SCIENCE AR: Educational system of natural science using augmented reality

SCIENCE AR: Sistema educacional de ciências naturais usando realidade aumentada

SCIENCE AR: Sistema educativo de ciencias naturales mediante realidad aumentada

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Abstract:
One of the problems in traditional teaching is the student's lack of understanding of theoretical learning, where there are often no visual stimuli, discouraging the student. According to the data collected through bibliographical research, the idea of creating an educational web system for 7th-grade students was developed, bringing a solution to the problems encountered. What can be done to help students learn more simply and objectively? With this problem in mind, the Science AR platform, using augmented reality, aims to increase the success rate of students learning the subject and engage them, making learning more dynamic, easier, and faster. The platform will provide support materials for students to study and will have quizzes on the topic studied, where students can apply their knowledge of the subject and visualize the 3D models within the application.

Resumo:
Um dos problemas de aprendizagem no ensino tradicional é a falta de compreensão do aluno em relação ao conteúdo teórico, processo didático no qual muitas vezes, não há estímulos visuais e, por consequência, resultam no desânimo do estudante. A partir de dados coletados por meio de pesquisas bibliográficas, foi desenvolvido um sistema web educacional para alunos do 7º ano do Ensino Fundamental que traz uma solução para os problemas encontrados de maneira que os alunos aprendam de uma forma mais simples e objetiva. Tendo em vista esta problemática, a plataforma *Science AR*, por meio da realidade aumentada, busca elevar a taxa de sucesso no aprendizado dos alunos na disciplina de ciências naturais, engajar o nível de aprendizado tornando-o o processo de ensino-aprendizagem mais dinâmico, fácil e rápido. A plataforma disponibilizará materiais de apoio para que os alunos estudem e disponibilizará questionários sobre o tema estudado, desta forma, o aluno poderá aplicar os seus conhecimentos teóricos sobre a matéria e visualizar os modelos 3D dentro do aplicativo.

Resumen:
Uno de los problemas de aprendizaje en la enseñanza tradicional es la falta de comprensión del contenido teórico por parte del alumno, proceso didáctico en el que a menudo no hay estímulos visuales y, en consecuencia, provocan el desánimo del alumno. Basado en datos recolectados por medio de investigación bibliográfica, se desarrolló un sistema web educativo para estudiantes del 7º grado de la secundaria que aportará una solución a los problemas encontrados de manera que los alumnos aprendan de forma más sencilla y objetiva. Con este problema en mente, la plataforma *Science AR*, por medio de la realidad aumentada, tiene como objetivo aumentar la tasa de éxito de los alumnos en la asignatura de ciencias naturales e involucrarlos en las clases, haciendo que el aprendizaje sea más dinámico, fácil y rápido. La plataforma brindará materiales de apoyo para que los alumnos estudien y contará con cuestionarios sobre el tema estudiado, donde los alumnos podrán aplicar sus conocimientos teóricos de la asignatura y visualizar los modelos 3D dentro de la aplicación.

EnGeTec em Revista

SCIENCE AR: Educational system of natural science using augmented reality
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ISSN 000-000
Volume 1 | Número 1 | Fevereiro 2024

1. INTRODUCTION

Among the many problems found in traditional teaching, it is possible to observe the student's lack of understanding of theoretical learning, which doesn't often have visual stimuli. According to Piaget (1973), the evolution of mental image cognition begins around two years old and continues in constant evolution, the cognitive capacity for resolution is being developed through images. The learning process can often be hampered by a lack of qualified teachers or teaching material that doesn't students' interests, making studying unproductive, dull, and exhausting. As Senhoras (2020) said, with the COVID-19 pandemic, the students have been confined, stopping them from going to school, making teaching difficult, and bringing the necessity of using technology in education.

According to ENEM (2021) "as Ciências da Natureza foram as áreas do ENEM com a menor proficiência média em 2021, contendo matérias lecionadas no 7º ano."

Taking into account the information collected by the Instituto Nacional de Estudo e Pesquisas Educacionais Anísio Teixeira (INEP, 2021), is necessary to get at least 25 questions right in natural science to score 700 points in the Exame Nacional do Ensino Médio.

Based on the data collected during the research, the idea of a project to solve the problems and difficulties found in the area of education developed.

This is exploratory bibliographical research that characterizes work about the use of new technologies in teaching science to 7th-grade students.

For Souza, Moita, and Carvalho (2011), the school needs to reinvent itself and teachers need to take possession of the presence of technology, as it is favorable to their work used with a good approach. The objective is to develop a web system application using Augmented Reality (AR), to help improve learning in the natural sciences, making it interactive and objective.

2. THEORICAL FOUNDATION

In this chapter, for the understanding of the article, the theoretical foundation is provided, addressing relevant topics and presenting the technologies/languages required for the project's development.

2.1. Augmented Reality

Augmented Reality, better known as AR, emerged in 1963, in the United States, with Ivan Suntherland inventing the first head-mounted display, the optical vision helmet.

According to Siscoutto, Kirner and Tori (2006, p.22) Augmented Reality (AR) brings the virtual environment into the user's place, allowing the user in the real world to interact with the virtual world. In this mixed reality environment, AR occurs when virtual objects are placed in the real world, enabling potential user interaction with the virtual object. According to Microsoft (2023), augmented reality creates an immersive experience for all who use it. The most common forms of AR are through glasses or camera lenses.

2.2. Main development technologies

In this section, all the technologies and tools used in the project's development are explored. The planning and execution process of the system is detailed, highlighting the approach adopted for this conception and implementation.

EnGeTec em Revista

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2.2.1. Laravel

According to Silva (2022), Laravel is an open-source framework that helps in creating PHP websites, which is constantly evolving and has a big community and good documentation. It was developed by Taylor Otwell.

Regardless of the language or technology that will be used, you have to think about the concept of infrastructure, but much of the structure of a piece of software is the same. According to Turini (2015), a framework is used to streamline the development process in an organized manner.

As described by Gabardo (2017), frameworks serve various purposes, such as eliminating the need to rewrite a piece of code through the reuse of methods, classes, and functions.

2.2.1.1.   MVC in Laravel

Laravel follows the MVC pattern, as mentioned by Gabardo (2017) MVC is an acronym for Model, View, and Controller. In Portuguese, it stands for Modelo, Visualização and Controlador. This is a design pattern that separates the project's layers as a means of organization. Laravel also employs a routing system to map requests.

2.2.2. Database

To carry out the project, a relational database will be used. According to Date (2003), a database is a system whose general purpose is to store information and allow users to retrieve and update the information requested. An example of how a database can be used is with customer registration, where login information is stored in a table.

According to Taylor (2015), modern databases can store data quickly and easily, they are secure, and all data is stored in the cloud, in addition to retrieving data quickly.

2.2.3. C#

The C# (pronounced "C Sharp") is a modern, highly versatile, object-oriented, and strongly typed programming language created by Microsoft. According to Microsoft (2023), the objective of C# is to enable to creation of a wide variety of systems, from data analysis applications, web programs, 2D and 3D games, as well as mobile applications.

To Trigo and Henriques (2023), programming is telling the computer what should be done, giving instructions to the computer in a logical way, and what results from programming is a system. Microsoft (2023) emphasizes that all applications are made of many lines of code that work together to achieve a task.

It is in this context that the choice of programming language becomes important. In the case of the project in question, Unity was selected as a development platform that uses the C# language to create games and applications.

2.2.4. Unity

The creation of 3D games has expanded more and more with the advance of technologies that have allowed access to more improved resources. Platforms such as Unity can offer a variety of tools for creating 3D games, scenarios, characters, and visual effects with different colors, textures, and depths.

EnGeTec em Revista

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Figure 1 – Unity Graphical Interface
Source: (Unity, 2023)

According to Viana (2009), Unity3D is a game development program with various features for creating games, the platform allows games can be published on the web page or for Windows. Unity3D is used by some companies as a tool for creating their projects, such as Ubisoft. This platform has an interface with toolbars, hierarchical windows, a game view, a scene view, superimpositions, an Inspector window, the project window, and status.

For the development of 3D games on platforms such as Unity3D Cartesian planes are used, and mathematical concepts are applied in the construction of these interfaces. 3D representation is usually realized through the use of polygons such as triangles to represent a mountain. As described by Viana (2009), combining various polygons and the tools proposed by the platform, makes it possible to construct more complex shapes, giving scene realism and depth.

As previously said and reinforced by Unity3D (2021), 3D modeling is constructed using polygons. To ensure that the feeling of hyper-reality is even greater, it is possible to implement textures, colors, and shadows on any object in the scene, using the Mesh Renderer component to implement textures for the final visualization of the merged application in a real environment through the camera of a mobile device.

2.2.5.Interface prototyping design

This chapter presents the process of creating the graphic interface for the main pages of Science AR, using tools that help create prototypes for the development of the application's screens.

Science AR's home page has a universe animation to capture the user's attention. There is a navigation menu that facilitates exploration of the other pages of the website. Finally, the layout shows a button where the user can be directed to find out more about science content.
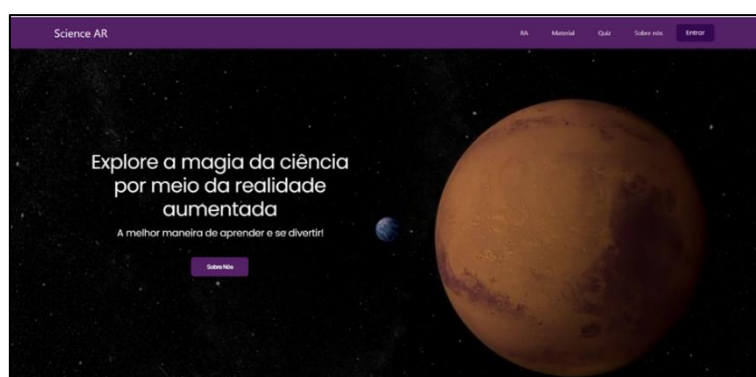

Figure 2 - Homepage
Source: From the author, 2023.

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ISSN 000-000
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The figure below shows the login interface, where the user who has already registered on the site can enter the corresponding information in the fields and finish the process by clicking on the "Entrar" button. In the layout, the user will find a link where they can create an account if they are not registered.
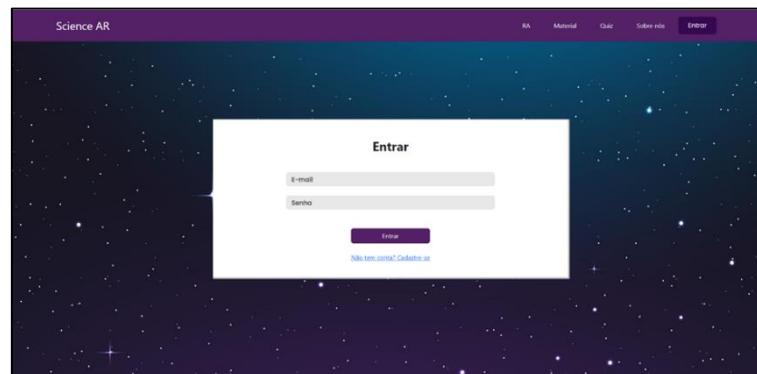

Figure 3 – Log In
Source: From the author, 2023.

The next figure shows the materials the user selected to study. The page shows information and images about the topics chosen, navigating through sub-topics with more information, making learning fluid and interactive.
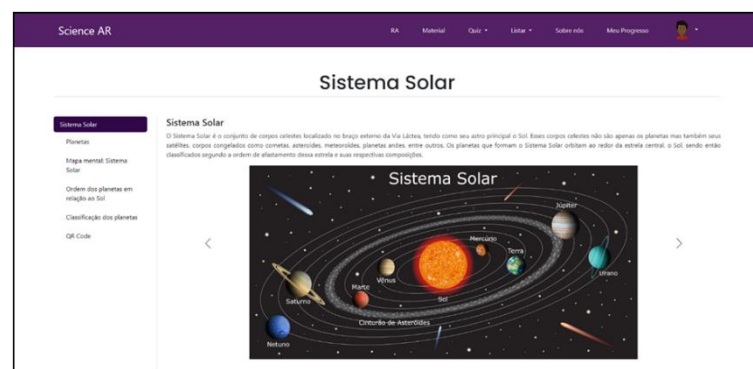

Figure 4 – Hold a class
Source: From the author, 2023.

Within the selected material, at the end of the content, a QR Code will be presented for scanning with the application.
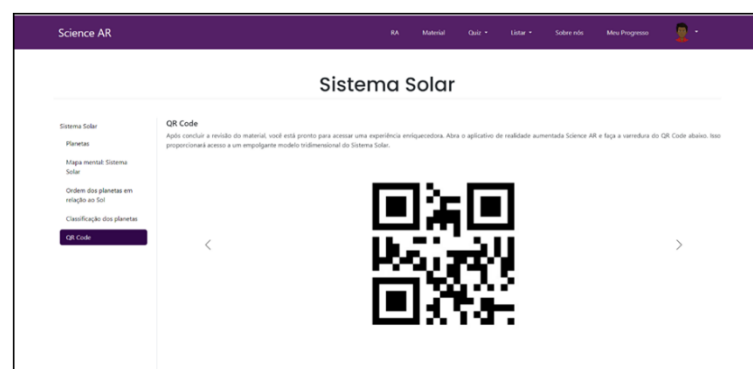

Figure 5 – QR Code
Source: From the author, 2023.

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After selecting a questionnaire, the logged-in user will be redirected to the screen containing all the questions related to the quiz. As soon as the user selects an answer and clicks "Próximo", the next question will be presented. Upon completing the questionnaire, the system will display the results of the responses.
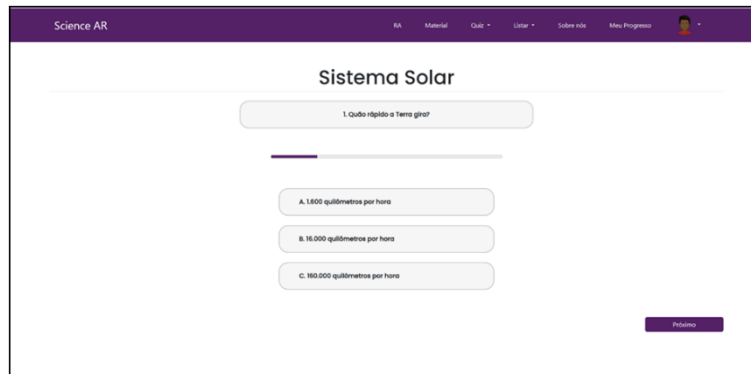

Figure 6 – Take the questionnaire
Source: From the author, 2023.

3. MATERIALS AND METHODS

The data collected through surveys provided information about many pupils and students who find it difficult to learn a new subject related to the natural sciences. The system that will be delivered in the project will help the student's development.

Considering the general problem (students' disabilities), pedagogy through augmented reality increases the success rate of students' learning in the subject and involves the level of learning, according to Alves and Sgarbi (2001, p.43), "Imagens são de fundamental importância tanto na construção quanto na representação e comunicação de ideias e conceitos científicos".

Within the theme of new technologies, this research primarily focuses on 7th-grade students who face difficulties in learning Natural Science.

To carry out the project, exploratory bibliographic research was conducted to characterize the works related to the use of new technologies in science education for students.

In pursuit of the main objective, a qualitative and descriptive method was employed, based on daily research and analyses conducted to address the current topic. The purpose is to add to knowledge, expand it, and efficiently utilize it to achieve effective results. According to Silva & Menezes (2000, p.21) "a pesquisa descritiva tem como objetivo descrever as características de determinada população ou fenômeno ou estabelecer relações entre variáveis".

The research was conducted to determine the subjects included in the 7th-grade student curriculum, and it also encompassed investigations into media resources such as images and 3D models that are relevant to teaching concepts through augmented reality.

Taking into account the general problem (students lagging), pedagogy through augmented reality increases the success rate of student learning in the subject and raises the level of learning.

4. RESULTS AND DISCUSSION

After the completion of the project, it was possible to observe some positive contributions to the explored topic. The results indicated that students have better information retention when exposed to

EnGeTec em Revista

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ISSN 000-000
Volume 1 | Número 1 | Fevereiro 2024

interactive and dynamic content, such as augmented reality. AR can provide students with more autonomous learning, allowing them to explore concepts more clearly and effectively. The results of this project highlighted the transformative potential of Augmented Reality in education. The ability to visualize and interact with information in a more immersive way can revolutionize how students absorb knowledge.

According to Robson de Souza (2011, p.21), digital technologies have great potential for new forms of teaching and pedagogical practices, through the use of applications or teaching platforms.
To achieve the objectives, modeling and 2D/3D technologies will be used to help elementary school students and teachers who teach the subject of natural sciences.

5. CONCLUSION

As we conclude this article, we would like to make a few final remarks.

In this study, we aimed to explore the application of augmented reality technology in the teaching of Natural Science to 7th-grade students. The proposal was to develop a web-based system that uses this technology as a complementary tool to traditional teaching, aiming to provide a more dynamic, interactive, and didactic learning experience.

During the project's development, several advantages and benefits of using augmented reality in the teaching of Natural Science were identified. Through this technology, students can visualize and interact with three-dimensional objects, simulations, and additional information related to the concepts being studied. Also, the application of augmented reality proved capable of sparking student's interest and motivation, as it provided a unique experience, bringing them closer to the playful and dynamic.

According to Kenski (2007, p.30), different forms of technology can create a dynamic where people can relate to knowledge by learning together, making it a revolutionary scenario. together, making it a revolutionary scenario.

Although augmented reality offers significant potential in the educational context, it is crucial to emphasize that it should not replace the role of the teacher but rather be used as a complementary tool to traditional teaching. The teacher plays a fundamental role in guiding the content presented by the technology.

It is considered that this work is timely and of the utmost importance, as it is a differential alternative for new teaching methods, where theoretical knowledge can be combined with practice, given that, according to Kenski (2007, p.45), the presence of a particular technology can induce profound changes in the way teaching is organized; technologies provoke new mediations.

APPRECIATION

EnGeTec em Revista

SCIENCE AR: Educational system of natural science using augmented reality
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wellspring of inspiration. Their unconditional backing and words of encouragement have provided us with the fortitude and motivation needed to persist on this challenging journey. We are profoundly grateful for the unwavering love and encouragement they have lavished upon us. Furthermore, our gratitude extends to our mentors and teachers, the luminaries whose wisdom, guidance, and unwavering dedication acted as the compass guiding us through the intricate terrain of knowledge. It is with utmost sincerity that we acknowledge that, without your sagacious counsel, vast knowledge, and unyielding support, this work would not have attained its current form. Your mentorship and contributions have been instrumental in refining and enhancing the quality of this article. This acknowledgment serves as a heartfelt tribute to the pivotal roles each of you played in our collective journey. We are genuinely honored and profoundly grateful for the privilege we have had to learn and grow alongside these remarkable individuals. To every person who has been a part of this endeavor, we offer our most sincere and appreciative thanks. Your unwavering support and commitment have been the cornerstone of our success.

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