Inclusive Virtual Reality in Education: Applying the STEAM Approach to Ease the Learning of Students with Disabilities

Alejandro Moreno-Cruz[1], Jaime Muñoz-Arteaga[1], Julio C. Ponce-Gallegos[1], Cesar A. Collazos-Ordóñez[2] and Adriana L. Iñiguez-Carrillo[3]

[1] *Universidad Autónoma de Aguascalientes, Avenida Universidad 940, Ciudad Universitaria, Aguascalientes, 20100, Mexico.*
[2] *Universidad del Cauca, Calle 5 No. 4-70 Popayán, Cauca, Colombia.*
[3] *Universidad de Guadalajara, Centro Universitario del Sur, Av. Enrique Arreola Silva No. 883, Colonia Centro, C.P. 49000, Ciudad Guzmán, Jalisco, México.*

Abstract
Barriers to learning are a major problem, especially for people at the high school level and above. This study demonstrates how the Design Thinking methodology together with the STEAM (Science, Technology, Engineering, Arts and Mathematics) approach are used in the creation of a virtual reality application focused on supporting the inclusive education of students belonging to the Attention Centers for Students with Disabilities (CAED). Working closely with teachers and a group of 18 students of varying ages (15-27 years old), can identify the critical stages to overcome some of the barriers that these students face in their educational process. This approach allows for continuous improvement of the prototype through multiple iterations at each stage of development by implicitly pointing out the areas of the applied approach on which each phase is focused. The importance of continuous communication with users (students with disabilities) and their teachers was emphasized to ensure that applications are best suited to individual needs. In conclusion, the adaptation of the methodology and approach used is successful for the creation of both the inclusive education support application and the planning of the activities that can be implemented within it, focusing on what the learners need directly.

Keywords
STEAM, Inclusive education, Virtual reality, Design thinking methodology, Educational applications.

CEUR-WS.org/Vol-3691/paper25.pdf

1. Introduction

Inclusive education poses a relevant challenge for institutions at the baccalaureate level, which strive to adopt new educational strategies daily [9]. Although significant progress has already been made in adapting institutions in terms of infrastructure and trained administrative departments [5], there are still areas where there is room for improvement, especially in terms of learning and motivation to participate in academic activities. The STEAM (Science, Technology, Engineering, Art, and Mathematics) approach presents itself as an innovative solution to address these challenges.

STEAM education combines traditionally separate disciplines into an interdisciplinary approach. This orientation seeks to enhance students' critical thinking, problem-solving skills, and creativity by implementing the areas involved in such an approach: science, technology, engineering, art, and mathematics into a single educational approach [17]. By incorporating

CISETC 2023: International Congress on Education and Technology in Sciences 2023, December 04–06, 2023, Zacatecas, Mexico
alejandro_moreno_cruz@outlook.com (A. Moreno-Cruz); jaime.munoz@edu.uaa.mx (J. Muñoz-Arteaga); julio.ponce@edu.uaa.mx (J. Ponce-Gallegos); ccollazo@unicauca.edu.co (C. Collazos); adriana.carrillo@cusur.udg.mx (A. Iñiguez-Carrillo)
0009-0007-9814-7711 (A. Moreno-Cruz); 0000-0002-3635-7592 (J. Muñoz-Arteaga); 0000-0002-1062-5288 (J. Ponce-Gallegos); 0000-0002-7099-8131 (C. Collazos); 0000-0001-9753-716X (A. Iñiguez-Carrillo)
© 2023 Copyright for this paper by its authors.
Use permitted under Creative Commons License Attribution 4.0 International (CC BY 4.0).
CEUR Workshop Proceedings (CEUR-WS.org)

artistic and creative elements into the teaching of technical disciplines, STEAM seeks to make learning more engaging and relevant to students.

Inclusive education is greatly benefited by the STEAM approach because it enables the use of teaching strategies to meet the needs of students with disabilities. In the project we present, we try to develop a prototype for the use of virtual reality, using the STEAM framework, to provide academic assistance for specific areas for individuals with disabilities.

The objective is to solve difficulties, such as the reduction of motivation and the consolidation of knowledge about the previous stages in which the student is studying, so that students can overcome doubts that can hold them back. In theory, this project is beneficial to all students with disabilities, however, those with mental and psychosocial deficiencies will benefit the most.

The project will serve as a didactic support for students in the open high school education modality of the Attention Centers for Students with Disabilities (CAED for its Spanish acronyms). By participating in interactive virtual activities, students can improve their motivation, attention, and academic performance. This increases their prospects for success, whether entering the job market or continuing their higher education.

This chapter is organized as follows: a general description of the content of the chapter is provided, then, the background of the topic is presented, the project objectives and expected results are described based on the STEAM approach applied. Then, related work on the application of emerging technologies in inclusive education is reviewed. The rationale section defines key concepts related to the "design thinking" methodology and the "STEAM" approach and describes adapted procedures. This chapter ends with some results, conclusions, suggestions for future work and thanks to the institutions that supported this research.

2. Related Works

Previously, several works have been developed related to the application of virtual reality technologies to support students with specific disabilities. Two of them will be mentioned below that focused on young people with Attention-Deficit-Hyperactivity-Disorder (ADHD), as well as another that used augmented reality in rehabilitation activities.

Table 1
Related jobs in learning support for people with ADHD.

Work	Applied technology	Benefits obtained
A Lean UX Process Model for Virtual Reality Environments Considering ADHD in Pupils at Elementary School in COVID-19 Contingency [6]	Project developed to create an application that implements a virtual reality environment on Android devices, allowing elementary school students to interact with activities by following a series of instructions provided by a Non-Player Character (NPC) within the virtual environment.	They identified how many times each student needed to review the instructions to assess their level of attention, while contributing to enjoyable and fun learning in the fields of education, health, and technology.
Development of virtual reality rehabilitation games for children with attention-deficit hyperactivity disorder [1]	Development of an application designed to be used in HTC VIVE viewers, which presented interactions aimed at promoting motor coordination in children with ADHD.	Improved attention, cognitive skills, and abstract reasoning.
Using Augmented Reality and Gamification to Empower Rehabilitation	Combined augmented reality and gamification system in an application to support	The data collected using the application can be visualized by therapists, who will be able to

Activities and Elderly Persons. A Study Applying Design Thinking [2]	rehabilitation activities for people with disabilities.	identify the effectiveness of the support provided and determine what strategies can be applied to improve concentration.

The articles mentioned at table 1 were discovered through a systematic search of various academic sources following the guide provided by J. Vilanova [10], this search was specifically focused on publications that concurred with our research goals. This extensive review process not only advised us on the proper course of action, but also inspired us. Through this analysis, we intended to identify effective methods of designating educational strategies that would facilitate student interaction with modern and pertinent technology, including virtual reality. Notably, the projects examined have a focus on individuals with ADHD, this is a disability that is prevalent among CAED students, as a result, it is pertinent to take inspiration from these projects to create a reference point.

Table 2
Applications developed using the STEAM approach.

Features\Application	Application under development	Tinkercad [20]	Scratch [21]	Minecraft Education Edition [22]	GeoGebra [23]	CoSpaces Edu [24]
Focus on Inclusive Education	X					
Emphasis on empathy with the users.	X		X			
Customization and adaptability	X	X		X		X
Integrated STEAM tools	X	X	X	X	X	X
Active and participatory learning	X	X			X	
Collaboration and communication	X		X			
Evaluation and follow-up	X					
Receives feedback for constant improvement	X			X		
Makes use of Virtual Reality						X
It has constant updates	X	X	X	X	X	X

Some projects where the STEAM approach is used and the characteristics that they include in comparison with the application under development in this work can be observed (Table 2).

3. Theoretical foundations

This section delves into the essential theoretical underpinnings that form the basis for understanding and applying interconnected concepts in the realms of education and technology. Five key areas are explored: STEAM (Science, Technology, Engineering, Arts, and Mathematics), Educational Applications, Virtual Reality, Design-Based Learning (Design Thinking), and the application of these approaches to students in Centers for Attention to Students with Disabilities (CAED).

3.1. STEAM

The STEAM approach is an interdisciplinary educational method integrating science, technology, engineering, arts, and mathematics [17]. Its primary objective is to cultivate students' creative and problem-solving abilities for real-world applications [18]. Key components and objectives include:

- Science: Focus on natural phenomena, scientific method, and knowledge acquisition in biology, chemistry, physics, fostering observation, investigation, and critical thinking skills.

- Technology: Emphasis on understanding and utilizing digital technology, software, hardware, and digital resources for information collection, analysis, and presentation.

- Engineering: Application of scientific and mathematical principles to design practical solutions, engaging students in problem-solving projects to develop design, logical thinking, and problem-solving skills.

- Art: Integration of creativity and artistic expression into the STEAM process through exploration of various art forms, fostering creativity, aesthetic appreciation, and visual communication.

- Mathematics: Essential for quantitative measurements, aiding in addressing complex problems by developing skills in data analysis, modeling, and informed decision-making.

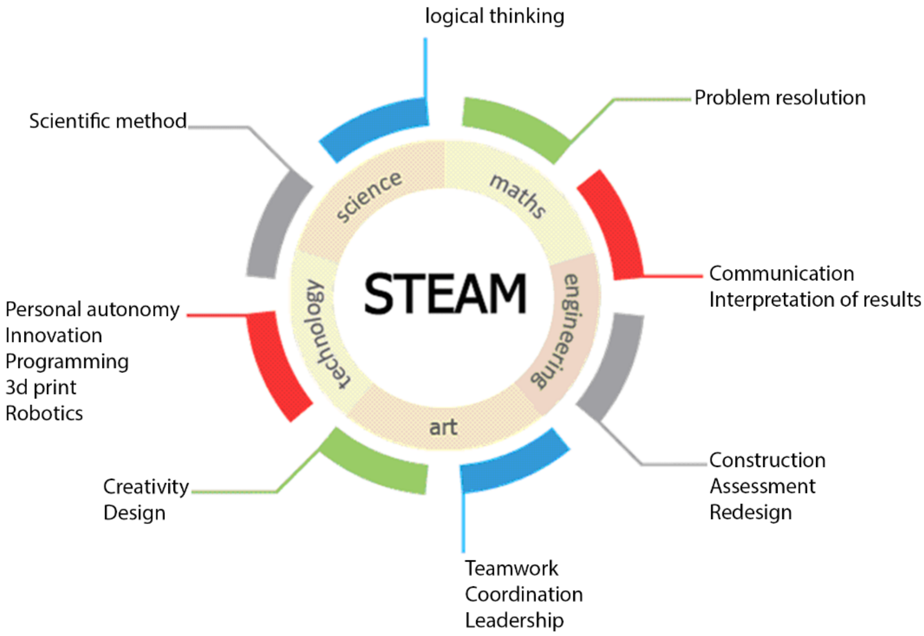

Figure 1: Education outline STEAM [18].

3.2. Educational Applications

Emerging technologies in the educational arena, such as Kahoot, ClassDojo, Khan Academy, and Duolingo, have transformed traditional learning materials. These applications, through interactive activities, provide hands-on experiences, enhancing understanding of the subject matter and complementing traditional learning materials [7].

3.3. Virtual Reality

Virtual Reality (VR) is a technology that generates a three-dimensional digital context in real time, providing immersive experiences through visual, auditory, and sometimes haptic components. It can replicate real-life or fictitious environments, allowing users taking some interactions with different objects in a virtual environment. VR is part of "Extended Reality Technologies" (XR), including Augmented Reality (AR) and Mixed Reality (MR) (see figure 2) [8].

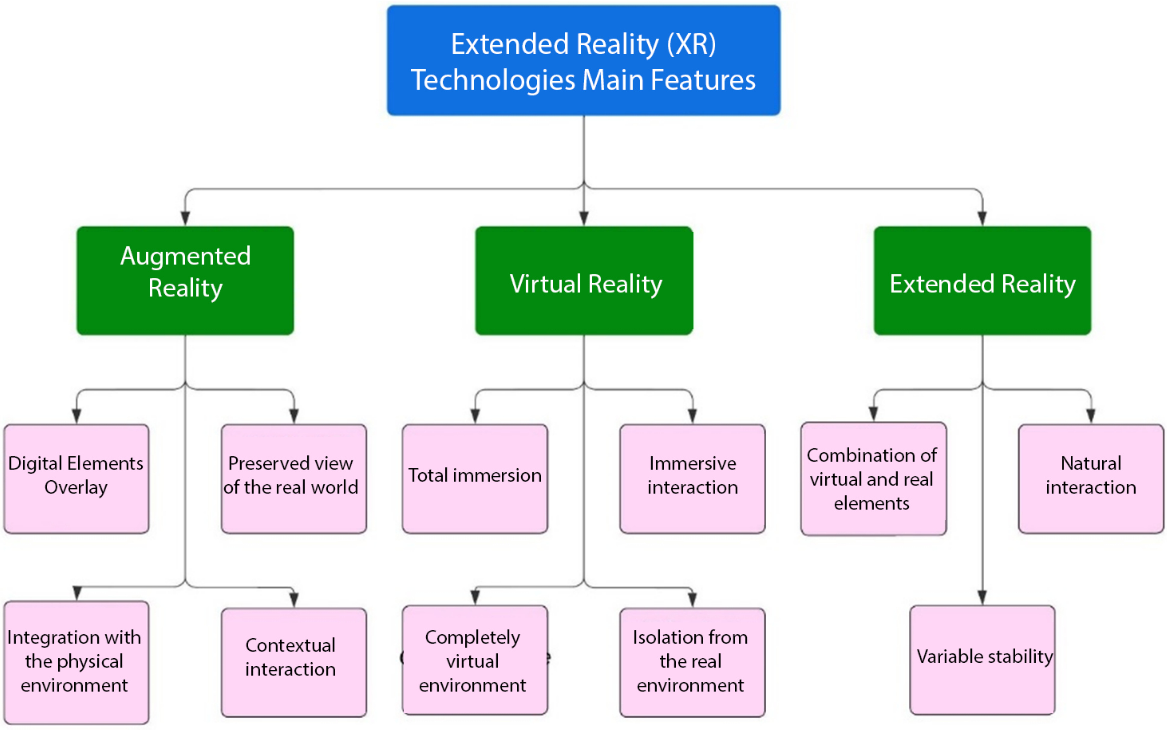

Figure 2: Main features of Extended Reality Technologies (own authorship).

3.4. CAED

Centers for Attention to Students with Disabilities (CAED) address the unique needs of students with disabilities. These centers, distributed across the country, cater to visually, hearing, or mentally impaired students [3]. Educational tools like audio books, sign language dictionaries, and Braille keyboards are provided. The educational program consists of twenty-two modules in communication, social sciences and humanities, experimental sciences, and mathematics (see fgure 3).

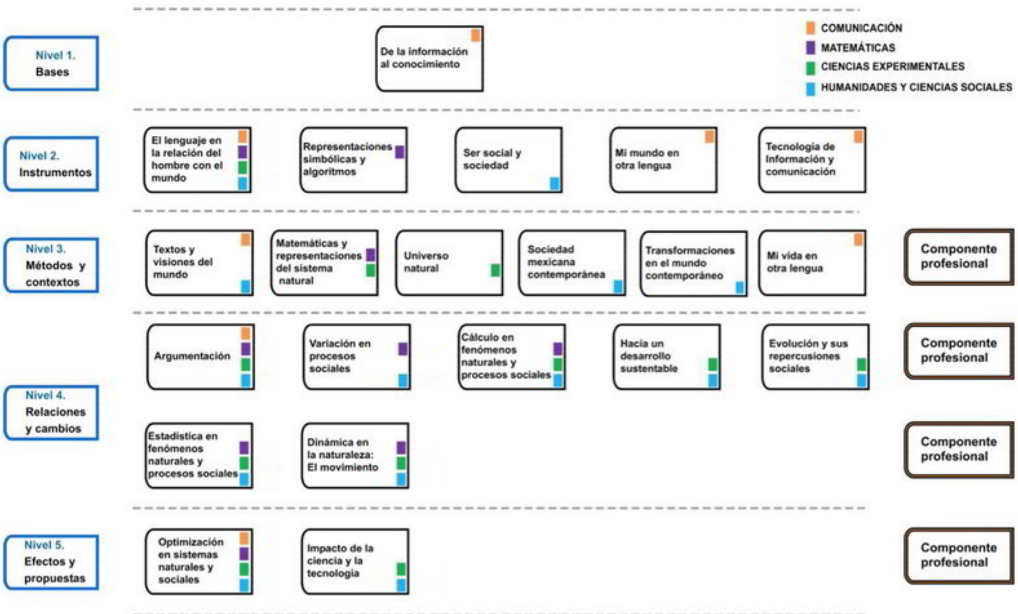

Figure 3: Curriculum map CAED [12].

3.5. Design Thinking

The approach we will use is based on a fusion of the STEAM together with the Design Thinking methodology. This iterative process is commonly used in various fields, particularly in software engineering. With this model, the needs to be addressed are obtained directly from the users' perspectives, allowing the generation of innovative solutions that meet the required functionalities and address the users' requirements.

The methodology consists of five main phases: empathize, define, ideate, prototype and test [13]. These stages can be performed in a specific order, but it is possible to return to a previous phase or jump to another; they are not performed to obtain a result from the beginning, but with the intention of performing them several times to polish each stage, i.e., to improve the product in each iteration (Figure 4). The latter is the main objective of the methodology to be employed.

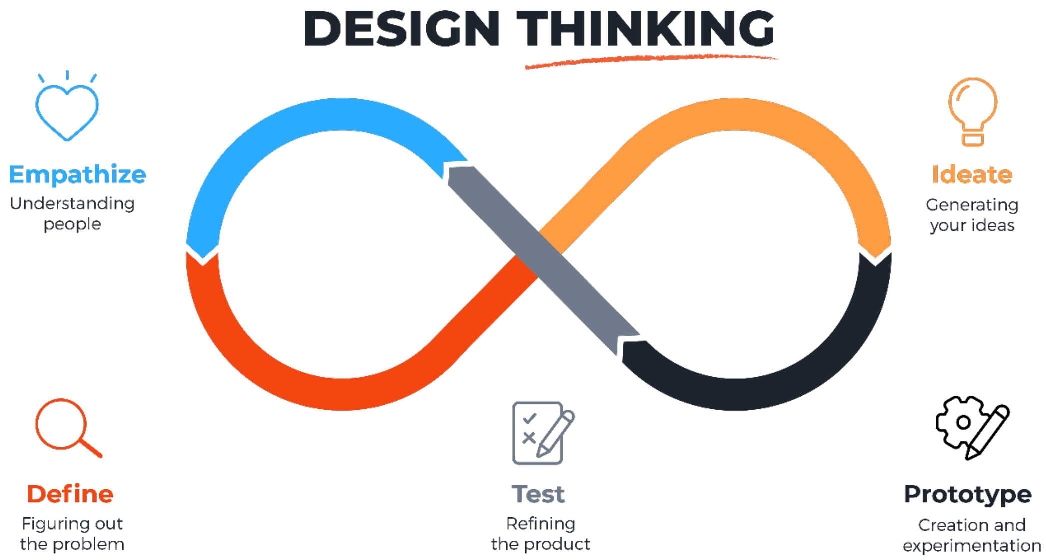

Figure 4: Stages of the Design Thinking Methodology [14].

4. Integration of the STEAM approach to the Design Thinking methodology

Issue: To develop innovative technological applications for inclusive education for students with disabilities.

In the context of the integration of STEAM methods into Design Thinking methods, we are faced with a challenge of great relevance: to develop an inclusive educational application as an important support tool in the educational process of students with disabilities. This situation arises from a widespread need to create innovative and effective educational solutions that address the barriers and challenges faced by students with disabilities when seeking a quality education.

Integrating the STEAM approach into the development of an inclusive education application can provide a few significant advantages that go beyond the simple delivery of educational content. These advantages can positively impact the student experience and the effectiveness of the learning process. Some of the key advantages are described below:

1. Stimulation of creativity and curiosity: Including artistic and design elements in the application can stimulate students' creativity and arouse their curiosity. The incorporation of attractive visual and graphic elements can make the learning process more motivating.
2. Deeper Understanding: By incorporating aspects of Science, Technology, Engineering and Mathematics, the application can provide a solid foundation for understanding educational concepts. The mathematical and scientific aspects can support students in learning to approach topics in a deeper and more analytical way.

3. Interactivity and engagement: Technology can enable active student interaction with educational content. Interactive elements, such as simulations, games, and hands-on activities, can improve student engagement and facilitate a more practical understanding of concepts.
4. Personalization and adaptability: Technology allows the personalization of content, which is essential in inclusive education. The application must be designed with the ability to adapt to the individual needs of each student [15].

It is necessary to make certain modifications within the stages to achieve a good integration of the approach and methodology used, based on both schemes (Figures 1 and 3):

- Define the challenge and Empathize: Start by clearly defining the challenge that the application seeks to address. What problem is it trying to solve? What is the main purpose of the application? Then, a solid empathy stage is performed, involving the future users of the application, including those who may have disabilities or specific needs. Understand their perspectives, challenges, and needs [4].
- Ideate and Design: In the ideation stage, a multidisciplinary team is assembled that includes experts in Science, Technology, Engineering, Art, and Mathematics. Each participant will bring important perspectives to the design process. encourage the team to creatively come up with innovative ideas to address the primary and secondary challenges that have been defined in advance. Combine artistic creativity with mathematical logic and technological capabilities to design application concepts [16].
- Testing and prototyping: Develop utility models that contain STEAM features. This may include incorporating visual components that are interesting, technology relationships that are advanced, and math considerations that support usability. Conduct testing with credible users, including those with disabilities, to get feedback and ensure that the application is accessible and productive for all.
- Implement and Evaluate: Use engineering and technology skills to create the application effectively and ensure that it adheres to quality parameters. Launch the application and perform constant evaluations to determine its influence and quality in solving its assigned problem [11].
- Improve and Iterate: Continue to improve the utility to make it even more useful and simple.

To perform the integration, it is possible to specify each STEAM approach at different stages of the resulting methodology (Figure 5), although this is not an absolute projection, since fragments of different approaches can be found in each of the methodology phases.

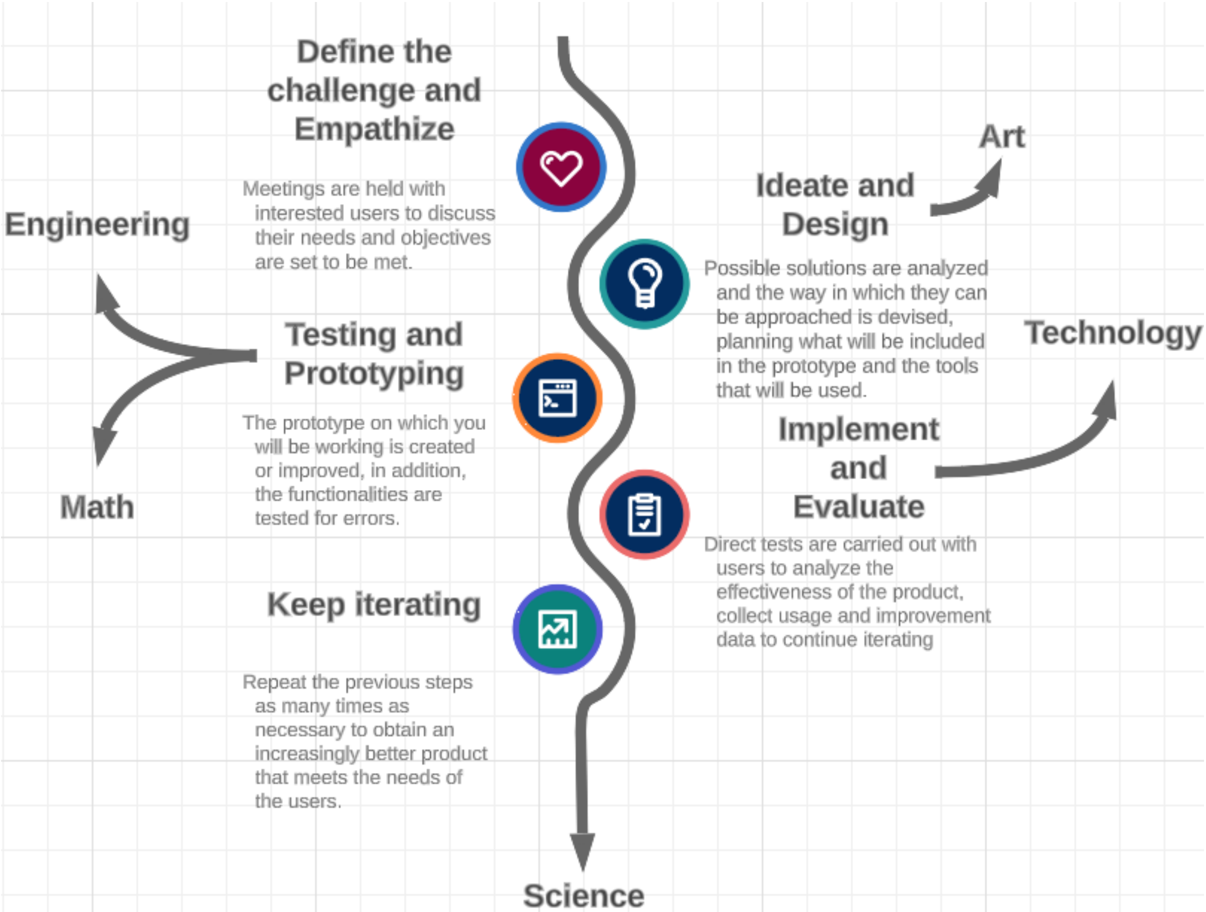

Figure 5: Design Thinking methodology diagram with approach STEAM (own authorship).

Integrating the STEAM point of view into the Design Thinking methodology procedure can lead to more substantial and creative solutions. This involves using art, science and mathematics to achieve positive effects and using technology to make an object functional. Also, the empathetic perspective ensures that the method is participatory and open to a range of users, including those with disabilities.

5. Implementing the Design Thinking methodology with the STEAM approach in Virtual Reality application.

In the following section, we outline the Design Thinking steps used during the development of the application mentioned in this analysis. We describe the way in which technological tools can support teaching projects that are conceived by teachers who consider the needs of students with disabilities. Then, we defined the proximate requirements they must solve. Next, we established tactics to achieve significant improvements and designed prototypes that worked in accordance with the intended objectives. A complete investigation of these models is done. In addition, this cycle-like procedure enables us to refine and perfect existing features as we go down new routes.

5.1. First iteration

5.1.1. Defining the challenge and empathizing

In a meeting at the Attention Centers for Students with Disabilities (CAED) within CBTis 168 in Aguascalientes, links were established with two teachers and eighteen students, most of them with mental disabilities. The purpose was to investigate the use of virtuality to support regular educational activities. A collaborative network was created, in which the CAED teachers provided the indications, and the specialists were responsible for ensuring that they were complied with. The STEAM point of view was used to devise methods to adapt the activities to the students' needs, highlighting the importance of incorporating motivational steps and discourses to stimulate constant learning.

5.1.2. Ideate and design

Extensive research was carried out to find the feasible tools to use in virtuality and the available equipment, being the selected option the Unity development engine due to its versatility and the integration of the kit to work with XR. To gather requirements, we started by developing a simple activity to highlight the opportunities and get a first interaction from the users so that they become familiar with the technology. At this stage, we worked with the generation of ideas and creative solutions.

5.1.3. Testing and Prototyping

A program was developed using Unity to visually classify objects in a virtual environment. The activity involves users interacting with colorful characters and placing them on corresponding tables, thus encouraging experimentation, creativity and problem solving (see Figure 6). This initial prototype does not include audio or text instructions.

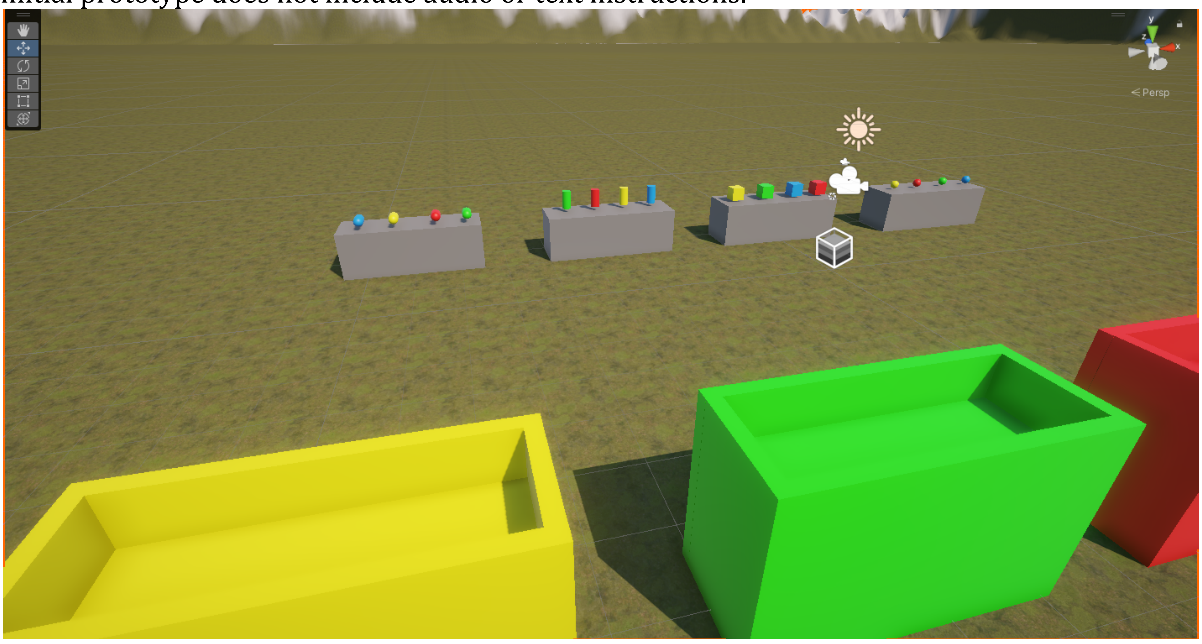

Figure 6: First prototype of the virtual environment (own authorship).

5.1.4. Implement and Evaluate

Demonstrations were given to CAED teachers to highlight possible applications of these techniques in their teaching strategies. Clearly, certain learning modules integrate more effectively with these activities. Intuitive controls require minimal instruction and are easy for teachers to operate in the first instance, which is known from teacher feedback.

5.2. Second iteration

5.2.1. Defining the challenge and empathizing

Within CAED, teachers identified two modules: Mathematics and Representation of Natural Systems (Module 8) and Calculus in Natural Phenomena and Social Processes (Module 15) (Figure 3), as areas where students face significant challenges. We visited the modules, presented the project, and sought student participation. Surveys were conducted to assess teachers' and students' competencies in Information and Communication Technologies (ICT) and an empathy map was created to understand students' needs and perspectives (Figure 7). Some lectures were planned with the objective of making students aware of new trends in technology (Artificial Intelligence, Extended Reality, Robotics, etc).

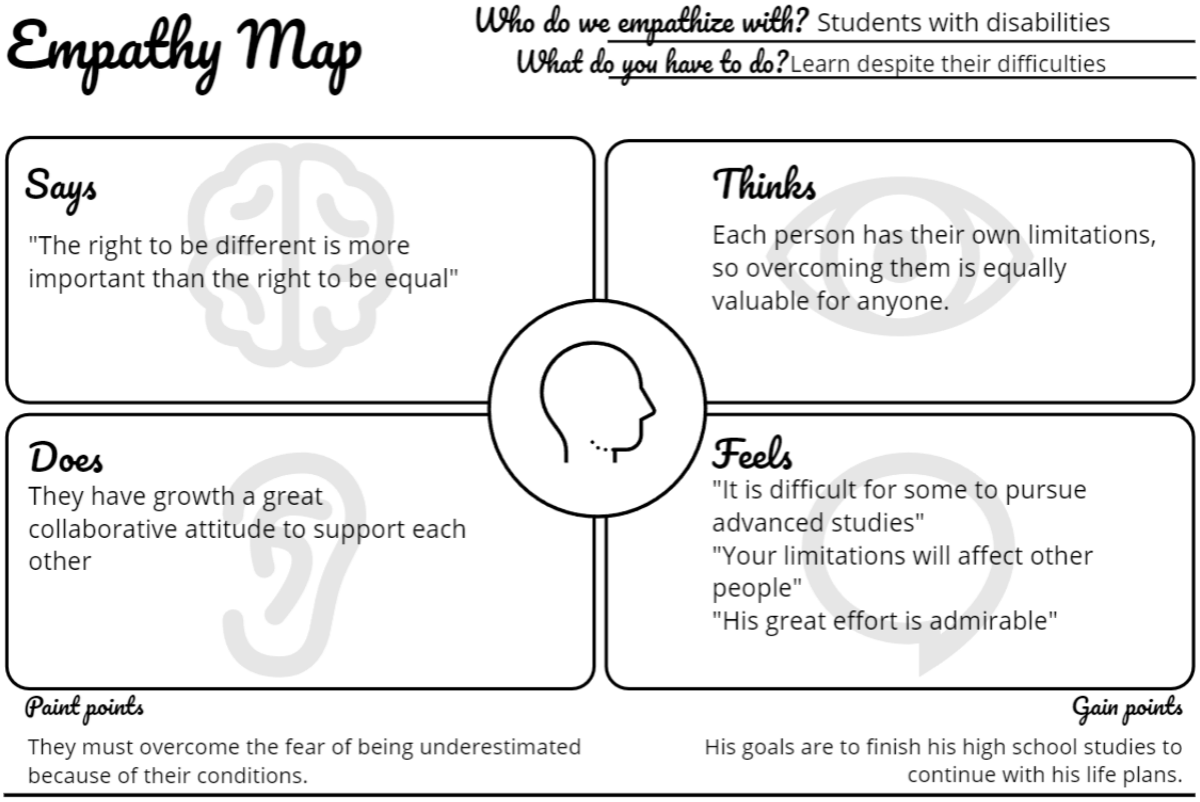

Figure 7: Empathy map of students at CAED CBTis168 (own authorship).

To access the content of the proposed study modules, it is necessary to perform a search directly on the CAED page [19], which shows a series of options to reach the material of interest; a Concurrent Task Tree (CTT) was created to show the steps that need to be performed by users who wish to access the content (Figure 8).

The CTT mentioned (figure 8) is constituted as follows: as an abstract task you enter the main page of CAED [25], it will direct you to the main menu where a list of options to which it is possible to access is shown, in order to go to the section of the subjects it is necessary to enter the list with the name "CAED" in which more options will be displayed, among them the one called study plan, When selecting it, the user will be automatically redirected to the modular plan where it mentions that it is made up of 22 modules, in addition, it will give the option to choose the area to be searched (communication, mathematics, experimental sciences, social sciences and humanities), selecting any of these, in the case of the example the area of mathematics was selected, after that, it will enable the selection of the subjects/modules related to that field. When accessing each subject individually, it will show a series of didactic materials, among which there are audio books, Mexican Sign Language (LMS) glossaries, Braille printing and intellectual disability booklets. Each of the accesses has its own support content to be able to carry out the activities to be developed in the CAED classrooms.

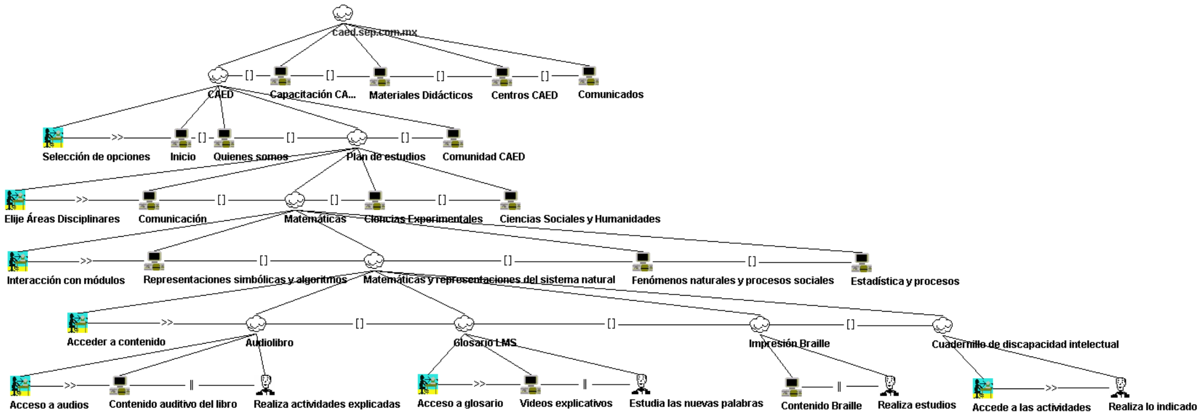

Figure 8: Concurrent Task Tree (CTT) to access the content of the CAED page (own authorship).

5.2.2. Ideating and Designing

The students were asked to think and create drawings of characters that they would like to be in the application, encouraging direct artistic participation in the development of the application. The Blender modeling tool was chosen because it allows us to model the students' characters as well as provide structure for their future animations.

5.2.3. Testing and prototyping

The first character was developed using Blender to test its ability to perform human movements and exhibit natural behavior (Figure 9). The development of the character was carried out without many complications, the structure and framework of the character behaves mostly as planned. It highlights the experimentation and problem solving of the STEAM approach by deciding to limit these movements until the desired results are obtained so that the final model can be exported to Unity.

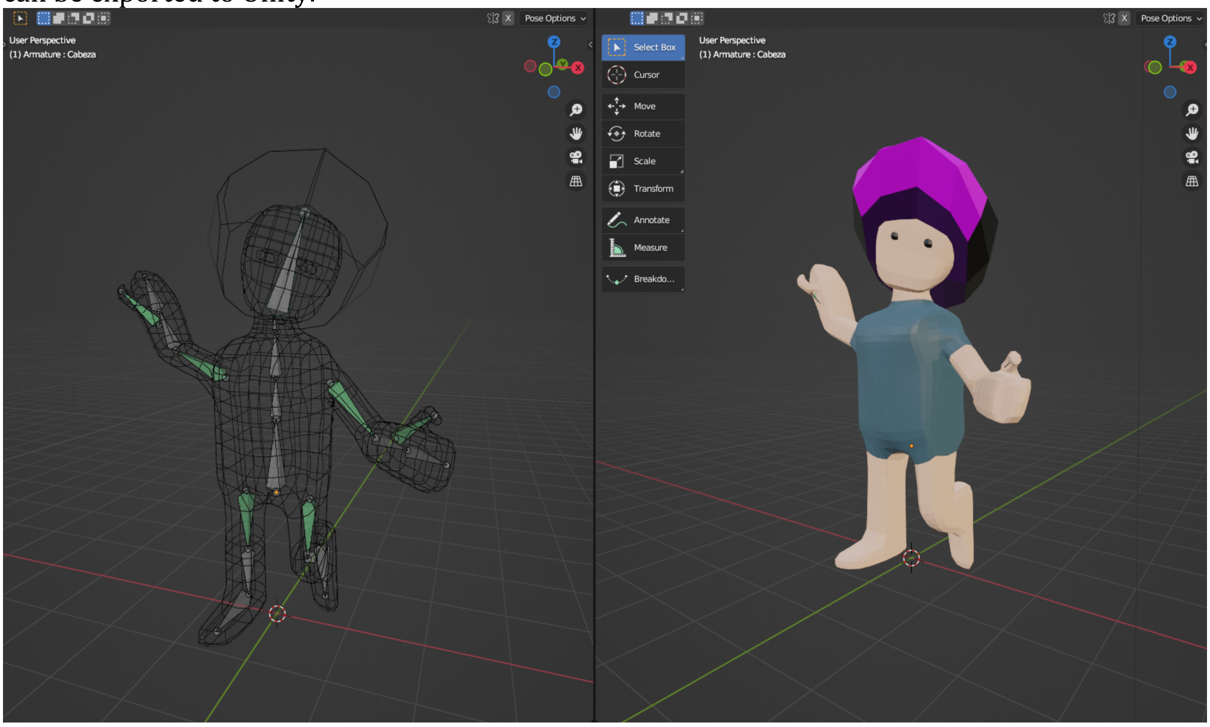

Figure 9: Three-dimensional modeling and character structure creation in Blender (own authorship).

5.2.4. Implement and Evaluate

After the initial motion test, it was ensured that the character behaves as expected. However, to ensure the desired performance, adjustments must be made to avoid excessive deformation in the character movements. Technological application and artistic creative need are reflected at this stage to achieve an efficient and realistic result.

5.3. Third iteration

5.3.1. Defining the challenge and empathizing

Frustration is a common experience in CAED, especially for students with physical and mental disabilities. It is crucial to address the challenges and find effective solutions to improve their learning experience. To overcome the barriers of frustration, strategies incorporating modern technology must be implemented to increase the concentration and motivation of students in CAED. Attention to students' needs and the search for creative and technological solutions to enhance their learning experiences, promoting interdisciplinarity and innovation within the approach being pursued, is of utmost importance.

Considering what was proposed in the previous stage, the team held a conference (Figure 10) whose main topics were those mentioned in the previous iteration, the purpose is to familiarize the students with the technologies they will be working on and to make them willing to participate in the project.

Figure 10: Conference given by the researchers (own authorship).

5.3.2. Ideate and Design

One possible solution is to integrate pop-up windows into the application that display motivational messages to help students stay calm and perform activities more efficiently, the selected language was Spanish due to our main users are Mexican students. These messages should also promote long-term learning beyond task completion (Figure 11).

5.3.3. Testing and prototyping

The pop-ups were created for students to understand that with patience and perseverance it is possible to overcome most obstacles (Figure 11).

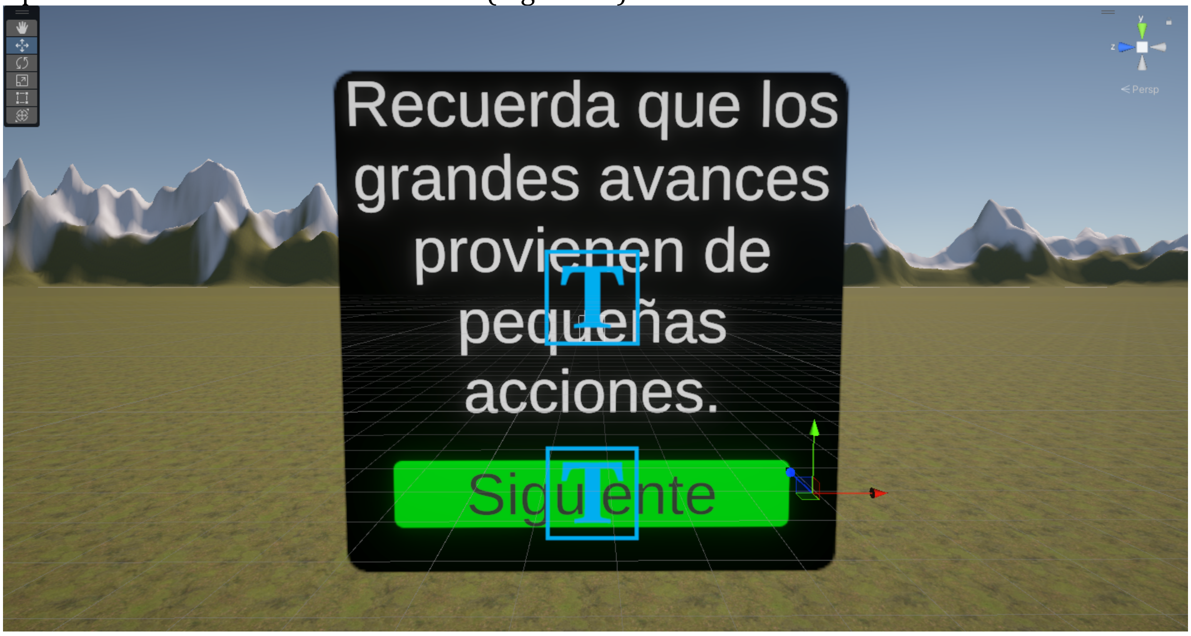

Figure 11: Implementation of motivational messages (own authorship).

5.3.4. Implement and Evaluate

A group of students tested the functionality of the pop-up windows, and the results revealed the challenges faced by visually impaired students who had difficulty identifying text within the boxes.

5.4. Fourth iteration

5.4.1. Defining the challenge and empathizing

The designers analyzed whether students had hearing problems that would prevent them from following spoken instructions. Since no hearing issues were identified, consideration was given to implementing an audio system in the application to address additional needs and barriers, particularly for those students with visual impairments. The consideration of in-app audio systems shows a focus on technology to address challenges and barriers.

5.4.2. Ideating and Designing

Using the Audacity audio recording and editing tool, a soundtrack is created for each instruction in the app, giving each student the ability to perform activities in a virtual environment in an accessible way. Within this stage, it is shown how technology is used to adapt and make the application visible to all students, a situation that is essential for inclusion, showing, in turn, a scientific approach when considering individual needs and addressing challenges in a manner creative and effective.

5.4.3. Testing and prototyping

Visual icons are added so that students press only the box that can be seen and, in this way, they are able to listen to the same instructions that are written, but in a narrated way (as shown in figure 12).

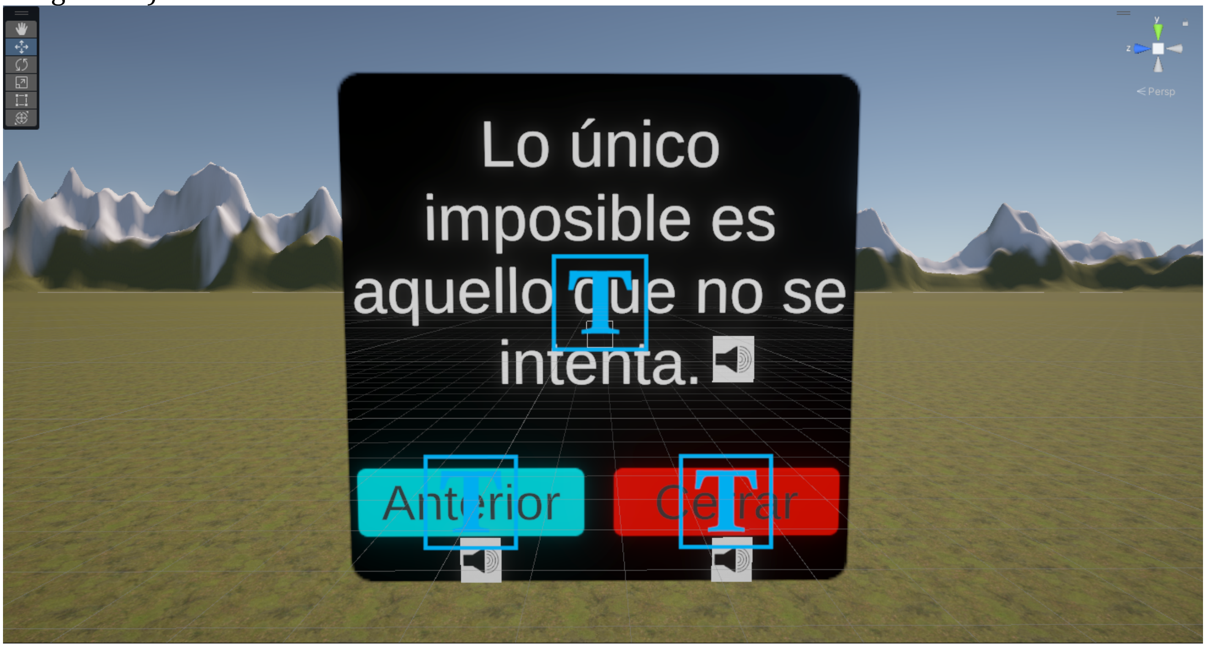

Figure 12: Motivational message in pop-up window with audio tracks implemented (own authorship).

5.4.4. Implement and evaluate

Sixteen students had the ability to continue with the activities and access the motivational messages, which brought us closer to our goal; However, two students with severe visual impairment could not even recognize the audio play icon, which prevented them from carrying out any activity. It also demonstrates how constant evaluation is essential to adapt and improve technological solutions, which is aligned with the STEAM approach of experimentation, adaptation, and continuous improvement to address challenges.

5.5. Fifth iteration

5.5.1. Defining the challenge and empathizing

To address the challenge of calculating volumes found within module 8 of the curriculum map (figure 3), an appropriate activity that is accessible to all students was sought in collaboration with teachers. Questions were selected that will help remember the formulas to calculate the volume of familiar figures such as the sphere, the cube, the cylinder, the cone, and the prism. It focuses on addressing mathematical and geometric challenges to promote active learning and problem solving, topics that fall into our focus.

5.5.2. Ideating and Designing

To address this challenge, the application of a brief questionnaire that includes three-dimensional models along with the questions is proposed. This allows users to be guided both by their memory and by a small real-time visual aid that they can analyze. With the use of three-dimensional elements, artistic visual understanding and practical application of scientific knowledge are encouraged.

5.5.3. Testing and prototyping

An environment identical to that of the previous activity was generated, the difference is that it includes new and different elements, having a text box with selectable buttons where a questionnaire related to the selection of formulas for calculating the volume of several three-dimensional figures is displayed. (figure 13). Creativity and consideration of how different activities can coexist seamlessly is encouraged by managing two distinct environments that can be accessed from the main menu.

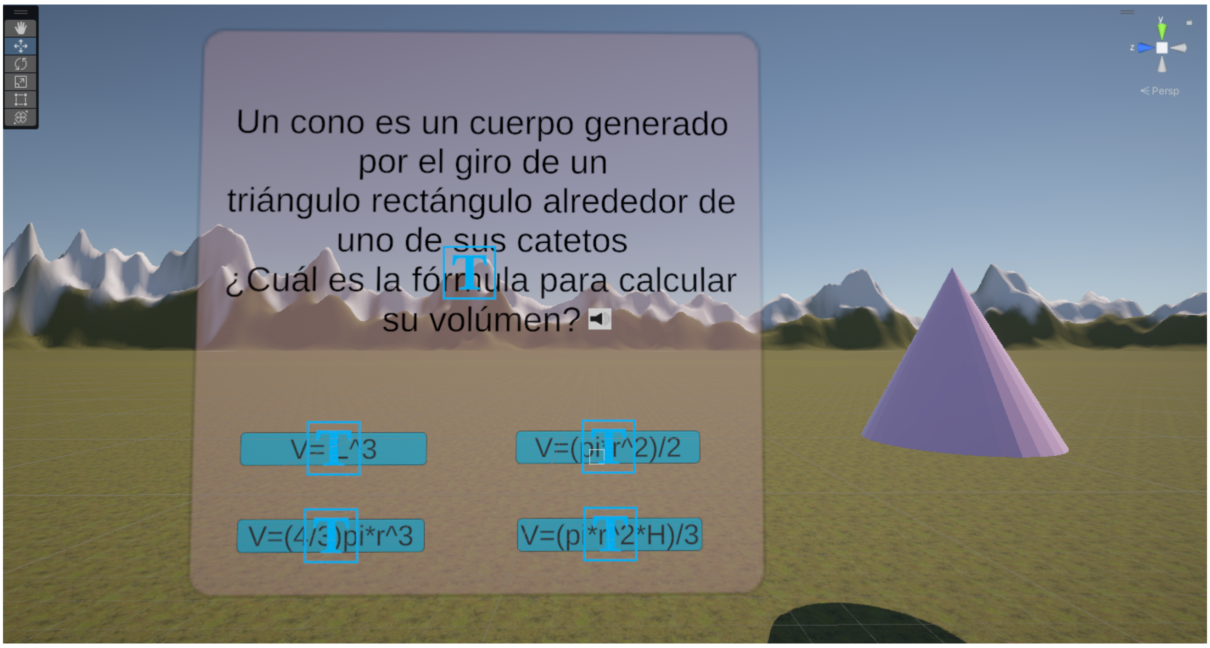

Figure 13: Volume calculation quiz (own authorship).

5.5.4. Implement and evaluate

Students memorize through trial and error, competing to see who can solve the problem in the shortest time and with the fewest errors. The activity was error-free and student feedback sparked the idea of adding a ranking mode to create healthy and educational competitions. A collaboration is reflected within the scientific and technological approach.

6. Results

The results of this study highlight the far-reaching impact of the application of virtual reality, which is the result of the synergy between the methods of the STEAM approach and the design thinking methodology in inclusive education. As the development process takes place, the application continues to improve and increase its content, thanks to the valuable knowledge provided by students and educators who actively participate in this transformative process.

The deployment of the prototype produced inspiring feedback that showed greater motivation on the part of the students to participate in the VR activities implemented in the application, a situation that led to higher levels of commitment in the study of some subjects related to the applied technologies.

The accessibility of technological educational content, as highlighted in the study, has opened a world of immersive, interactive, and customizable learning experiences. The iterative development process, guided by continuous communication with users and their teachers, ensures a tailored approach that directly addresses the immediate needs of each student. In conclusion, the adaptation of the methodology and approach proves successful in creating an inclusive education support application, ultimately focusing on providing direct support aligned with the learners' specific needs.

7. Conclusions and future works

The use of methodologies focused on understanding the needs of users first-hand with them is efficient within the development of most of the applications analyzed, this impact is even greater if technologies focused on inclusion are discussed, even more so in terms of inclusive education since they allow achieving adequate assertiveness when covering what is necessary to overcome the barriers that occur individually in the target users.

Speaking specifically about the design thinking methodology, although it has not yet been proven through certified methods, we can consider that it is suitable for carrying out this work specifically (although there could be many others that correctly adapt to the needs of the project), since the stages of empathizing and carrying out tests are repeated as many times as necessary to achieve significant progress and focused on gradually solving each of the barriers that the students have, initially the barriers regarding the use of emerging technologies through modifications and sessions training and subsequently addressing learning barriers directly.

The modifications made to the methodology to be able to focus more on the STEAM approach can always be improved and adapted depending on the context in which the project is located, the fusion of the new stages presented in this project makes the approach itself more understandable and can identify in a better and simpler way in which stage each area of the mentioned approach is most concentrated, although it is important to mention again that these areas, even if they are more present in specific stages, can be presented implicitly or explicitly at any time during both the development of the application as well as the content as such.

As future work, it is proposed to continue iterating to be able to implement more content from the modules worked on so far from the CAED curricular map (figure 3), as well as seeking to implement activities from some other subjects. More sessions were held with the institution's teachers. with which we are collaborating, and it was agreed to begin looking for strategies to implement in communication areas, it is also expected to obtain statistical data that guarantees that the work carried out had benefits through methods of obtaining certified data.

Aknowledgements

This work is possible thanks to the support provided by the "National Council of Humanities, Science and Technology" (CONAHCYT) under the number of CVU 1198948, in addition to the collaborative work carried out together with the CAED CBTis 168 and the Autonomous University of Aguascalientes.

References

[1] Yang-Kun Ou, Y.-L. W.-C.-Y.-H.-O. Development of virtual reality rehabilitation games for children with attention-deficit hyperactivity disorder. Journal of Ambient Intelligence and Humanized Computing (2020): 5713-5720.

[2] Korn, O., Buchweitz, L., Rees, A., Bieber, G., Werner, C., & Hauer, K. Using Augmented Reality and Gamification to Empower Rehabilitation Activities and Elderly Persons: A Study Applying Design Thinking. In Advances in Intelligent Systems and Computing book series. (AISC, volume 787) (2018) (219-229). DOI: 10.1007/978-3-319-94229-2_21

[3] Medina, B. A. Formación integral, inclusión educativa y responsabilidad social. DOCERE (2019). 33-36.
[4] Brown, T. Design thinking. Harvard Business Review, 86(6), 2008: 84-92. DOI: 10.1162/pres.1997.6.6.603.
[5] Seamus Hegarty. Educación de niños y jóvenes con discapacidades (1.a ed.) [PDF]. UNESCO, 1994.
[6] Cardona-Reyes, H., Muñoz-Arteaga, J., Villalba-Condori, K., & Barba-González, M. A Lean UX Process Model for Virtual Reality Environments Considering ADHD in Pupils at Elementary School in COVID-19 Contingency, 2021.
[7] Di-Cristo, V.; Bonilla Cerón, J. C. LA IMPORTANCIA DEL USO DE APLICACIONES INTERACTIVAS Y MULTIMEDIA EN LA EDUCACIÓN Y CAPACITACIÓN ACTUAL (1.a ed.), 2003.
[8] Sherman, W. R., & Craig, A. B. Understanding virtual reality: Interface, application, and design. Morgan Kaufmann Publishers, 2003. DOI: 10.5555/1055377
[9] De la Cruz Orozco, I. Educación inclusiva en el nivel medio-superior: análisis desde la perspectiva de directores. Sinéctica, Revista Electrónica de Educación, 2020. ISSN 2007-7033. doi: 10.31391/S2007-7033(2020)0054-008
[10] JC. Revisión bibliográfica del tema de estudio de un proyecto de investigación. Radiología. 2011. doi:10.1016/j.rx.2011.05.015
[11] Latorre-Cosculluela, C., Vázquez-Toledo, S., Rodríguez-Martínez, A., & Liesa-Orús, M. Design Thinking: creatividad y pensamiento crítico en la universidad. Revista Electrónica de Investigación Educativa (REDIE), 22 (2020). DOI: 10.24320/redie.2020.22.e28.2917
[12] Dirección General del Bachillerato de la Secretaría de Educación Pública. Mapa curricular - Centros de Atención Para Estudiantes con Discapacidad Información para auxiliares (2014).
[13] Interaction Design Foundation. Obtenido de What is Design Thinking? Interaction Design Foundation, diccionario en línea, 2022. URL: https://www.interaction-design.org/literature/topics/design-thinking.
[14] Karl S. The Design Thinking Process – How does it work? MAQE, blog informative, 2020. URL: https://www.maqe.com/insight/the-design-thinking-process-how-does-it-work/
[15] Recla, & Recla. El aula digital: las asombrosas ventajas de la tecnología en la educación. *RECLA*, blog informativo, 2023. URL: https://recla.org/blog/ventajas-de-la-tecnologia-en-la-educacion/
[16] Pérez, A. 3 tipos de equipos de trabajo y un proyecto. *OBS Business School*, blog informative, 2021. URL: https://www.obsbusiness.school/blog/3-tipos-de-equipos-de-trabajo-y-un-proyecto
[17] Martinez, M. Á. V. (s. f.). Desbloquea tu potencial: ¡Aprendiendo con Steam!, publicación en red social, 2023. URL: *es.linkedin.com*. https://es.linkedin.com/pulse/desbloquea-tu-potencialaprendiendo-con-steam-vite-martinez
[18] *Educación STEAM – Domingo Sánchez 3D*. (s. f.-b). blog informativo, 2020. URL: https://domingosanchez3d.es/educacion-steam/
[19] Secretaría de Educación Pública, sitio web oficial del CAED, 2023. URL: https://caed.sep.gob.mx/
[20] Tinkercad. Tinkercad | Create 3D digital designs with online CAD, 2023. URL: https://www.tinkercad.com/
[21] Scratch. Scratch - Imagine, Program, Share, 2023. URL: https://scratch.mit.edu/
[22] Minecraft Education Edition – Exploración Educativa en Minecraft, 2023. URL: https://education.minecraft.net/es-es
[23] GeoGebra - Mathematics Apps, 2023. URL: https://www.geogebra.org/?lang=es
[24] CoSpaces Edu - Virtual Reality in Education, 2023. URL: https://www.cospaces.io/
[25] CAED – Centros de Atención para Estudiantes con Discapacidad, 2023. URL: https://caed.sep.gob.mx/