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Original Article

Virtual Reality and Its Influence on the Future Education of Adolescents in Peru

Lida Asencios-Trujillo[1], Lucia Asencios-Trujillo[2], Carlos La-Rosa-Longobardi[3], Djamila Gallegos-Espinoza[4]

[1, 2,3,4]*Postgraduate School, Enrique Guzmán y Valle National University of Education, Lima, Peru.*

[1]*Corresponding Author : asenciostrujillolida@gmail.com*

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Abstract *- Education faces challenges both in Peru and worldwide that increasingly require high-quality instruction, alongside updates in approaches, methodologies, and tools. However, the most crucial aspect is how those involved in teaching and learning adapt to the rapid changes in contemporary society. This article contributes to the study of implementing virtual reality in education, focusing on adolescents aged 10 to 19 as a tool for teaching and learning processes. The objective of this study was to determine the impact of using Virtual Reality as a tool to reinforce teaching and learning strategies, thereby enhancing formative quality. This allows students to study in a 3D environment where reality is dynamically represented, enabling them to explore and interact by manipulating the elements that make up that reality. This research was applied, with an experimental design and a quantitative approach. The initial survey involved 19 students before they underwent the VR experience, and a subsequent survey included 16 students to measure their satisfaction after the VR experience. The data collection technique was a survey, and the instrument used was a questionnaire. This research investigates previously published works whose contributions are considered adaptive, developed, and applied in educational settings, demonstrating effective results in the educational process. In conclusion, the potential of virtual reality as an educational tool capable of transforming educational models and improving the teaching-learning process is evident.*

Keywords *- Academic performance, Student success prediction, Predictive models in education, Influence of study hours, Academic history.*

1. Introduction

The use of virtual reality in education represents a significant advancement in scientific practice, elevating it to the next level. Virtual reality allows individuals to experience remarkable events without leaving their location. While this may sound like fiction, it is indeed a reality. We are witnessing one of the most pivotal technological changes, revolutionizing all fields and evolving over a considerable period. At first glance, the concept of virtual reality may seem illogical. Therefore, it is crucial to pay attention to the definitions of the underlying concepts. Virtual reality derives from the Latin word "realitas," meaning "things," as opposed to fiction; it denotes what exists and is real. Conversely, the term "virtual," also from Latin "virtualis," signifies that which is not real but feasible or possible. According to the same author, virtual reality in the field of computer science is defined as a natural form of human-machine interaction by immersing the user in a virtual environment [4].

Virtual reality refers to "enhanced user interfaces" with functions such as viewing and navigating in a three-dimensional environment and interacting with elements within that environment in real time. According to these authors, user interaction with the real world can be experienced through the human senses of sight, hearing, smell, touch, and taste. Virtual reality is a computer system that allows users to create artificial environments. These environments enable users to interact, navigate, and immerse themselves in three-dimensional space through multisensory channels [2].

Virtual Reality (VR) can be understood as the concept of representing non-existent or simulated scenes generated by computer systems. This sensory immersion in new environments, which may or may not be based on real locations, has a remarkably realistic appearance that allows individuals to imagine themselves in any scenario. To achieve this, specialized devices such as glasses or helmets are necessary to fully immerse oneself in the experience. These devices enable users to participate and interact in this new virtual environment without the risk of injury or accident.

Similarly, the use of virtual reality in education facilitates knowledge transfer, fosters empathy among individuals, and promotes higher levels of self-awareness. Providing this educational tool stimulates the senses, and it is essential that

teachers are trained to incorporate these resources into their daily practice, adjusting the subject level to bring out the best in their students. The educational prospects in Peru are concerning.

A recent survey reveals figures that paint an alarming picture of education in the country. Action is needed to improve the quality of education and make it more accessible to all. Unfortunately, school closures due to COVID-19 further impacted the learning of children and young people. Factors such as lack of connectivity, educational materials, and access to basic services worsened existing educational disparities in Peru. According to the Ministry of Education, a total of 124,533 students canceled classes in 2021 due to the pandemic. The Ministry of Education (Minedu) reports a dropout rate of 6.3% in Peru. According to the INEI 2021 survey, 22 out of every 100 adolescents aged 17 to 18 did not finish high school, and 5 out of every 100 adolescents aged 13 to 19 did not complete high school [3]. This means a significant portion of the population lacks the necessary skills to compete in the labor market and boost the country's productivity.

Approximately 1.3 million people aged 15 and over reported not knowing how to read or write, according to the census conducted by the National Institute of Statistics and Informatics (INEI). In rural areas, the illiteracy rate rises to 22.8% for women [4]. The quality of education in a country is heavily impacted by literacy levels because students cannot access or understand available educational resources.

The United Nations Children's Fund (UNICEF) warns that Peru faces an unprecedented educational crisis, urging the parliament, executive branch, private sector, and citizens to prioritize the education of children and young people through educational agreements and place this issue at the center of the political agenda. UNICEF representative in Peru, Ana de Mendoza, emphasized the need for a long-term educational pact where investment is higher, sustained, and efficient, with greater participation from the private sector to ensure children and adolescents receive the education they deserve [4].

According to UNICEF representatives, this global educational crisis is unprecedented, and Peru is no exception. Peru was one of the slowest countries in the world to reopen schools. After two years of closed classrooms, the learning loss is estimated by the World Bank to be equivalent to a decade of setbacks. Additionally, the country faces a significant deficit in educational infrastructure, which has been an ongoing issue for decades. The Ministry of Education (Minedu) estimated this deficit at S111 billion, highlighting the urgent need for infrastructure improvements and teacher updates. Education faces challenges both in Peru and globally that increasingly require high-quality instruction and updates in approaches, methodologies, and tools. The most critical factor is how those involved in teaching and learning adapt to the rapid changes in contemporary society. Virtual reality presents a viable solution to these challenges. It is rapidly gaining popularity as a practical, flexible, and effective method for developing high-quality educational programs. This method is widely recognized for democratizing access to education and supporting lifelong learning through information and communication technologies [3].

While distance education with new technologies has brought significant changes to Peru's complex educational landscape, certain elements still need strengthening to provide high-quality educational services. These include initiating guided didactic conversations for learning, integrating learning resources reasonably, encouraging autonomous learning, thoughtfully designing, developing, and validating educational materials, creating collaborative learning groups, and offering support services to help students reach their highest potential.

This study examines the potential of virtual reality to support teaching and learning in an educational setting for adolescents aged 10 to 19. It explores how traditional education and remote learning can be enhanced using virtual reality. Surveys will be developed to gather information and analyze opinions from adolescents within this specific age range. The additional benefit of virtual reality is its ability to provide a higher level of educational quality by allowing students to study in a dynamically represented 3D environment, enabling them to explore and interact with various components of that reality.

2. Literature Review

This article contributes to the research on the use of virtual reality as a tool for instruction and learning, particularly in the fields of basic and vocational education. The analysis demonstrates that virtual reality can serve as an alternative means to ensure the quality of the educational process, especially in light of the physical separation necessitated by the pandemic. This study examines previously published works developed and used in basic and vocational education settings, which have shown positive effects on the educational process. These contributions can be considered adaptive. In conclusion, this article highlights the significant positive contributions that virtual reality can offer as a teaching tool [4].

The purpose of this study was to examine the state of virtual education in Peru, focusing on the social inequalities that emerged during the pandemic beginning in 2020. The methodology employed is based on periodic reports and journalistic analyses of information from social networks, which revealed the condition of education in the country. The findings indicate that virtual teaching exacerbates technological and educational disparities, threatening equal educational opportunities. In conclusion, during the pandemic, education in Peru has been an invisible right, favoring those

with favorable social, technological, and economic circumstances at the expense of vulnerable groups, thus increasing social inequalities. As a result, there is a need for a comprehensive transformation that promotes educational equity [5].

The teaching quality of online courses has not been attractive or sufficient to provide a better educational experience. Therefore, the general objective of this article is to explore and analyze virtual reality (VR) and its use as a "technological intermediary" in educational teaching and learning processes. The ultimate goal is to engage students more deeply in challenging class topics, enabling effective and comprehensible learning outcomes [6].

Each student's deficiencies in their understanding of the geography course make it challenging to find effective teaching strategies that foster student interest. This study aimed to determine whether the implementation of virtual reality improved deep learning in the geography course at the Santísima Guadalupe Educational Group. As a result, observational learning increased from 3.25 to 7.5, an average increase of 4.25. Experiential learning also rose from 5.2 to 7.3, an average increase of 2.1 [7].

3. Methodology

The educational system and reforms in our country have undergone significant changes in recent years, aiming to enhance the quality of education for Peruvians. Introducing technological elements into the educational field is in its early stages. It should be noted that the government has made substantial improvements in the infrastructure and technical equipment of educational institutions, including the use of computer labs. However, as technology continues to evolve, it is imperative to stay current to optimize the use of these tools.

At the educational level, new technologies are breaking down the traditional student-teacher hierarchy, transforming everyone into both instructors and learners. Therefore, educators must utilize new technologies to teach without needing to be experts in their application. Helping teachers become familiar with the latest technological tools is essential, and virtual reality presents a particularly interesting technological tool for enhancing student learning. Considering the definitions provided regarding VR, it is crucial to understand and be clear about its key elements. Virtual reality is emphasized as a computer-generated simulation that is three-dimensional (3D) and interactive.

Additionally, depending on the technology used, there are two types of virtual reality:

- VR for a specific space and
- VR for total immersion.

The first type, commonly used by a single person or a small group, displays a virtual environment on a computer monitor and allows participants to interact with it using special devices, such as a 3D navigation mouse, position sensor, gloves, etc.

The second type, total immersion, involves the psychophysiological effect of feeling "inside" a hardware-created virtual environment. In fully immersive virtual reality, the user wears a headset or virtual reality device that covers the field of view to see the virtual environment and uses data movements and gloves. This equipment allows users to achieve a high level of immersion, provided that the equipment and environment are applied/adjusted correctly [8].

In this work, we will apply fully immersive VR, which requires significant conditions related to the device, such as:

High-Resolution Displays: The VR headset must have high-resolution screens, ideally 4K or better for each eye, to ensure clear visuals and minimize pixelation.

Low Latency: The system must provide real-time responsiveness with minimal delay, which is crucial to prevent motion sickness and maintain immersion.

Accurate Tracking: Precise tracking of head and hand movements is essential for maintaining immersion and ensuring that virtual actions correspond with physical movements.

Ergonomic Design: The VR device should be designed for comfort, allowing extended use without discomfort. It should feature adjustable straps and balanced weight distribution.

Powerful Processing: The hardware must include a high-performance GPU and CPU to manage complex graphics and ensure smooth performance.

High-Quality Audio: Immersive sound, with high-fidelity spatial audio, is necessary to create a realistic and engaging audio environment.

Wireless Freedom: Ideally, the VR setup should offer wireless connectivity, providing the freedom to move without being tethered, supported by strong signal stability.

Long Battery Life: For wireless devices, a durable battery is necessary to support prolonged use, especially for demanding research tasks.

Safety Features: The VR system should include safety mechanisms such as boundary warnings and eye protection features to reduce strain during extended sessions.

Software Compatibility: The VR device must be compatible with the specific research software and applications, ensuring smooth integration and performance.

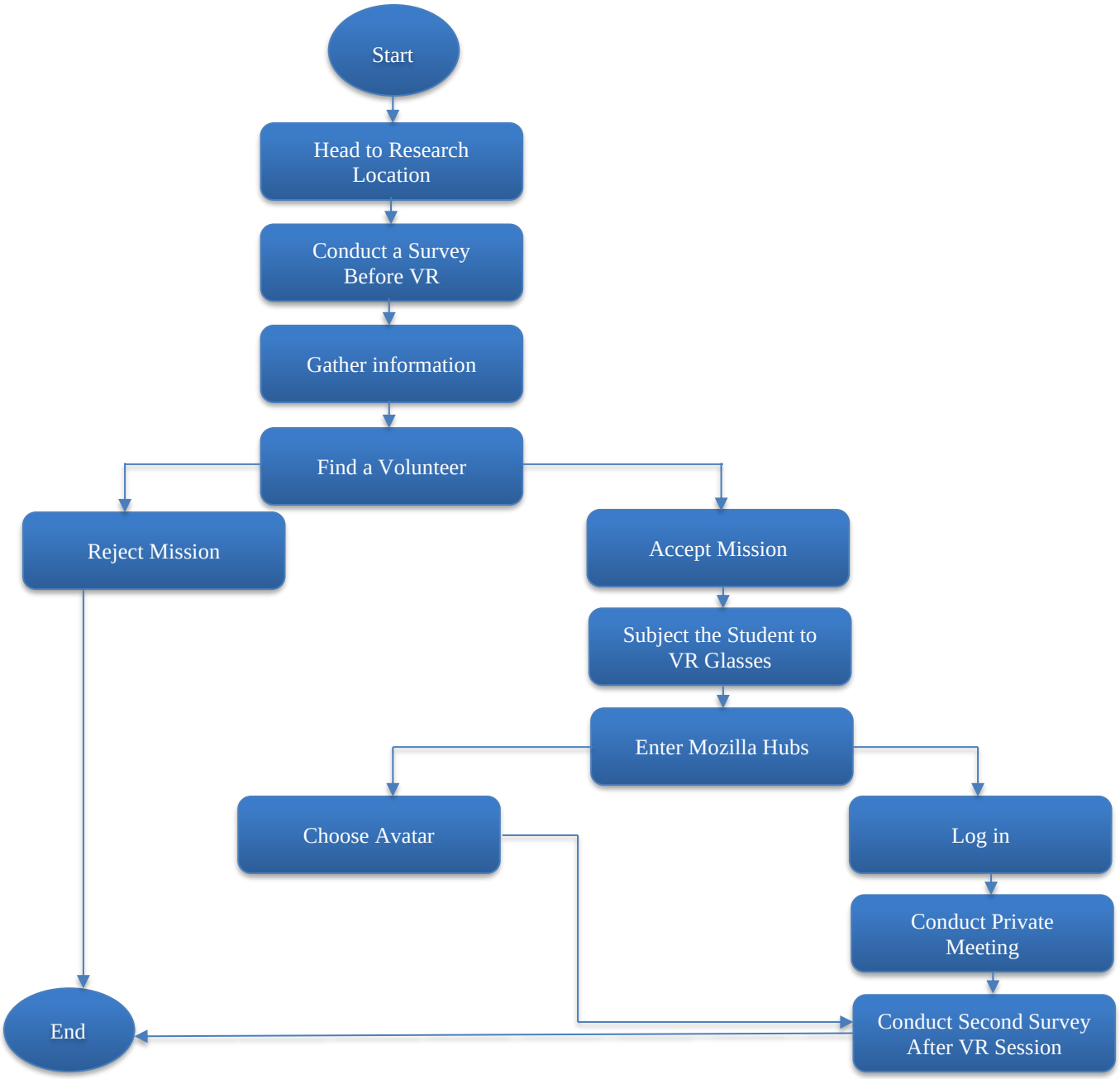

Fig. 1 Virtual reality flowchart

3.1. Steps to Follow

Figure 1 illustrates the steps from the beginning to the end of the investigation. The first step focuses on identifying the population to be analyzed, which in this case, comprises adolescents aged 10 to 19 years. To achieve this, we will visit classrooms to survey students before exposing them to VR, aiming to gather preliminary information on their understanding and perceptions of virtual reality. Following this, a volunteer will be selected to experience VR. Once the student puts on the virtual reality glasses, they will enter the Mozilla Hubs platform. The student will register to log in, allowing them to choose an avatar (such as a panda, hamburger, or robot) and participate in private meetings within a three-dimensional space. This space facilitates interaction with different people and can be used for teaching sessions. Finally, a second survey will be conducted after the VR experience to measure the students' degree of satisfaction. Before fully applying and focusing on the methodology, a survey will be conducted among adolescents aged 10 to 19. The aim of this survey is to collect data on their knowledge of Virtual Reality (VR). For this purpose, the Google Forms tool will be used.

3.2. Survey before Submitting Students to the R.V.

This survey was conducted taking into consideration the research works that address the specific topic. Based on this, the following questions were formulated, as shown in Table 1. Table I presents 13 questions extracted from the research works of [13], [14], and [1]. For example, from the research of [13], questions such as "Do you know what virtual reality consists of?" and "If a training course on virtual reality was offered, would you attend?" were included.

3.3. Survey after Submitting Students to the R.V.

This survey was conducted taking into consideration the research work that addresses the specific topic.

For this inquiry, a Likert scale was applied to measure student satisfaction, as shown in Table 2. Table 2 presents 20 questions extracted from the research of [12], which highlights the potential benefits of VR for students.

Table 1. Survey questions number 1

No.	Questions
1	How is your teaching in traditional education?
2	Do you feel that communication is fluid between students and teachers?
3	Are you comfortable with the traditional education you are taking?
4	What would you like to improve from the traditional education you have?
5	In the time of the pandemic, how happy were you with the apps/platforms used for distance learning?
6	How helpful has the [school or university] been in providing learning materials at home?
7	How effective are your teachers at providing online education?
8	Do you think technology would give advantages in the education sector?
9	Do you know what virtual reality in education consists of?
10	Do you think virtual reality would contribute to your education?
11	Do you think it would be a good idea to implement Virtual Reality in education?
12	If a training course on virtual reality was offered, would you attend?
13	Would you submit to the simulation of Virtual Reality?

Table 2. Survey questions number 2

No.	Questions
1	Could using the VR app improve learning?
2	Would using the VR app during class make it easier for students to understand certain concepts?
3	Do you think the use of VR apps is useful when you are teaching and students would be learning?
4	Do you think the VR app is easy to use?
5	Learning how to use and manage the VR app is not a problem for you?
6	Is the interaction with the VR app clear and understandable?
7	Do you think the VR app allows students to reinforce the topic seen in class by playing?
8	Did you enjoy the class with the use of the VR app?
9	Is watching the class topic with such a VR app entertaining?
10	Does using the VR app make the class more interesting?
11	Did watching the class topic with the use of the VR app seem boring to you?
12	Do you think using a VR app in the classroom is a good idea?
13	Would you like to use the VR app in the future if you had the chance?
14	Do you think that using VR apps would allow students to review and reinforce topics seen in class on their own?
15	Would you like to use the VR app to go over what wasn't clear to you in class?
16	Are the objects produced in the VR app aesthetically suitable for the subject at hand?
17	Do objects produced in the VR app work properly?
18	Are the objects produced in the VR app well-structured and organized?
19	Are the objects produced in the VR app attractive?
20	Do the objects produced in the VR application not affect the user in any way?

Fig. 2 Virtual reality glasses for mobile devices

3.4. Supported Virtual Reality Devices

Having an Android or iOS cell phone allows you to enter the world of Virtual Reality. By simply placing your mobile device inside VR BOX glasses, you can enjoy a unique experience, as shown in Figure 2 extracted from [9]. The VR BOX is compatible with screens ranging from 3.5 to 6 inches, offering a 360-degree viewing angle for watching videos. It features large lenses made of high-quality resin optics and provides total freedom of movement during use. Additionally, it includes a soft and comfortable protector for prolonged use without causing discomfort.

3.5. Supported Applications of Virtual Reality

Figure 4 extracted in [11] shows the official Mozilla Hubs page where you can create your own immersive class with virtual reality and you can meet with several people. Works with any browser on computers, tablets and cell phones.

It does not require any account to be used, but only a URL that gives direct access to a digital space within a virtual reality environment. It's based on WebVR, that means we could use any mixed reality headset. Figure 5 shows a blue button labeled "Join Room," which is used for entering a virtual room for those who only have a computer, laptop, or cell phone. The second purple button, labeled "Enter on Device," is for those who have virtual reality glasses, facilitating three-dimensional visualization. Finally, the orange button labeled "Spectate" allows users to enter spectator mode. Additionally, it offers the option to invite others by sharing the link to the virtual room with multiple people. Figure 6 shows a text field where the user's name is entered. An avatar is then generated automatically, with the option to change the avatar if desired. To complete the process, the user clicks the "Accept" button to finalize the registration.

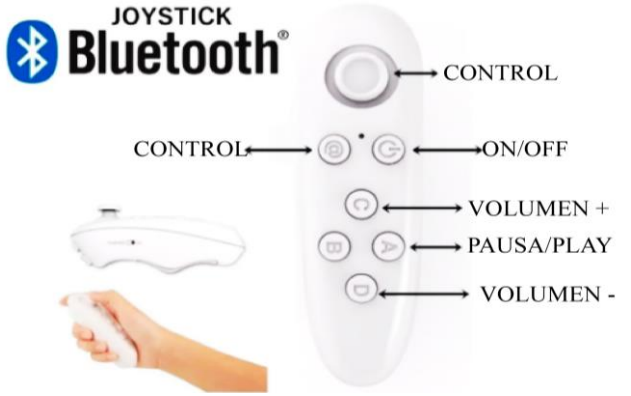

Fig. 3 Wireless Bluetooth remote control gamepad VR-BOX

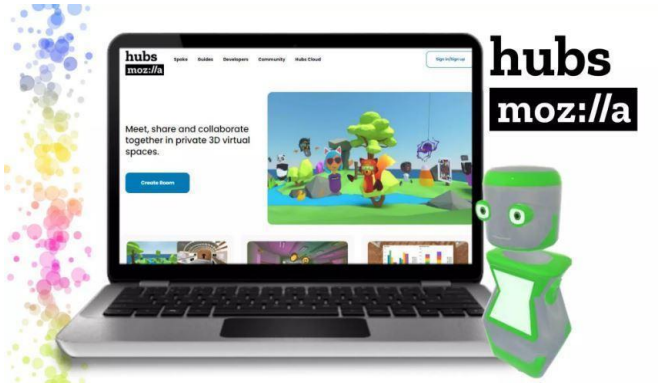

Fig. 4 Official Mozilla Hubs platform

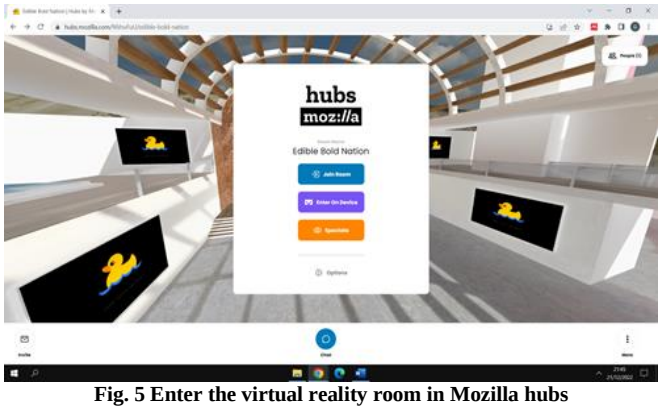

Fig. 5 Enter the virtual reality room in Mozilla hubs

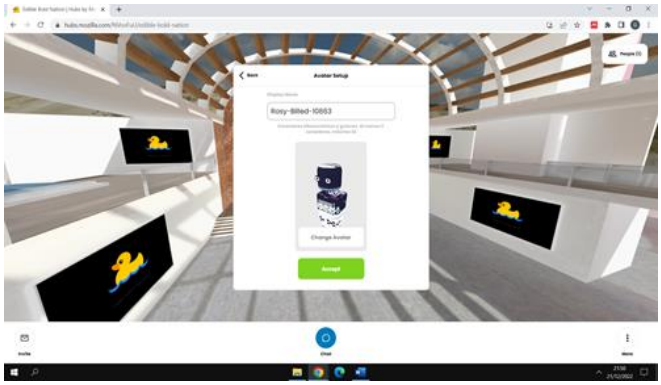

Fig. 6 Registering users in Mozilla hubs

Figure 7 illustrates that the user can choose from various avatars to represent themselves, such as SpacePerson Pride, Webcam Astronaut, Webcam Hologram, Foxr, Quantum Fox, Triangle Avatar, Triangle Avatar w, Outline Test - Triangle, 666th Dimensional Angel, Yellow Duck, Box Fox, Firefox Reality Avatar, Panda, Polar Bear Sweater, Snowman Sweater A, Space T-shirt, Ducky Bobble Grey Sweater, MC Duck, Penguin Sweater, Dancer Gif 5, Dancer Gif 2, Dancer Gif 4, and Sweater Bot 05.

Figure 8 illustrates a virtual space designed for private meetings, featuring several interactive options. The "Share" option allows users to share their screen or camera. The "Place" option enables users to place 3D objects within the virtual space. The "React" option provides various reactions, such as a happy, sad, or angry face, as well as options to raise a hand, applaud, or display a heart symbol. Finally, the "Chat" option allows users to write messages to communicate their thoughts or engage in discussions. At this point, how can we contribute virtual reality technology to the current training environment? Undoubtedly, the inclusion of virtual reality represents a significant advancement, especially in fields of learning and areas of knowledge where the object of study is difficult to visualize. Using virtual models provides a sense of 3D space that other graphical rendering systems do not offer.

Additionally, it is a fairly intuitive technology which facilitates the explanation of complex or abstract concepts. Similarly, the critical question arises: Has Peru introduced technology and the internet in its educational centres? Are students utilizing technological resources for learning? Technology presents numerous opportunities to solve problems, but it is also crucial to understand how to use it effectively for educational purposes. Virtual reality is a 21st-century trend that can offer indescribable experiences. Its application in education can be highly effective for the cognitive learning of students.

4. Results

The population of our research study consists of adolescents aged 10 to 19 years. To analyze this group, we conducted two surveys using Google Forms to gather information on the topic we are addressing. The first survey consists of 13 questions aimed at determining whether they are familiar with Virtual Reality in Education. We surveyed secondary students from the Franz Tamayo Solares 3096 school located in the District of Comas. The following results were deemed most important for our research:

Figure 9 shows that out of the 19 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the majority of students strongly agree that technology would provide advantages in the education sector. Figure 10 shows that out of the 19 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the largest number of students have a moderate understanding of what Virtual Reality consists of in education.

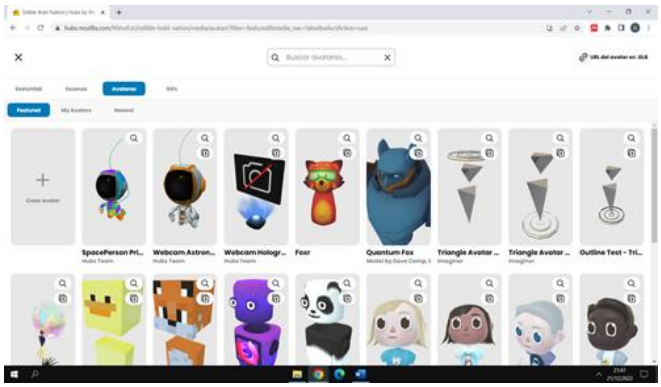

Fig. 7 Select avatars in Mozilla hubs

Fig. 8 Meeting room in Mozilla hubs

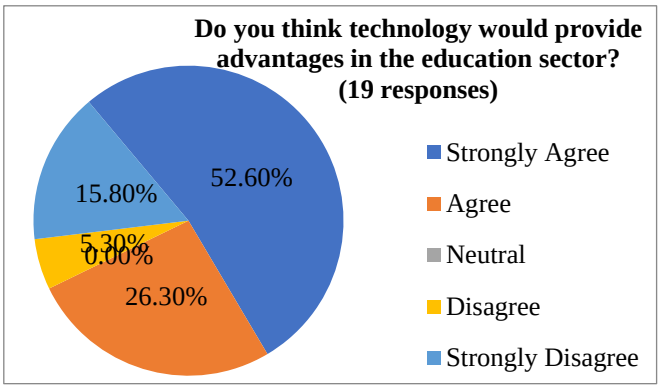

Fig. 9 Statistics of question N°08 of the first survey

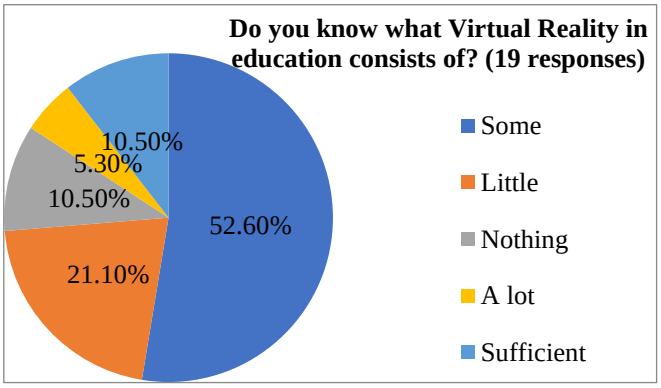

Fig. 10 Statistics of question N°09 of the first survey

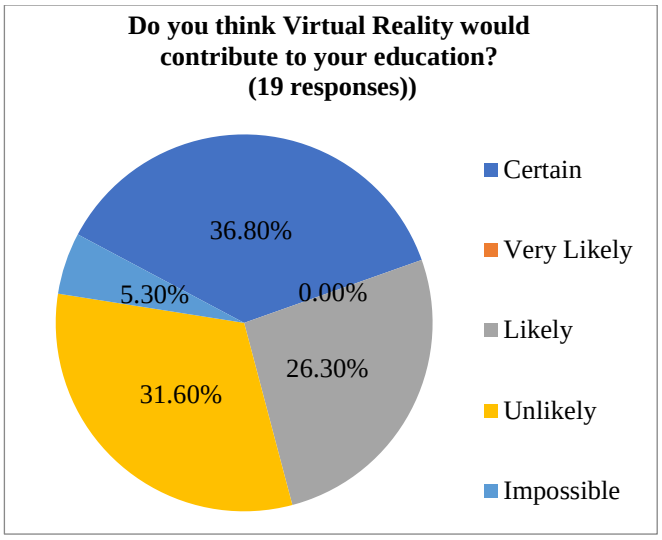

Fig. 11 Statistics of question N°10 of the first survey

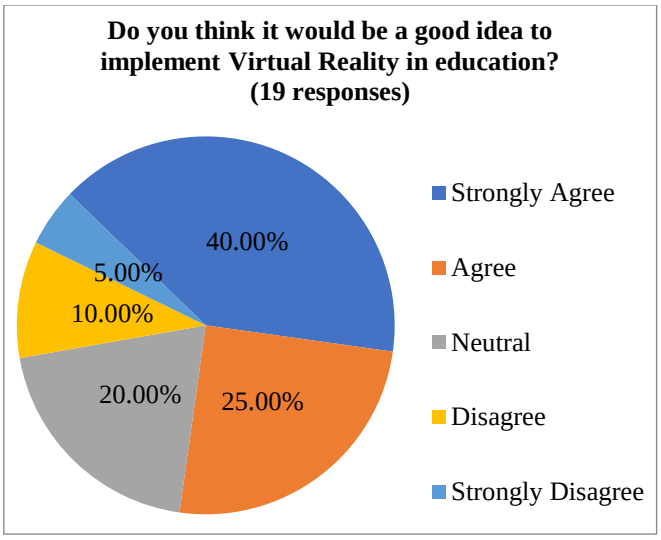

Fig. 12 Statistics of question N°11 of the first survey

Figure 11 shows that out of the 19 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students are confident that Virtual Reality in Education would significantly contribute to their student training.

Figure 12 shows that out of the 19 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree with the idea of implementing Virtual Reality in education.

Figure 13 shows that out of the 19 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree with undergoing the simulation of Virtual Reality in education.

Once the information from the first survey was obtained and the volunteer students had experienced Virtual Reality, the final questionnaire consisting of 20 questions was conducted to measure the degree of satisfaction among the secondary students of the Franz Tamayo Solares 3096 school, located in the District of Comas. The following are the most important results for our research study.

Figure 14 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students marked the option "very likely" regarding the use of VR improving learning. This suggests that we are on the right track, as we have the acceptance of our study population for the potential future implementation of VR in education in Peru.

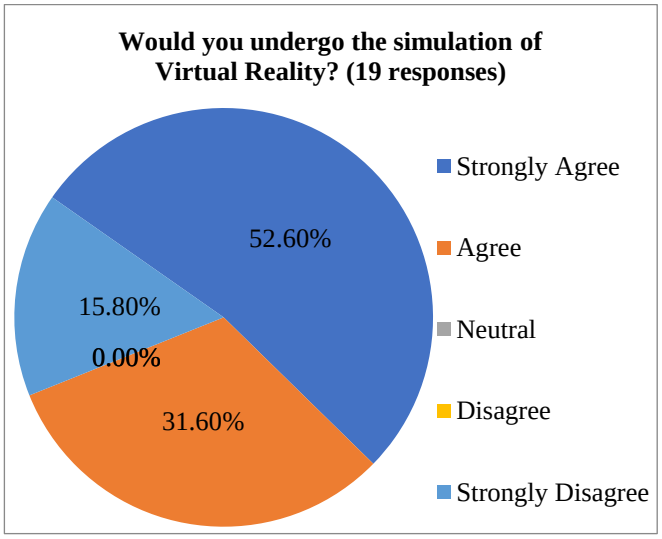

Fig. 13 Statistics of question N°13 of the first survey

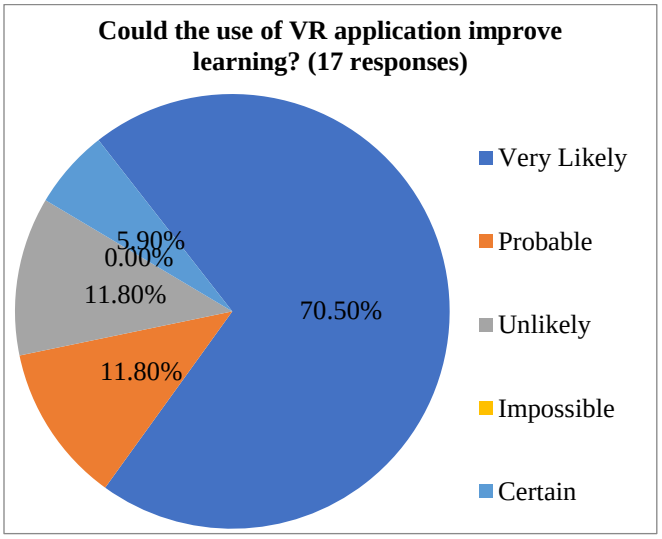

Fig. 14 Statistics of question N°01 of the second survey

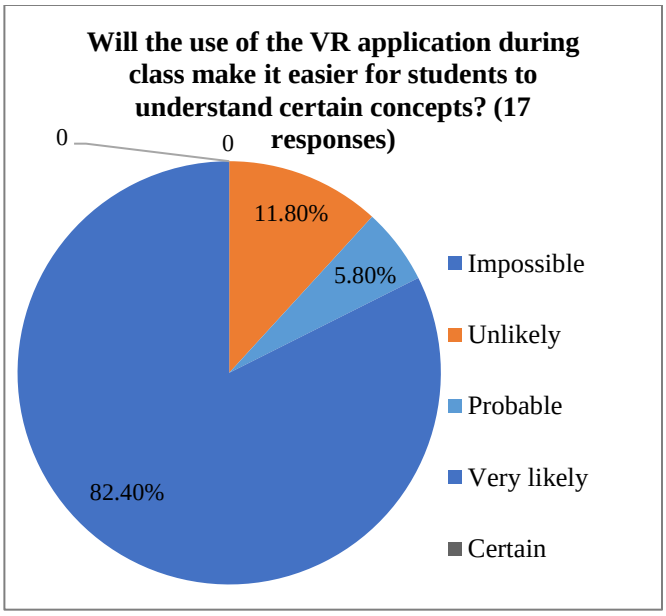

Fig. 15 Statistics of question N°02 of the second survey

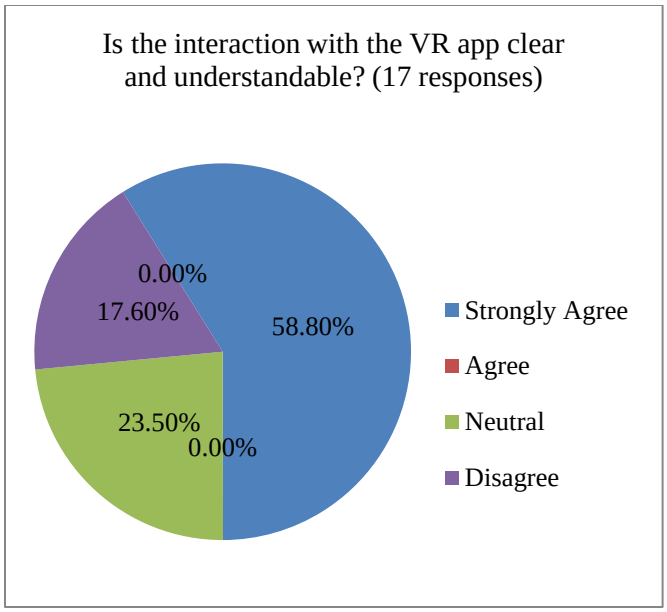

Fig. 16 Statistics of question N°06 of the second survey

Figure15 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students believe it is very likely that the use of the VR application during class will make it easier for them to understand the material.

Figure 16 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree that the VR interaction is clear and understandable.

Figure 17 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students enjoyed Virtual Reality in Education.

Figure 18 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree that the use of the Virtual Reality application makes the class more interesting.

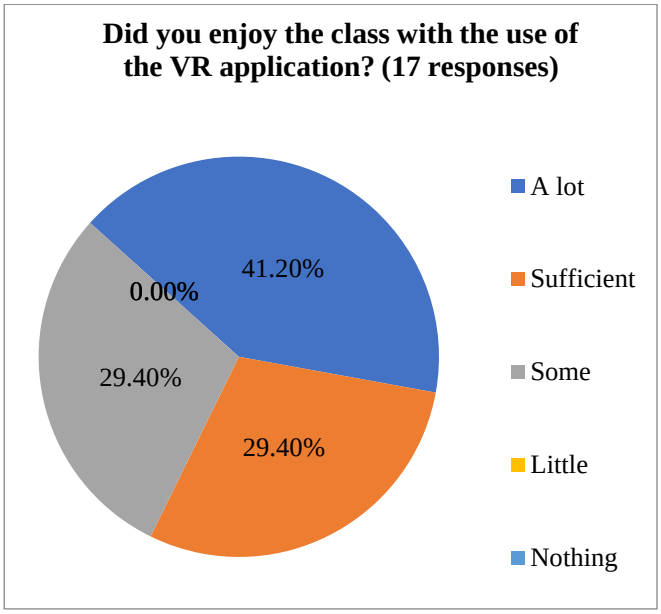

Fig. 17 Statistics of question N°08 of the second survey

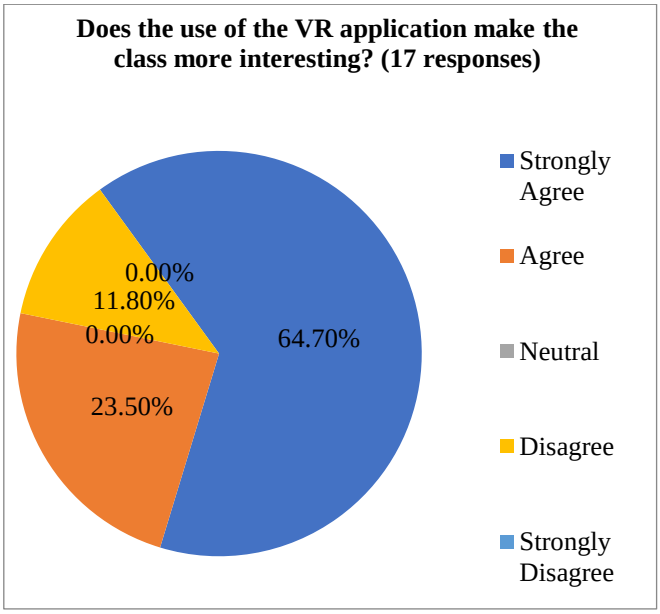

Fig. 18 Statistics of question N°10 of the second survey

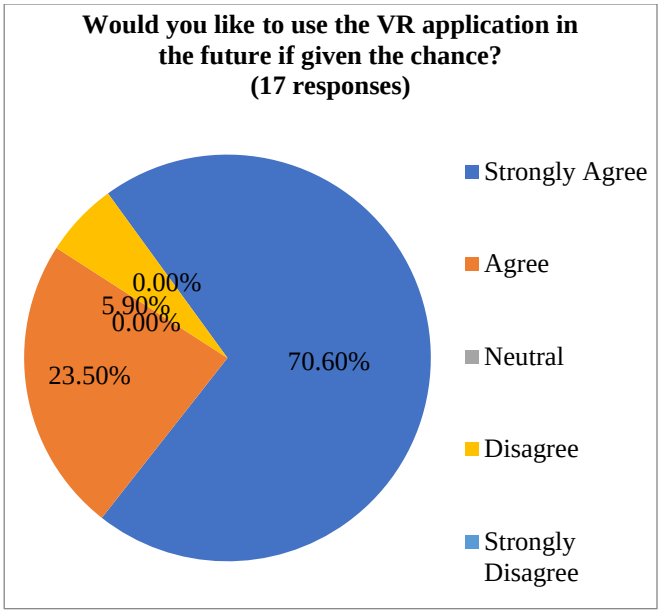

Fig. 19 Statistics of question N°13 of the second survey

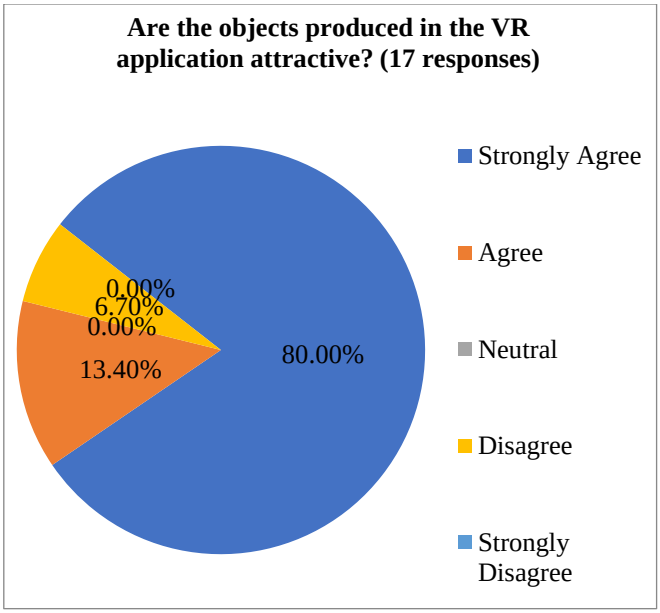

Fig. 20 Statistics of question N°19 of the second survey

Figure 19 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree that they would like to use the Virtual Reality application in the future if given the chance. Figure 20 shows that out of the 17 students surveyed at the secondary level of the Franz Tamayo Solares 3096 school, the data indicates that the highest percentage of students fully agree that the objects produced in the Virtual Reality application are attractive.

5. Discussions

In this research work, it was necessary to conduct a series of surveys with teachers to gather their perspectives on "Virtual Reality in Education," as suggested by the thesis of [12]. It is believed that teacher participation is also crucial for our research study. Therefore, a survey should be created for both students and teachers. Moreover, our research work stands out compared to other works of [13], [14] in the creation of the survey, the number of respondents, and the representation of results in statistical data. The questionnaire uses a Likert scale to measure the degree of student satisfaction. Likewise, the next future step to enhance the research work is to turn our proposal into reality by implementing a functional Virtual Reality application focused on education. This involves adopting and using VR as a didactic resource for the education sector, as it is a tool that contributes to the visual abstraction of content alongside theoretical learning.

6. Conclusion

It was determined that Virtual Reality in Education meets the requirements to be used as a didactic resource, as it has the following objectives: to motivate, awaken, and maintain interest, provide information, guide student learning, assess knowledge and skills, and offer simulations that provide spaces for observation, exploration, and experimentation. Mozilla Hubs was used as a didactic resource, complemented with videos related to the subject matter, and concluded with surveys to measure the degree of satisfaction among the secondary-level students of the Franz Tamayo Solares 3096 school. The results were positive, concluding that all students agree that this resource contributes as an introductory tool in the education sector. Additionally, a considerable percentage considers that Virtual Reality is an innovative tool that motivates and promotes deeper inquiry into the topics discussed in class. Virtual Reality was applied for teaching adolescents (10-19 years of age) in Peru, and it was observed that the students responded positively. This approach allowed a new way of learning for students and provided teachers with a novel method of instruction.

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