The Blender 3D computer program and learning styles

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ABSTRACT
This article highlights the use of Blender 3D in the teaching of Science to three 6th-grade classes in the lower secondary school. The outlined objectives aimed to analyze, from the theoretical perspective of different learning styles, its effectiveness to the greatest extent possible in classroom use. Five methodological stages were developed: class selection, 3D instructional material development, activity implementation, data collection, and results analysis. Considering the analysis and discussion, it was possible to indicate that the results demonstrated its potential effectiveness, as well as an improvement in the understanding of scientific concepts, leading to increased student engagement. It's worth noting the importance of the Pedagogical Residency Program in providing the opportunity for research within the school context.

Keywords: Blender 3D, Learning styles, Technology, Science teaching.

1 INTRODUCTION

The use of 3D teaching technologies, such as Blender 3D, plays a significant role in enhancing science teaching and learning. These tools make it possible to view and understand scientific concepts in a clearer and more engaging way, providing a practical and interactive approach to learning.

The use of 3D technologies in science education opens doors to a more dynamic and contextualized education, allowing students to explore complex concepts in an immersive way. The problem question was subsidized by the question: How does the use of Blender 3D software influence the teaching and learning of science and how to analyze the different learning styles?

The methodological path took place in five stages, and the selection of the participating classes was the first stage. The research involved students in the 6th grade of elementary school at a state school in Manaus.

The second stage was the development of the 3D teaching material for the classes. The undergraduate, in partnership with the preceptor professor of the Pedagogical Residency Program, focused on the creation of didactic material based on 3D modeling for the classes. The didactic material was prepared according to the teaching plan of the preceptor teacher, 3D models of gaseous and rocky planets, natural satellites, galaxies, stars, black holes, asteroids, comets, and other elements relevant to the teaching of the Solar System were created.

The third stage took place with the implementation of the activities. The classes were applied in 3 classes of the 6th year of elementary school, totaling 95 students, the classes were accompanied by the preceptor teacher and the researcher. Students were able to explore scientific concepts in a practical and visual way, using Blender 3D as a teaching tool.

The fourth stage was subsidized with data collection. During the implementation period, qualitative and quantitative data were collected, including classroom observations, questionnaires and student surveys to assess the impact of the activities on their understanding of scientific concepts and their engagement with the learning process.

Finally, the fifth stage was the analysis of the results. The collected data were analyzed in the light of Discursive Textual Analysis by the undergraduate student to illustrate how the use of Blender 3D contributed to the improvement of students' understanding of scientific concepts and to the promotion of engagement. And considering the analysis and discussion, it was possible to verify that the Blender program can be effective in teaching science.

It is important to know that the Pedagogical Residency Program plays a key role in the initial training of teachers, providing practical experiences and research perspectives in the educational context.

In this sense, the partnership between the researcher and the preceptor teacher promoted the opportunity to carry out research in the school environment, including the integration of innovative technologies, such as Blender 3D, in order to improve science teaching and, thus, promote a more effective and engaging education.

2 BLENDER 3D COMPUTER PROGRAM

Blender 3D is a versatile 3D creation, modeling, and rendering tool that plays a crucial role in teaching diverse scientific components. Its effectiveness is evident in clearly and accurately simulating the complex structures present in areas such as biology, chemistry, physics, astronomy, geology, and mathematics. In addition to being free and open source, Blender 3D offers a range of features ranging from the creation of three-dimensional models to the composition and rendering of realistic scenes (BARROS, 2018).

Through this tool, students can interact in a practical and visual way with abstract and challenging concepts, making learning more engaging and accessible. Creating 3D models allows for detailed exploration of molecular structures, planets, complex physical phenomena, and more. The ability to create 3D games and videos further enriches educational experiences by providing students with the opportunity to immerse themselves in interactive scenarios that consolidate understanding of complex topics (TEPLÁ, 2022).

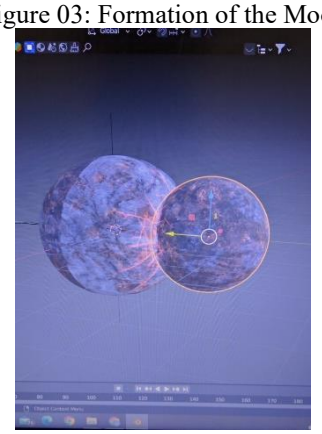
Figure 01: Mars

Source: Author's compilation[1]

Figure 02: Sun

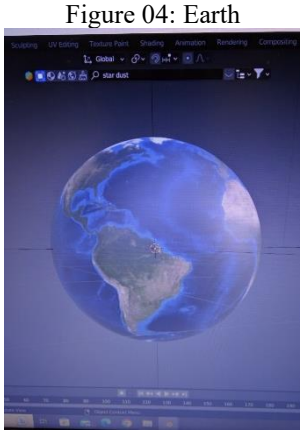
Source: Author's compilation[1]

Figure 03: Formation of the Moon



Source: Author's compilation[1]

Figure 04: Earth



Source: Author's compilation[1]

The accessibility of Blender 3D, being free and open-source, makes it a valuable option for educational institutions with limited resources, democratizing access to advanced visualization tools. In addition, the wide community of users and the wide range of tutorials available online make it easy to learn and adopt this software (BRITO, 2007).

All in all, Blender 3D plays a key role in enhancing science education by empowering students to explore, understand, and communicate complex concepts in a visually appealing and interactive way. Its versatility, affordability, and robust features make it a remarkable choice for educators who want to enrich the learning experience for students.

From a practical point of view, I got to know the Blender program through the Curricular Extension Activity Program (PACE), and reflecting on the potential offered by this 3D creation and modeling tool, I planned and developed a Scientific Initiation Project for which I acted as a volunteer and given the possibility of being approved in the selection of the Pedagogical Residency Program I explored the research performance to investigate how this technology can improve student learning.

The central focus since the beginning of the research was to understand how the resources offered by Blender can act as enhancers in learning in order to discover through classes using Blender 3D as a didactic tool to investigate the learning styles that make up an elementary school classroom.

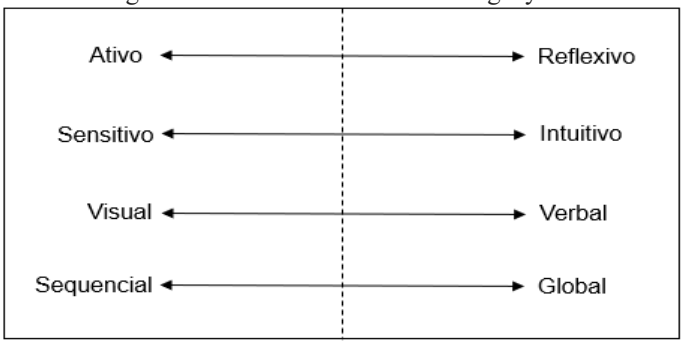
3 LEARNING STYLES

The Blender 3D Computational Program applied in the teaching of Astronomy, explored how its application could enhance the learning of 6th grade students. In view of the theoretical perspective of learning styles outlined by Felder and Silverman (SANTOS, 2020).

Felder's Theory of Learning Styles proposes that students have individual preferences in how they absorb, process, and retain information, and can be categorized into different dimensions, including active vs. reflective, sensitive vs. intuitive, visual vs. verbal, and sequential vs. global (GRAF, 2007).

According to Felder and Silverman's studies, these preferences are organized on a scale that describes four different dimensions of learning styles, each with two opposite extremes. Each dimension represents a learning preference that can vary from person to person, and understanding these dimensions is critical to creating learning environments that are more effective and tailored to students' individual needs (SANTOS, 2010).

Figure 05: Felder-Silverman learning styles



Fonte: FELDER, Richard M. et al. 1988.

The four dimensions are composed of the following learning styles:

1. Active Style, which focuses on hands-on, direct learning of concepts, and Reflective Style, which prioritizes observation and reflection before acting.
2. Sensitive style, which values concrete examples, and Intuitive style, which seeks insights and abstract theories.
3. Visual style, which prefers visual representations, and Verbal style, which is based on verbal explanations.
4. Sequential Style, which focuses on following detailed instructions, and Global Style, which prioritizes understanding the big picture before exploring details.

Understanding students' learning style can improve the effectiveness of learning strategies by adapting them to individual preferences and thus optimizing performance (DIAS, 2013).

The analysis of the results obtained in the classes taught with the application of Blender 3D revealed a remarkable predominance of the visual learning style among the students. They showed a keen interest in the visual representations of the Solar System and the complex astronomical concepts, created with the help of Blender. This result aligns directly with the visual approach to learning styles, as advocated by Felder.

According to the comparative study carried out by Barbosa (2020), it is possible to relate the preference for visual learning with the use of technological tools in the learning process, such as the integration of Blender 3D in teaching. The comparative study looked at several Python learning platforms and applications to help college students choose the best option for their learning process.

As in the case of Blender 3D, creating three-dimensional models, animations, and simulations with these tools offers students the opportunity to explore abstract concepts in a concrete and engaging way, promoting more effective and meaningful learning. This approach goes beyond the mere absorption of information and involves active interaction with the content, allowing students to build their understanding through visualization and experimentation.

By taking into account the emphasis given to the visual dimension in Felder's Theory of Learning Styles, our results reinforce the importance of using Blender 3D as an effective pedagogical tool to meet the needs of students with visual learning styles. Through the creation of three-dimensional models and animations, Blender enables an immersive learning experience that resonates deeply with students who learn best through visual representations (CAVELLUCCI, 2005).

However, it is vital to point out that while Learning Styles Theory offers valuable insights into individual student preferences, the approach to adapting teaching based on these styles is a point of debate in the educational community. It is important to consider a balanced approach that takes into account different learning styles without neglecting other aspects of teaching (EL-BISHOUTY, 2019).

In short, the study carried out on the use of Blender 3D in the teaching of Natural Sciences finds affinity with Richard Felder's Theory of Learning Styles. The predominance of the visual learning style, identified in the results and discussions, reinforces Blender 3D's ability to meet the needs of students who learn best through visual representations. By integrating this technological tool, the teaching of Astronomy becomes more engaging and effective, providing students with a unique opportunity to explore complex concepts in a tangible and stimulating way (SANTOS, 2015).

During its application phase, the contents of Solar System and Theories of Earth Formation were taught, I was also interested in the research that had as a subsidy to discover how 3D technology can make science content more dynamic and accessible.

From an empirical perspective within the school environment, I've noticed that Blender can effectively create animation, simulation, and visualization that help students understand more and more specific abstract concepts. Additionally, using Blender can help develop logical thinking and creativity.

In short, the importance of implementing 3D technology in teaching was noted, as it can provide interesting results to the teaching process, such as making it motivating and attractive to students. I intend to continue exploring its pedagogical potential as well as identify its limitations. With the prospect that more educators will be interested in using it in their pedagogical practice.

4 METHODOLOGICAL INCURSIONS

The activities were carried out in a public school in the city of Manaus with a group of 6th grade students, under the supervision of the preceptor teacher. The content was about the Solar System.

To collect the data, questionnaires were applied at the end of the classes, with open and closed

questions, which aimed to identify the type of learning that the students had in each stage. The questionnaire was applied anonymously and the data were analyzed in the light of discursive textual analysis (DTA), which is a methodological approach that seeks to understand and interpret the meaning of texts from a discursive perspective. In other words, it is concerned with analyzing the way information is presented and organized, in addition to considering the sociocultural context in which it was produced. This approach is often employed in fields such as social sciences, psychology, linguistics, and cultural studies to examine how people construct and communicate meaning through their words (SOUSA, 2018).

One of the distinguishing features of ATD is its interpretive approach, which recognizes the complexity of linguistic representations and seeks to understand the multiple perspectives and meanings present in texts. Different levels of analysis are applied to unveil the intentions, beliefs, values and representations of the authors or speakers (MORAES, 2006).

ATD also values the importance of the context in which texts are produced and interpreted. This means considering cultural, historical, social, and individual factors that can influence how the text is constructed and understood. This contextual approach helps to avoid superficial or simplistic interpretations. In summary, Discursive Textual Analysis is a qualitative methodology that focuses on the in-depth and interpretive analysis of written texts or spoken discourses. It seeks to understand the underlying meanings, thematic patterns, and contextual relationships present in the texts, contributing to a richer and more detailed understanding of the perspectives and intentions of the authors or speakers (MORAES, 2003).

That said, the general objective of this research project is to analyze the effectiveness of Blender 3D in the teaching of Natural Sciences, specifically with regard to the teaching of Astronomy, using the approach of discursive textual analysis.

5 DATA ANALYSIS AND DISCUSSION

After analyzing the data from the project subsidized by the Blender Computational Program, applied in sixth grade classes of elementary school, it was possible to observe that the students presented different learning styles. Among the most notable styles, visual styles stand out, which refer to the preference for information presented graphically, such as images, charts, and drawings.

The students who presented this learning style showed a great interest in the visual representations of the Solar System made with Blender, using the tools available to create three-dimensional models of planets, stars, comets, black holes and the Milky Way.

Figure 06: Lesson on rocky planets

Source: Author's compilation[1]

They have been actively involved in the lessons that have been applied, showing that they prefer classes with different approach styles, which encourage 3D visualization of scientific content, rather than just passive absorption of information.

In addition to visual styles, other learning styles were also observed, such as auditory style, which refers to the preference for information presented orally. However, the visual style stood out as the most present among the classes that participated in the project.

This finding can be an indicator of the quality of teaching and the use of visual and graphic resources in the teaching and learning process, especially in disciplines such as Astronomy, which involve complex and abstract concepts. By using Blender as a pedagogical tool, it was possible to explore the potential of visual resources and offer a more meaningful and engaging learning experience for students.

Based on the students' responses, it is possible to see that there are a variety of learning styles. Some students seem to be more visual and learn better from images and videos, while others prefer a more hands-on, interactive approach where they can tinker with objects and perform experiments. There are also those who learn best with verbal and detailed explanations. It is important to remember that each student is unique and may have a combination of different learning styles.

In one of the experimental classes with a 6th grade class of 30 students, 3D visual representations were used to explain important concepts in geology, such as the theory of the formation of the Earth and its atmosphere, the theory of the formation of the Moon, the change of the atmosphere and the theory of Plate Tectonics.

At the end, a questionnaire was given with 5 discursive questions about the content presented by Blender. This innovative and immersive approach allowed students to visualize abstract concepts in a concrete and understandable way, making learning more meaningful and memorable.

Figure 07: Lesson on the natural history of the Earth

Source: Author's compilation[1]

As we examined the responses, we identified remarkable patterns. The most frequent responses were as follows:

First question: In the question related to the formation of the Earth, the most frequent answer to "How did the Earth form?" was "by the collision of several rocks and dusts".

Second question: Regarding the question "What did the Earth look like at its beginning?", the predominant answer was "Hot, covered with lava and volcanoes".

Third question: To the question about the Theory of Plate Tectonics, the majority of respondents defined plates as "large plates of rock that move under the Earth and cause earthquakes and tsunamis."

Fourth question: Regarding changes in the Earth's atmosphere over time, the common answer was "Through the smoke of volcanoes and the formation of the oceans."

Fifth question: As for the formation of the Moon, according to the Great Impact theory, the most frequent answer was "By the collision of the Moon with a minor planet, the rocks of the impact formed the Moon soon after".

The experiment yielded good results. This can be measured by the quiz that was applied at the end of the lesson. Of the 30 students, only 6 students made a mistake in one of the questions and got the others right, demonstrating a significant accuracy of questions.

Table 01: Performance of students in the experiment

Performance	**Number of Students**
Hits	24
Misconceptions	6
Total	30

Source: Survey questionnaire

In addition, the questionnaire included an extra question about the children's preference regarding the teaching method. So, 25 students in this class answered that they prefer visual classes with Blender, while only 5 prefer classes with other didactic modalities. This is equivalent to 83% of the class having a preference for the teaching method that used 3D visual representations, and 16% preferring discursive or textbook classes.

The question about didactic preference: Is it easier for you to learn science content by listening,

observing, creating the content with your own hands, or reading textbooks? Responses varied, but many showed a preference for classes with visual stimuli, indicating an inclination toward visual teaching approaches.

Table 02: Observed Learning Styles

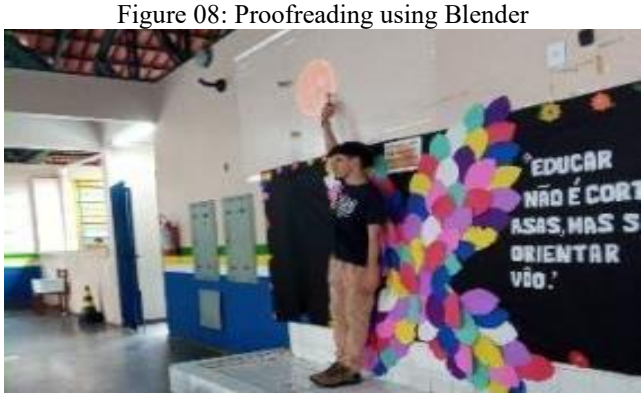
Didactic Modality	Number of Students	Percentage
Discursive classes	3	10%
Lessons with textbooks	2	6,67%
Visual Lessons	25	83,33%

Source: Question of methodological preference

These results can be explained by the fact that the 3D visual approach allows students to learn in a more engaging and interactive way. The use of Blender allowed for the creation of graphics and animations that helped explain complex concepts in a clearer and more interesting way. In addition, the use of technology may have aroused the interest and curiosity of students, which may have influenced their preference for the teaching method used. In addition to the application of the questionnaire after the content was administered, two test reviews were carried out with two sixth-grade classes.

The first review was done using Blender, in which students were presented with a general review of the solar system with the help of animations and 3D models created in the software. The second review was carried out with a discursive approach, without the use of technological resources.

Figure 08: Proofreading using Blender



Source: Author's compilation[1]

Each class had about 35 students and, at the end of the experiment, it was possible to observe that the class that had the revision with Blender 3D obtained a better performance in the correct answers of the questions that involved general subjects about the Solar System, getting an average of 9 points in the test compared to the class that had the revision with a discursive didactic approach that had an average of 7 points.

In addition to the post-class questionnaires, we seek to broadly understand the effect of Blender 3D on the teaching of Natural Sciences. Collecting qualitative feedback from students about their

experience with the software was a crucial part of this evaluation. During the classroom discussions, students shared valuable impressions, such as "We had never had 3D classes before" or "The content was much easier to understand because there was not just a mental image, we could see the Solar System", these were some of the most common impressions of the classes about the use of Blender 3D as an educational tool.

Qualitative feedback revealed that three-dimensional visual representations made abstract concepts more tangible and understandable. Students expressed excitement when interacting with 3D models and animations, which helped them solidify their understanding. In addition, student feedback identified areas that could be improved, offering valuable tips for optimizing future teaching approaches.

In the same context of exploration of educational technologies, a lecture was held during the 13th Academic Week of the ICB (Institute of Biological Sciences), with the theme "3D Virtual Reality Simulator in Science Teaching". This lecture, given by the undergraduate student in collaboration with professors, attracted the enthusiastic participation of two classes of the 9th grade of elementary school, as well as academics from the Federal University of Amazonas.

Figure 09: Classes gathered at the end of the lecture

Source: Author's compilation[1]

This activity offered participants the opportunity to experience first-hand how 3D visual representations, created with Blender, can significantly enrich the learning process in science. This successful experience further highlights its potential as an effective and promising tool in the educational field.

These results suggest that the use of technological resources, such as Blender, may be a more effective approach in teaching science compared to purely discursive lessons. The use of 3D models, animations, and simulations allow learners to visualize abstract concepts more concretely and thus be able to understand them more clearly and objectively.

Figure 10: Lecture held at the 13th ICB Week

Source: Author's compilation[1]

Additionally, the use of 3D technologies in teaching can help spark students' interest in learning science and encourage the development of skills such as creativity, critical thinking, and problem-solving. Blender, in particular, offers a series of advanced features that can be explored in different areas of knowledge, making the teaching-learning process more dynamic, interactive, and engaging.

During its application as an educational tool, adapting content to 3D models was a challenge, highlighting the importance of selecting suitable topics. It is also recognized that simulations are not a substitute for the hands-on experience of real experiments. In addition, the preference for different learning styles may affect their effectiveness. Visual engagement can be impactful, but diversifying teaching methods is key to accommodating different preferences.

6 CONCLUSION

Based on the results obtained in the research, it can be concluded that Blender is an effective tool in teaching science, especially with regard to teaching Astronomy. Its use allowed the development of practical and interactive activities, which helped learners to understand complex concepts in a clearer and more objective way.

The experiment conducted in the 6th grade class with the use of 3D visual representations was highly effective in conveying important geology concepts. The high rate of correct answers in the questionnaire and the preference of the vast majority of students for the method used proves the effectiveness of this innovative and immersive approach.

In addition, the research also revealed that Blender is an enhancer for students' skill development, as well as for sparking scientific curiosity. During the classes with Blender, the classes were able to develop skills in different areas, such as: critical thinking, problem solving, creativity and digital skills. In addition, it was possible to perceive a greater scientific curiosity on the part of the students, demonstrated through interest and questions during the class.

Its use in science teaching can be considered an innovative and promising approach, capable of providing basic education with a more meaningful and motivating learning. The software offers

advanced technological features that allow the creation of 3D models, animations, and simulations that enrich the teaching-learning process and make learning more dynamic and attractive.

Current research on the use of Blender 3D as a pedagogical tool points to several directions of future research. In addition to astronomy, there is significant potential to explore its application as an educational resource in other scientific fields, such as chemistry, physics, and biology. In addition, investigating its feasibility for 3D printing in the educational context also presents an exciting opportunity. By understanding how to adapt its effectiveness to these curricular components and how to empower educators to better use this technology in the teaching-learning process.

In short, the Blender 3D Program in the teaching of Astronomy has demonstrated that the software is an effective and potentiating tool for the development of students' skills, as well as for arousing scientific curiosity. The innovative approach provided by its use can be explored in other areas of knowledge, allowing students to learn innovatively and meaningfully.

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