEEE Access, 7,* 62465-32478. https://doi.org/10.1109/ACCESS.2019.2916324

ITACARAMBI, R. R. O. (2013). jogo como recurso pedagógico para trabalhar matemática na escola básica: ensino fundamental. 1. ed. São Paulo: Livraria da Física.

JOHNSON, L. et al. (2012). Technology Outlook: Brazilian Primary and Secondary Education 2012-2017. An NMC Horizon Project Regional Analysis. New Media Consortium.

MORAN, José. (2015). Mudando a educação com metodologias ativas. Coleção mídias contemporâneas. *Convergências midiáticas, educação e cidadania: aproximações jovens, 2*(1), 15-33. Access in 11/08/2023. https://moran.eca.usp.br/wp-content/uploads/2013/12/mudando_moran.pdf

ONU - ORGANIZAÇÃO DAS NAÇÕES UNIDAS. (2015). Transformando Nosso Mundo: A Agenda 2030 para o Desenvolvimento Sustentável. Access 12 nov., 2021, https://nacoesunidas.org/wp-content/uploads/2015/10/agenda2030-pt-br.pdf.

PRENSKY, M. (2000). Digital Game-Based Learning. McGraw-Hill, 442 pages.

UNESCO - ORGANIZAÇÃO DAS NAÇÕES UNIDAS PARA A EDUCAÇÃO, A CIÊNCIA E A CULTURA. (2020). Educação para o desenvolvimento sustentável na escola: ODS 11, cidades e comunidades sustentáveis /editado por Tereza Moreira e Rita Silvana Santana dos Santos. – Brasília: UNESCO. Access 11 nov., 2021, https://unesdoc.unesco.org/ark:/48223/pf0000375081