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Assessment of Virtual Reality as a Pedagogical Tool using ARCS and TAM in a Latin American context

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ABSTRACT Virtual reality (VR) tools represent current interactive computerized tools for simulating scenarios. Applying VR can provide immersive simulations by facilitating hands-on exploration and analysis, fostering a deeper understanding of complex phenomena. VR can also permit the development of competencies in different contexts, such as in education. This article investigates the potential of VR as an educational tool at two educational levels in Chile: high school and university students. Given the positive experience results, this article aims to generalize in academic contexts about how the implementation of VR can support learning in the academic field and analyze the associated benefits and challenges. The experimental study was carried out with groups of students from the two educational levels, applying a standard instrumental model to identify VR's advantages and limitations concerning improving students learning, participation, and motivation to continue learning with similar experiences. We highlight that the obtained results provided valuable information for understanding the impact of VR in education and offering recommendations for its effective implementation in educational environments. The primary limitation of this study is the existing hardware limitations that prevent this experience from being repeated in other academic contexts. However, technology has reduced costs and is more accessible than before. Concerning the students' experience, they expressed their satisfaction and motivation regarding experiencing VR and related learnings. Hence, without a doubt, VR represents a transformative tool in education.

INDEX TERMS Virtual Reality, VR, ARCS mode, motivation, high school, university.

I. INTRODUCTION

One important and persistent challenges in the learning and education process is the lack of motivation and attention of students [1]. This issue significantly affects students' academic performance and personal development. The lack of motivation and attention can result in low achievement, disinterest in school subjects, low self-esteem, and difficulties in retaining knowledge [2]. Moreover, that issue can significantly affect school dropout rates. Addressing the lack of motivation and cultivating a motivating educational environment can prevent dropout and promote students' academic and personal success [3], [4].

The COVID-19 pandemic greatly exacerbated challenges in education [5]. The impact of the pandemic on motivation

and academic performance was extensive and diverse. The sudden change to distance education, the lack of social interaction and the widespread uncertainty have negatively affected the motivation of many students [6]. Studies conducted in countries such as Denmark have revealed a concerning decrease in student motivation in recent years [7].

A. PROBLEM STATEMENT, GOAL, AND CONTRIBUTIONS

Traditional teaching methods are often boring and uninspiring, with evidence suggesting limitations in concentration and learning effectiveness [8]–[10]. As [11], [12] remark, the implementation of virtual reality in the educational process can significantly improve the concentration of students. Stu-

dents who participate in virtual reality classes show greater concentration than in traditional classes [13]. Furthermore, virtual reality can positively impact learning effectiveness and persistence [14].

In this context, the implementation of Virtual Reality (VR) emerges as a relevant and promising tool to complement traditional teaching methods. It has become an innovative technology offering immersive and interactive virtual experiences through visualization devices and motion sensors such as glasses, headphones, or special helmets [15], [16]. Thus, this technology is present in various fields such as entertainment, design, medicine, industry, and education.

According to market projections, there will be a significant increase in VR headset sales in 2025 [17]. In addition, considerable growth is expected in the global market for extended reality (XR) technologies in the coming years [18]. Recent studies have shown that the VR market has experienced significant growth, projecting an estimated value [19], [20].

Virtual reality has become an essential tool for transforming education by creating immersive environments that enhance the practical application of theory and promote deeper learning in the context of the challenges of the 21st century [5]. However, the impact of VR on education is not yet fully understood, particularly in terms of competency development, which limits its strategic implementation and hinders informed decisions on resources, curriculum, and teacher training [6]. Based on the above, VR emerges as a relevant and promising proposition. Its ability to generate immersive and stimulating experiences can revitalize student interest and motivation and improve student performance [21], [22]. Although these findings support the idea that virtual reality can be a valuable complementary tool to enrich the educational process, it is essential to further explore the potential of VR in education, analyzing its benefits and considering the obstacles and limitations that may arise in its effective implementation. Hence, the general objective of this article is to evaluate attention, relevance, confidence, and satisfaction (ARCS) in adopting VR technologies in educational environments. The following operational objectives are proposed to fulfill this general objective.

- First, we propose a Virtual Reality (VR) experience for high school and university students.
- Second, apply this experience as a workshop during university major promotion events (ExpoUCN).
- Third, once the experience has been applied, the students must respond to a brief survey to analyze their responses using a standard model and evaluate their satisfaction with applying this technology in their education.
- Finally, based on the results, benefits, challenges, and recommendations for implementing VR in classrooms will be proposed.

B. THREATS TO VALIDITY

This article considers the following threats that could distort the expected results.

- *Selection Bias.* Study participants are those who were interested in being part of the study; therefore, they are not randomly selected and may not be representative of the wide population of students.
- *Hawthorne Effect.* The Hawthorne effect occurs when participants modify their behavior because they are aware of being observed. In the context of a study on VR in education, students might change the way they engage with the VR system or the educational material simply because they know that they are part of an experiment.
- *Maturation.* Changes occur in participants over time, regardless of the treatment being studied. If the study is conducted many times or over a long period, the students can naturally improve in learning, participation, or motivation due to their own personal development or experiences. This improvement could be incorrectly attributed to the VR intervention rather than other factors.

By addressing these threats through careful study design, data collection methods, and statistical analysis, researchers can enhance the validity of their findings and ensure that the results accurately reflect the impact of VR as an educational tool. In this study, we used the ARCS model to assess the motivational effects of Virtual Reality (VR) in academic settings. Recognizing that the ARCS model was developed several decades ago, we complement this framework with insights from recent advancements in UX design and modern pedagogical theories. These contemporary approaches, such as user-centered design and adaptive learning strategies, not only support but also enhance the ARCS model, ensuring a comprehensive evaluation of student engagement and learning outcomes through the integration of VR technology.

This article is structured as follows. It begins with a literature review discussing the history of Virtual Reality (VR), its application in education, and some of the models used in previous research, such as the ARCS (Attention, Relevance, Confidence, and Satisfaction) model and the TAM (Technology Acceptance Model). It continues with the theoretical framework that underpins the research and hypotheses on how variables from both models are related. Subsequently, the methodology is detailed, establishing the study's objectives and describing the approach adopted to conduct the research. The selected population and sample are specified, and the measurement scales used to evaluate the variables of interest, in this case, are the well-known Likert scale. The data collection procedure is presented, which includes participant preparation, virtual reality (VR) experience using the Sites in VR application, and the application of questionnaires based on the ARCS and TAM models to be analyzed and determine relevant aspects regarding the potential implementation of virtual reality (VR) technology in the learning process.

II. BACKGROUND

A. VIRTUAL REALITY

In the context of this study, it is essential to understand the critical concepts related to virtual reality. According to [23], “reality” is the real and effective existence of something, while “virtual” refers to something that has apparent and not real existence. Etymologically, the word “reality” comes from Latin “realitas” derived from “res”, which means “thing” or “entity” [24]. Meanwhile, the term “virtual” originates from the Latin “virtus”, which translates as “power” or “virtue” [25]. Thus, “virtual” refers to the ability to simulate or represent something with characteristics similar to those of reality. Therefore, the term “virtual reality” gains coherence when described as a technology that generates virtual environments, either simulating existing reality or creating fictional worlds. However, it is possible to find different meanings depending on the branch in which VR is applied. Some authors, such as Green and Halliday [26], mentioned that VR is a simulation of a three-dimensional environment generated by computers in which the user can both view and manipulate the contents of that environment”. There are also articles that define it as a technology that generates a simulated immersive environment, allowing users to navigate and control their behavior [27].

In the literature on VR, three key characteristics of the VR user experience are identified: immersion, presence, and cybersickness. Slater and Wilbur [28], conceptualize immersion as the objective capabilities of a system to deliver an inclusive, extensive, surrounding, and vivid illusion of reality. Presence is described as a psychological state in which individuals perceive themselves as being in a place within a virtual environment. Expanding on this, Slater [29] offered a more granular differentiation by introducing place illusion (PI), which denotes the compelling sense of physically ‘being there’ in virtual spaces, even with the explicit awareness of the artificial nature of the environment. In addition, he introduced the concept of plausibility illusion (Psi), which pertains to the illusion that events unfolding within the virtual environment are genuinely occurring, despite conscious knowledge to the contrary. Tang (2020), as well as studies by Ali Raza et al. [30] and Lønne et al. [31], demonstrate that increased levels of immersion in VR environments significantly enhance the user’s sense of presence. The third characteristic is cybersickness, characterized by symptoms like nausea, dizziness, headaches, and eye fatigue [32]. It is caused by factors such as visual-vestibular mismatch, device latency, and VR design [32]. The relationship between immersion and cybersickness is complex, with mixed results in the literature. Most studies indicate a significant negative correlation between presence and cybersickness, although some exceptions, such as Servotte et al. [33], did not find a significant relationship. Although immersion can enhance the sense of presence, it may also increase cybersickness due to sensory conflicts, especially when visual cues in the virtual environment do not align with the user’s physical sensations [34].

Virtual reality has gained popularity in education and is defined as a tool to improve student-centered learning and collaboration [35]. In addition, it is highlighted that virtual reality favors interaction and the construction of knowledge, facilitating the acquisition of critical thinking skills and experiential learning [36]. VR has been used in architecture to enhance the learning experience and visualize abstract concepts, demonstrating advantages in structural understanding and analysis [37]. In general, VR in education offers benefits such as increased motivation, efficiency in the learning process, and the creation of personalized and immersive environments [38], [39].

The use of virtual reality to promote teaching processes in educational settings falls within the scope of Learning and Knowledge Technologies (LKT). These technologies are characterized by their didactic approach, unlike the mere use of devices without clear educational purpose [40]. In this way, it is the educational use of the tool that enhances aspects such as attention, the sense of learning, motivation, and satisfaction with the learning experience, which are crucial elements in promoting meaningful learning. In summary, VR is a technology that uses computer systems to create simulated, immersive and interactive environments, with the aim of providing a sensory and perceptual experience similar to reality by combining visual, auditory and tactile elements to create a feeling of presence and transport users to digital environments that can recreate existing reality and completely imaginary worlds. This is possible through devices such as VR headsets and motion controllers. As [11] describes, VR technology has applications in various fields, including the entertainment industry, architecture, and, of course, highlighting its participation in education as a facilitator of learning and interaction.

B. MODELS USED IN RESEARCH ON VR IN EDUCATION

The use of Virtual Reality (VR) in educational settings can be effectively analyzed through various frameworks, with the Technological Pedagogical Content Knowledge (TPACK) framework being one of the most prominent. TPACK ensures that technology, such as VR, is meaningfully integrated with pedagogy and content, rather than being used in isolation [41]. Additionally, VR is often linked to Constructivist Learning Theory, which emphasizes learning through active participation and exploration [42]. VR also aligns with Experiential Learning Theory, as it immerses students in simulations where they can directly engage with content [39]. In this study, we employ the ARCS model (Attention, Relevance, Confidence, and Satisfaction), which is particularly well-suited for VR research in educational contexts due to its emphasis on enhancing learning motivation.

1) ARCS Model (Attention, Relevance, Confidence, and Satisfaction)

The ARCS model aims to design effective strategies to encourage students’ motivation and commitment to learning [43], [44]. It was developed by John Keller in the 1980s, who,



FIGURE 1: ARCS model.

after a review of motivational literature and a subsequent grouping of motivational concepts based on shared attributes, discovered that these could be classified into four categories: attention, relevance, trust and satisfaction [45], [46]. These categories influence the motivation to learn and are defined as follows [45].

- **Attention:** It is the ability to capture and maintain student interest. Attention can be achieved through stimuli that activate curiosity, either using reflective or unexpected points of interest, such as challenging or problematic; variability must be incorporated to avoid monotony and, thus, losing attention.
- **Relevance:** It is what the student perceives as necessary to satisfy his or her needs and desires or to fulfill personal goals in the future. Relevance can be achieved with guidance and setting of various objectives. It is also possible to achieve relevance by providing various learning environments since if the student is in an environment that generates positivity, they will feel greater relevance. Finally, it is important to incorporate familiarity because students tend to be more interested in content related to previous experiences and interests.
- **Confidence:** Help students feel capable of successful learning. It is important to let them know what is expected of them to succeed in challenging tasks and maintain personal control over their ability to succeed and the subsequent results.
- **Satisfaction:** Students experience gratification and joy, leading to constant motivation. Such satisfaction can come from a natural consequence of success, positive consequences such as recognition, incentives, and equity. The latter is substantial because if a student perceives his result as less important than another, he will feel disappointed, and negative emotions will arise.

As Figure 1 [45] shows, if students succeed in these lateral categories, in the center, they will feel motivated to learn, giving way to the last category, satisfaction, which is the feeling of achievement and gratification that the student has and can result from both intrinsic and extrinsic factors. As noted in [47], [48], it is essential to recognize and reward these achievements.

Considering the characteristics of the ARCS model and its variables, it is crucial to examine it in the study to evaluate students' attitudes and determine whether motivation is obtained from implementing virtual reality in learning. Previous studies have shown that ARCS positively influences students' attitudes in certain learning processes, such as STEAM education, where technology is used [49]. In addition, ARCS was also found to have a positive and significant influence on perceived usefulness and ease of use, strengthening student attitudes [50]. Keller [51] has already tested this motivational model in teacher training programs, and based on the results obtained in these tests, it was determined that the ARCS model is useful for instructors and teachers.

Although the ARCS model provides a well-established framework for understanding motivation in educational settings, it is essential to consider how it intersects with recent developments in UX design and pedagogy. Recent studies in UX emphasize user-centered design and iterative feedback loops [52]–[54], which align with the ARCS model's focus on maintaining attention and relevance. Moreover, advances in pedagogical strategies, such as gamification and adaptive learning, further enhance the ARCS framework by increasing student engagement and satisfaction in digital learning environments.

2) TAM Model

The TAM (Technology Acceptance Model) model is widely used to understand and explain user acceptance and adoption of technology [55]. It was proposed by Fred Davis in 1985 [56], who stated that the use of technology depended on the mediation between perceived usefulness (PU) and perceived ease of use (PEOU). These variables simultaneously influence the attitude towards use, the intention to use, and actual use of the technology [57]. Figure 2 [58] illustrates the main TAM model components and their relationship. The next lines describe those variables.

- **Perceived Utility (PU)** refers to the user's belief that technology will improve performance. Also, it refers to the degree to which the individual, in this case, the student, perceives that this tool can increase their effectiveness when carrying out a task.
- **Perceived Ease of Use (PEOU)** refers to the user's belief that the technology is easy to use and does not require excessive effort; the greater the perception of ease of use, the more likely the user will accept and adopt the technology.
- **Attitude Towards Use** comes from the positive or negative feeling generated by the use, in this case, of technology.
- **Intent to Use** represents the extent to which a user intends to use the technology in the future, where a period is expected according to the importance of deciding to use it.

As [59] describes, the TAM model is based on the Theory of Reasoned Action (TAR), which seeks to measure the

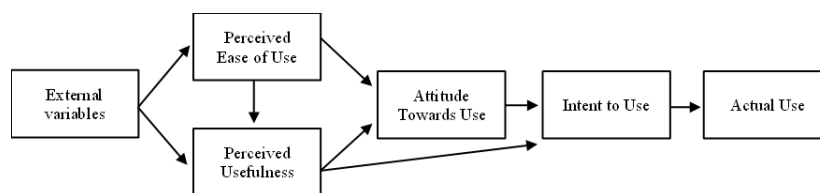


FIGURE 2: TAM model.

factors that determine human behavior as a predictor of behavior toward an object or situation. It is based on the assumption that people are rational beings, where through this, they perform actions or conduct behaviors according to the information available analyzing behavioral intentions rather than attitudes [60]. Davis [56] states that perceived ease of use has a causal effect on perceived usefulness, that these two variables simultaneously influence the attitude toward use, and that only perceived usefulness affects the intention to use. Wu, Liu, and Huang [50], in their research on STEAM education, sought to explore the relationship between perceived usefulness and perceived ease of use with the attitude towards use and intention to use, where the result was that These were related in a positive and significant way.

In research carried out in an institute in China, the variables of the TAM model were studied in a cognitive system using VR as the main tool for teaching ancient Chinese architecture [61]. That study concluded that implementing Virtual Reality benefits learning, describing it as a useful and practical tool that facilitates student learning.

Although the TAM model represents a standard to measure and evaluate the impact of technological items, the ARCS model provides a robust framework for evaluating the motivational effect of technology by considering multiple dimensions of user experience and perception in a structured and customizable manner [44]. This research applied the ARCS model to determine the motivational impact of VR technology on high school and university students' experiences, learning, applications, and future competencies.

III. METHODOLOGY AND RESEARCH DESIGN

A. METHODOLOGY

In this study, an experimental methodology is used based on implementing VR in the educational field, teaching a workshop for students belonging to the sample determined for this research. Two theoretical models will be used to analyze this tool's impact: the ARCS and TAM models. These models will provide a solid basis for evaluating student motivation and their acceptance of VR as an educational tool.

B. POPULATION AND SAMPLE

In Chile, by 2023, 1,341,439 enrollments in higher education will be reached, covering undergraduate, postgraduate, and postgraduate programs. Of this total, undergraduate enrollments represent 1,249,401 students aged between 15 and 40 years or older, with 667,136 women, 582,263 men,

and 2 non-binary genders. If we focus on the Antofagasta region, the number of undergraduate students enrolled for 2023 reached 36,705 students [62]. Table 1 summarizes the number and percentage of students in higher education in Chile.

TABLE 1: Students enrolled in higher education

Level of education	Number	Percentage
Undergraduate	1,249,401	93.1%
Postgraduate	52,312	3.9%
Posttitle	39,726	3.0%
Total	1,341,439	100.0%

Based on the data provided by [62] and [63], the target population was considered to be high school Chilean students who are in their third and fourth year since they are the main guests at the VR workshop that was carried out at the Catholic University of the North, Chile. The main goal of that event was to disseminate university majors. This study also considers undergraduate university students within the age range of 18 to 40 years. A simple random sampling was performed to obtain a representative population sample.

Table 2 provides a detailed view of the 53 participants surveyed, segmented by various categories. First of all, we have gender, where 54.7% are men, 43.4% women, and a small percentage (1.9%) prefer not to reveal their gender. The respondents' ages ranged from 16 to 29, with an average of 20. It is highlighted that most students are between 16 and 24 years old, with the group being 16 years the most represented, with 20.8%. Concerning education, most participants were studying high school education, with a significant presence in high school third and fourth year, with 34% and 22.6% respectively. Regarding university majors, Commercial Engineering leads with 24.5%. The general distribution of the educational level reflects that 56.6% of the students were studying secondary education, while 43.4% were pursuing a university degree. All respondents are familiar with VR glasses, and the vast majority (92.5%) have had experience using these devices. Regarding ownership, 84.9% do not own VR glasses at home. Regarding use, a diversity of contexts is observed, from entertainment to educational purposes, with entertainment and video games are the most common applications, with a total of approximately 75.4%.

C. MEASURING SCALES

The Likert scale, named after its creator, Rensis Likert, is a psychometric scale used to prepare questionnaires in various investigations. It is one of the most used measurement methods for measuring attitudes since it allows them to be

TABLE 2: Students enrolled in higher education (I)

Item	Option	Count	Percentage
Sex	Man	29	54.7
	Women	23	43.4
	I prefer not to say	1	1.9
	Total	53	100.0
Age	16	11	20.8
	17	9	17.0
	18	10	18.9
	19	1	1.9
	22	4	7.5
	23	7	13.2
	24	4	7.5
	25	2	3.8
	26	2	3.8
	28	2	3.8
	29	1	1.9
	Total	53	100.0
Education	Architecture	3	5.7
	Law	1	1.9
	Nursing	1	1.9
	Civil Engineering in Mines	1	1.9
	Industrial Civil Engineering	2	3.8
	Commercial Engineering	13	24.5
	Information Engineering and Management Control	2	3.8
	High School – 3rd Year	18	34.0
	High School – 4th Year	12	22.6
	Total	53	100.0
Educational level	University Major	23	43.4
	High School	30	56.6
	Total	53	100.0
Do you know VR glasses?	Yeah	53	100.0
	Total	53	100.0
Have you used VR glasses?	4	7.5	
	Yeah	49	92.5
	Total	53	100.0
In what context have you used it?	Has not used it	4	7.5
	Entertainment	21	39.6
	Entertainment / Educational Purposes	1	1.9
	Entertainment / Play Video Games	4	7.5
	Workshop / Fair	2	3.8
	Educational Purposes	4	7.5
	Work Purposes	1	1.9
	Playing Video Games	15	28.3
	Play Video Games / Educational purposes	1	1.9
	Total	53	100.0
Do you have VR glasses at home?	No	45	84.9
	Yeah	8	15.1
	Total	53	100.0

TABLE 3: Questionnaire based on the ARCS model(I)

ARCS Categories	Questions
Attention	I found the experience of exploring virtual environments attractive and exciting.
	Exploring virtual environments captured my attention and increased my concentration.
	The visual and auditory elements of the virtual environment kept my attention at all times.
Relevance	The experience of visiting virtual environments using VR allowed me to connect with topics that interest me personally.
	The virtual environments explored offered relevant and enriching information about the places and cultures represented.
	The ability to visit real places through VR made the experience relevant and meaningful to me.
Confidence	The instructions on using virtual reality made me feel confident in my ability to explore virtual places.
	I felt safe and comfortable using virtual reality during the experience. Experience using VR helped me develop confidence in adapting to new technologies and learning environments.
	Using Virtual Reality increases my confidence and security that I can obtain good results at the end of the learning process.
Satisfaction	Exploring virtual environments improves my learning ability and gives me a feeling of satisfaction.
	The experience in virtual environments exceeded my expectations and left me with a feeling of satisfaction.
	I received positive feedback and recognition during the experience in virtual environments, which contributed to my satisfaction.
Motivation	If teachers implemented Virtual Reality in the learning process, my commitment and motivation to study would increase.
	I am willing to use Virtual Reality if the teacher implements this technology in future learning activities
	I would actively participate in the learning process if the teacher implements Virtual Reality in the classrooms

TABLE 4: Questionnaire based on the TAM model

TAM Categories	Questions
Perceived ease of use	I quickly learned to use the Virtual Reality glasses in the experience.
	I think it would be easy for me to use virtual reality in future classes.
	The Virtual Reality interface is intuitive and easy to interact with. In general, I find VR devices to be easy to use.
Perceived usefulness	Virtual reality can improve my academic performance.
	Virtual reality can be a useful tool to improve learning. Virtual reality is an effective tool for practice and application of knowledge.
	I consider that Virtual Reality can be useful in teaching.
Attitude toward the use	I have enjoyed using Virtual Reality as a learning method. I feel greater enthusiasm and motivation if Virtual Reality is used as a teaching method.
	It would be curious and fascinating to use virtual reality as a learning method.
	Virtual reality is a viable and preferable option for my learning. I would like to have the opportunity to use virtual reality in my classes.
Intention to use	I would continue to use Virtual Reality in the future as a learning method if it is applied in the classroom by teachers.

quantified, thus facilitating the analysis and interpretation of the data collected [64]. The Likert scale uses an ordinal level of measurement, given that, in the items presented, the alternatives range from the most unfavorable to the most favorable, making it one of the simplest to respond to [65]. The Likert scale has been selected as the measurement scale for the questionnaire applied in this article due to its wide use in measuring attitudes and its ability to provide quantitative data relevant to the research objectives set out in the TAM and ARCS models. This study uses a five-grade scale, with 1 “Totally disagree”, 2 “Disagree”, 3 “Neutral”, 4 “Agree” and 5 “Totally agree”.

Table 3 presents the questionnaire delivered to the students who participated in the experience for variables of the ARCS model. Through this, students’ perceptions about the implementation of VR in the learning process will be known, as well as how it influences the different categories (Attention, Relevance, Confidence, and Satisfaction) and motivation to learn through VR. Table 4 shows the questionnaire providing information about students’ perceptions based on the four categories of TAM model.

D. WORKSHOP DESCRIPTION

The workshop “We Learn What We Live” immersed deeply in VR’s educational possibilities. This initiative was developed with enthusiasm and dedication on October 17, 18, and 19, 2023, at the Catholic University of Noth, Antofagasta, Chile. Subsequently, it was extended in subsequent weeks with additional scheduled sessions, approximately two workshops per week, adjusting to the demand for registrations. 53 students participated during these sessions, guided through an educational journey using virtual reality glasses to explore places such as Machu Picchu and the Great Wall of China. This hands-on approach allowed for the collection of valuable data for our research and provided participants with a unique and unforgettable educational experience. This workshop considered both theory and practice, providing a deeper understanding of the implementation of virtual reality in the academic field.

In this study, we used Google Cardboard, an affordable and accessible virtual reality (VR) headset widely implemented in educational settings. Google Cardboard allows users to experience virtual reality content using a simple and inexpensive cardboard headset and their smartphones [1]. Google Cardboard VR headsets cost only a few dollars and work with most smartphones, enabling mobile virtual reality to enter the everyday realm [2]. Cardboard glasses are made of cardboard and focal length lenses. Regarding the application, the Nearpod platform was originally designed for teachers [66], which allows the creation of interactive presentations that incorporate places to visit virtually and that are compatible with Virtual Reality technology; it also provides feedback to the creator of the presentation. In summary, the “We Learn What We Live” workshop pursues disseminating information about historical places and focuses on exploring how Virtual Reality can enrich learning through immersive experiences. During the experience, students used their smartphones. This was possible due to the rapid advancement of mobile devices in recent years, featuring larger screens and higher resolutions [3]. User experiences are a combined function of screen size, content resolution, and viewing distance [4]. Previous studies show that increases in resolution beyond a specific limit are not noticeable and, therefore, have little impact on the user experience [3]. Its interactive and educational approach makes it a valuable tool for evaluating the perception and acceptance of Virtual Reality technology in the educational environment, a crucial aspect that will be analyzed in depth in this research.

E. DETAILED DESCRIPTION OF THE WORKSHOP

The procedure used in this research is broken down into several stages to determine the execution of the VR experience and maintain organization in the research. Table 5 describes each stage.

IV. DATA ANALYSIS & RESULTS

A. LEARNING OUTCOMES

As mentioned above, the Nearpod platform was used to carry out the workshop “We learn what we live”. This allowed the creation of lessons in slide format where it was possible to insert interactive images, specifically the virtual Field Trip (virtual field trip), which allowed one to visit various places in the world through Virtual Reality. This platform, in turn, allows the creation of questionnaires, games, and debates for students during or after lessons, providing more information about the learning that students obtain in them. Considering all the tools that Nearpod has, a small questionnaire was carried out to the students who participated in the Virtual Reality experience to measure the learning they obtained after visiting the virtual spaces and providing them with relevant information about them. The questionnaire (Table 6) comprises six questions in total; 3 of them are related to Machu Picchu, and the rest to the Great Wall of China.

Table 7 specifies the students’ scores after completing the experience. It must be taken into consideration that the mini-

TABLE 5: Stages of the VR experience

Stage	Description
Introduction to the experience	- A presentation is made of the researchers who teach the workshop and a brief introduction is given to the students about the objective of the study in which they are participating, where simultaneously a consent or informed assent is given, depending on the age of the participant, which They must read in detail and then sign and approve their participation in the workshop and subsequent survey. - Important information is provided about Virtual Reality technology and its applications. - Participants are informed of the name of the application to use, which is Nearpod, explaining how it works. This application will facilitate the experience of visiting the predetermined locations for the workshop. - Cardboards are shown, providing some characteristics and instructions for their use, such as their placement. - Before starting the experience, the students are informed that at the end of the experience, a small questionnaire will be done about the places visited. Likewise, the places they will visit are mentioned, including two emblematic places, Machu Picchu and La Great Wall of China.
Experience	- Students must enter their names and nicknames in the Nearpod application to access the virtual room where the places will be observed. The students will be observed and attended to by the researchers regarding any questions and inconveniences that may arise during the experience. - Students begin the tour in virtual environments, starting on a train trip to Machu Picchu and culminating in the extensive Great Wall of China. - Simultaneously, they will be provided with relevant information about the places they are visiting, including historical data, geographical details, and certain curiosities about them. The above will allow students to better understand the importance and uniqueness of each place since it is not only seeks to provide an immersive experience but also enriches their knowledge about these emblematic sites.
Quiz	- At the end of the experience, a brief questionnaire is carried out to measure the learning that the students obtained during the adventure. - A reward is given to the participant who obtained the highest score in the questionnaire and to the rest of the students for participating in the workshop.
Data collection	- Once the experience and the first questionnaire are finished, the students will be given a printed survey related to the study itself, in this way, the experience will be evaluated using variables based on the ARCS and TAM models, said questionnaire will contain questions/statements specific ones related to the constructs of Attention, Relevance, Trust, Satisfaction, Motivation, Perceived Ease of Use, Perceived Usefulness, Attitude Towards Use and Intention to Use.
Analysis of data	- The data collected during the sessions carried out are entered into an Excel spreadsheet, where they are tabulated and categorized to create a database. - Once the database is created, it is taken to the SPSS software for statistical analysis. This statistical analysis will consider descriptive tables, cross tables, and bar graphs, which will provide more detailed information on the responses of each variable.
Interpretation	- After having obtained all the necessary information from the data provided by the SPSS software and previous literature and research, a descriptive analysis will be carried out. It will be discussed whether the findings support or contradict existing theories and research about implementing VR technology in education. - The benefits and limitations that come with the implementation of VR technology in an educational context will be made known according to this study, which will provide a comprehensive view of the results and their relevance for the educational area.
Conclusions	- Conclusions will be drawn on the most relevant findings of the research and their relevance in the educational context. Recommendations and suggestions will be offered for possible future research or a possible future implementation of this technology in classrooms.

TABLE 6: Questions to measure learning

Quiz Questions
1. What does “Machu Picchu” mean?
2. What was the main purpose of Machu Picchu according to what you have learned?
3. Who built Machu Picchu?
1. What is the approximate length of the Great Wall of China?
2. In what year was The Great Wall of China named one of the 7 wonders of the world?
3. What function did the Great Wall of China serve?

mum score is 1 point. That is, they only got 1 question right, while the maximum score is 1 point. 6 points, successfully answering all questions. The table presents the frequency and percentages of the scores obtained by the students, classifying the data according to their educational level and giving us the total obtained from the general sample. In the first instance, we obtained that the general average is 4 points, where 33.3% of the students answered correctly in 4 of 6 questions (4/6); of this percentage, 19.6% were high school students, and 13.7% were university students. Secondly, we have that 23.5% reached 5 points. That is, they got 5 questions right. Of this percentage, 13.7% of the students belonged to secondary education and 9.8% to higher education. Then, we found equality in percentages between

TABLE 7: Learning outcomes

Item	Punctuation	Frequency	Educational level		Total
			High school	University	
Score	1/6	Count	1	0	1
		%	2.0%	0.0%	2.0%
	2/6	Count	5	0	5
		%	9.8%	0.0%	9.8%
	3/6	Count	2	6	8
		%	3.9%	11.8%	15.7%
	4/6	Count	10	7	17
		%	19.6%	13.7%	33.3%
	5/6	Count	7	5	12
		%	13.7%	9.8%	23.5%
	6/6	Count	3	5	8
		%	5.9%	9.8%	15.7%
	Total	Count	28	23	51
		%	54.9%	45.1%	100.0%

TABLE 8: Results of variable Attention

Construct	Item	Alternatives	Frequency	Educational level		Total
				High school	University	
Attention	I found the experience of exploring virtual environments attractive and exciting.	Disagree	Count	2	0	2
			%	3.8%	0.0%	3.8%
		Neutral	Count	6	0	6
			%	11.3%	0.0%	11.3%
		Agree	Count	9	3	12
			%	17.0%	5.7%	22.7%
		Totally agree	Count	13	20	33
			%	24.5%	37.7%	62.2%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	Exploring virtual environments captured my attention and increased my concentration.	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	3	0	3
			%	5.7%	0.0%	5.7%
		Neutral	Count	7	1	8
			%	13.2%	1.9%	15.1%
		Agree	Count	13	8	21
			%	24.5%	15.1%	39.6%
		Totally agree	Count	6	14	20
			%	11.3%	26.4%	37.7%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	The visual and auditory elements of the virtual environment kept my attention at all times.	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	2	0	2
			%	3.8%	0.0%	3.8%
		Neutral	Count	7	1	8
			%	13.2%	1.9%	15.1%
		Agree	Count	14	7	21
			%	26.4%	13.2%	39.6%
		Totally agree	Count	6	15	21
			%	11.3%	28.3%	39.6%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%

the students who obtained 3 and 6 points, with 15.7% of students in both cases. Subsequently, we have 9.8% and 2% of students who obtained a score of 2 and 1, respectively, coming only from high school students.

B. ARCS RESULTS

The next lines describe the ARCS results.

- Attention construct.** In the first item of Table 8, “I found the experience exploring virtual environments attractive and exciting,” 24.5% of high school students and 37.7% of higher education students said they completely agreed with the statement. On the other hand, 22.7% expressed agreement, 11.3% experienced neutrality, and only 3.8% disagreed. In the second item, “The exploration of virtual environments captured my attention and increased my concentration,” a more equitable distribution was observed between the positive statements: 37.7% said they totally agreed, 39.6% agreed, 15.1% neutral, 5.7% disagreed and only 1.9% totally disagree. Regarding the third item, “The visual and auditory elements of the virtual environment kept my attention at all times,” there is a symmetry of percentages in the “Agree” and “Totally agree” options, with 39.6% in both. However, in the “Agree” alternative, there is a higher percentage of high school students, with 26.4%, while in the “Totally agree” option, the percentage of university students is higher, with 28.3%.
- Relevance construct.** Table 9 presents the variables belonging to the Relevance dimension, revealing the percentages obtained in the alternatives of each item, focusing mainly on those that achieved the highest percentage of responses. In the first item, “The experience visiting virtual environments using VR allowed me to connect with topics that interest me personally,” a diversity of responses is observed. Regarding the percentages, 39.6% expressed agreement with the previous statement, of which 24.5% were high school students and 15.1% were university students. On the other hand, 30.2% said they totally agreed, where 5.7% were high school students and 24.5% were university students. Finally, 24.5% expressed neutrality, of which 20.7% were high school students, and 3.8% were higher education students. In the second item, “The virtual environments explored offered relevant and enriching information about the places and cultures represented,” the majority of students expressed agree or totally agree with the statement, obtaining 26.4% and 60.4% respectively. Regarding the “Agree” option, 22.6% were from high school students and 3.8% from university students, while in the “totally agree” option, 20.8% were from high school students and 39.6% were from university students. For the third item, “The possibility of visiting real places through VR made the experience relevant and meaningful to me,” the positive options reached a higher percentage of responses, where 50.9% of respondents stated that they completely agreed. agree with the statement, of this percentage being 37.7% university students. Then the “Agree” option continues, which reached 32.1% of responses, where 26.4% of said percentage were high school students.

- *Confidence construct.* Table 10 details the results of this construct. In the first item of Table 10, "The instructions given about the use of virtual reality made me feel confident in my ability to explore virtual places," a significant majority is observed in favor of the previous statement, where 32.1% said they agreed and 50.9% totally agreed. Of the 32.1% who said they agreed, 18.9% belonged to secondary education and 13.2% to higher education, while of the 50.9% who expressed total agreement, 20.7% belonged to secondary education and 30.2% were university students. The alternatives "Totally disagree," "Disagree," and "Neutral" obtained a lower percentage of responses, being only from students on average. In the second item of Table 10, "I felt safe and comfortable using virtual reality during the experience," again the responses are mainly concentrated in the alternative "totally agree," with 58.5% of this percentage, 26.4% are high school students, and 32.1% are university students. As for the rest of the alternatives, "Agree" obtained 20.8% and "Neutral" 15.1%, while a minimum percentage said they disagreed or totally disagreed. For the third item of Table 10, "Experience using VR helped me develop confidence in my ability to adapt to new technologies and learning environments," 49.1% stated that they completely agree; of this percentage, 18.9% are high school students, and 30.2% are university students. Then we have that in the "Neutral" and "Agree" options, 17% and 32.1% were obtained, respectively. In the fourth item of Table 10, "Using Virtual Reality increases my confidence and security that I can obtain good results at the end of the learning process," the responses were mostly concentrated in the "Agree" option, with 41.5%, being this percentage 26.4% high school students and 15.1% higher education students. Then we have the alternatives "Neutral" and "Totally agree" with 15.1% and 35.8%, respectively.
- *Satisfaction construct.* The Satisfaction dimension is made up of three variables, and each of them has 5 response alternatives. In the first item in Table 11, "Exploring virtual environments improves my learning capacity and gives me a feeling of satisfaction," a greater percentage of people agree and totally agree with the statement proposed. The "Neutral" option obtained 15.1%; of this percentage, 13.2% were high school students, and 1.9% were university students. On the other hand, the alternative "Agree" reached 34%, where 20.8% belonged to high school students and 13.2% to university students. Finally, 49.1% leaned toward the "Totally agree" option, where 20.8% were high school students and 28.3% were university students. In the second item, "The experience in virtual environments exceeded my expectations and left me with a feeling of satisfaction," there is a higher percentage of responses in the "Agree" and "Totally agree" options; that is, 26.4% of the students agreed with the statement, with 18.9% being average students and 7.5% university students.

Then we have that 56.6% totally agreed, where 24.5% were high school students, and 32.1% were higher education students. As for the alternatives "Neutral," "Disagree," and "Totally disagree," these reached 13.2%, 1.9%, and 1.9%, respectively. In the third and last item, "I received positive feedback and recognition during the experience in virtual environments, which contributed to my satisfaction," 52.9% said they totally agreed, where 18.9% were high school students and 34% university students. Then we have 24.5% in the "Agree" option, where 18.9% were high school students, and 5.6% were higher education students. Meanwhile, the alternatives "Neutral" and "Totally disagree" obtained a total of 18.9% and 3.8%, respectively.

- *Motivation construct.* The Motivation construct (Table 12) was created to overview the students' perceptions based on the ARCS model. In addition, the variables are established considering the role of teachers since they are a fundamental part of implementing teaching strategies using VR technology. In the first item, "If teachers implemented Virtual Reality in the learning process, it would increase my commitment and motivation to study," the alternative "Totally agree" obtained the highest percentage (58.5%). Of the latter, 26.4% were high school students, and 32.1% were university students. Then we are followed by the "Agree" option, which obtained 24.5%, of which 15.1% were high school students and 9.4% were university students. Regarding the alternatives "Neutral" and "Totally disagree," 15.1% and 1.9% were obtained, respectively, received mainly from high school students. In the second item, "I am willing to use Virtual Reality if the teacher implements this technology in future learning activities," there is a high percentage of students who are willing to use VR, reaching a significant 75.4%, with an equitable distribution of secondary and higher education students. Concerning the alternatives "Agree," "Neutral," and "Disagree," these had a total percentage of 15.1%, 5.7%, and 3.8%, respectively, obtained mainly from high school students. In the last item, "I would actively participate in the learning process if the teacher implements Virtual Reality in the classrooms," a trend for positive responses continues to be reflected, where 60.4% totally agree with the statement, with a percentage balance of students from different educational levels.

Meanwhile, the alternative "Agree" reaches a percentage of 22.6%, maintaining the equitable distribution of middle and higher education students. Then we have "Neutral" and "Disagree" with 15.1% and 1.9% correspondingly. These percentages come mostly from high school students.

V. DISCUSSION

The study's general objective was successfully achieved, where the variables of attention, relevance, confidence, and

TABLE 9: Results of variable Relevance

Construct	Item	Alternatives	Frequency	Educational level		Total
				High school	University	
Relevance	The experience of visiting virtual environments using VR allowed me to connect with topics that interest me personally.	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	2	0	2
			%	3.8%	0.0%	3.8%
		Neutral	Count	11	2	13
			%	20.7%	3.8%	24.5%
		Agree	Count	13	8	21
			%	24.5%	15.1%	39.6%
		Totally agree	Count	3	13	16
			%	5.7%	24.5%	30.2%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	The virtual environments explored offered relevant and enriching information about the places and cultures represented.	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Neutral	Count	6	0	6
			%	11.3%	0.0%	11.3%
		Agree	Count	12	2	14
			%	22.6%	3.8%	26.4%
		Totally agree	Count	11	21	32
			%	20.8%	39.6%	60.4%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	The ability to visit real places through VR made the experience relevant and meaningful to me.	Totally disagree	Count	3	0	3
			%	5.7%	0.0%	5.7%
		Neutral	Count	6	0	6
			%	11.3%	0.0%	11.3%
		Agree	Count	14	3	17
			%	26.4%	5.7%	32.1%
		Totally agree	Count	7	20	27
			%	13.2%	37.7%	50.9%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%

satisfaction in adopting Virtual Reality technology in educational contexts could be evaluated, considering the perceived ease of use, perceived usefulness, attitude towards use, and intention to use. In addition, the ARCS motivational model was generally evaluated, considering the role of teachers. The general objective was achieved by meeting the operational objectives, where a Virtual Reality experience was proposed and successfully applied for third-year, fourth-year, and university students, thus favoring data collection. The main findings are discussed below.

Starting with the ARCS variables, we captured the students' attention during the virtual reality experience, highlighting an especially positive response from the university students. The results align with the theory of the ARCS motivational model, where the importance of generating stimuli that achieve students' interest is raised. These stimuli were achieved by delivering an attractive and exciting experience, with 84.9% approval, capturing the attention and concentration of 77.3% of the total number of students as it is an immersive experience that uses visual and auditory elements, keeping students involved throughout the course of the workshop. This level of attention achieved during the VR experience suggests that implementing this

TABLE 10: Results of variable Confidence

Construct	Item	Alternatives	Frequency	Educational level		Total
				High school	University	
Confidence	The instructions provided on the use of virtual reality made me feel confident in my ability to explore virtual places	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Neutral	Count	7	0	7
			%	13.2%	0.0%	13.2%
		Agree	Count	10	7	17
			%	18.9%	13.2%	32.1%
		Totally agree	Count	11	16	27
			%	20.7%	30.2%	50.9%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	I felt safe and comfortable using virtual reality during the experience	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	2	0	2
			%	3.8%	0.0%	3.8%
		Neutral	Count	6	2	8
			%	11.3%	3.8%	15.1%
		Agree	Count	7	4	11
			%	13.2%	7.5%	20.8%
		Totally agree	Count	14	17	31
			%	26.4%	32.1%	58.5%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	Experience using VR helped me develop confidence in my ability to adapt to new technologies and learning environments.	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Neutral	Count	8	1	9
			%	15.1%	1.9%	17.0%
		Agree	Count	11	6	17
			%	20.8%	11.3%	32.1%
		Totally agree	Count	10	16	26
			%	18.9%	30.2%	49.1%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%
	Using Virtual Reality increases my confidence and security that I can obtain good results at the end of the learning process	Totally disagree	Count	1	0	1
			%	1.9%	0.0%	1.9%
		Disagree	Count	2	1	3
			%	3.8%	1.9%	5.7%
		Neutral	Count	6	2	8
			%	11.3%	3.8%	15.1%
		Agree	Count	14	8	22
			%	26.4%	15.1%	41.5%
		Totally agree	Count	7	12	19
			%	13.2%	22.6%	35.8%
		Total	Count	30	23	53
			%	56.6%	43.4%	100.0%

technology can be effective in educational environments to engage students further and provide an environment conducive to learning. In the second instance, we focus on the Relevance variable, where again positive results are obtained that support that the experience was relevant for the students, confirming what was proposed by Keller, who mentions the importance of generating positivism in learning environments and processes. On this occasion, and adding the percentages obtained in the positive opinions, 69.8% of the students expressed a high connection with topics of

TABLE 11: Results of variable Satisfaction

Construct	Item	Alternatives	Frequency	Educational level		Total
				High School	University	
Satisfaction	Exploring virtual environments improves my learning ability and gives me a feeling of satisfaction	Disagree	Count	1	0	1
			% of the total	1.9%	0.0%	1.9%
		Neutral	Count	7	1	8
			% of the total	13.2%	1.9%	15.1%
		Agree	Count	11	7	18
			% of the total	20.8%	13.2%	34.0%
		Totally agree	Count	11	15	26
			% of the total	20.8%	28.3%	49.1%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%
	The experience in virtual environments exceeded my expectations and left me with a feeling of satisfaction	Totally disagree	Count	1	0	1
			% of the total	1.9%	0.0%	1.9%
		Disagree	Count	1	0	1
			% of the total	1.9%	0.0%	1.9%
		Neutral	Count	5	2	7
			% of the total	9.4%	3.8%	13.2%
		OK	Count	10	4	14
			% of the total	18.9%	7.5%	26.4%
		Totally agree	Count	13	17	30
			% of the total	24.5%	32.1%	56.6%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%
	I received positive feedback and recognition during the experience in virtual environments, which contributed to my satisfaction	Totally disagree	Count	2	0	2
			% of the total	3.8%	0.0%	3.8%
		Neutral	Count	8	2	10
			% of the total	15.1%	3.8%	18.9%
		Agree	Count	10	3	13
			% of the total	18.9%	5.6%	24.5%
		Totally agree	Count	10	18	28
			% of the total	18.9%	34.0%	52.9%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%

TABLE 12: Results of variable Motivation

Construct	Item	Alternatives	Frequency	Educational level		Total
				High school	University	
Motivation	If teachers implemented Virtual Reality in the learning process, my commitment and motivation to study would increase.	Totally disagree	Count	1	0	1
			% of the total	1.9%	0.0%	1.9%
		Neutral	Count	7	1	8
			% of the total	13.2%	1.9%	15.1%
		Agree	Count	8	5	13
			% of the total	15.1%	9.4%	24.5%
		Totally agree	Count	14	17	31
			% of the total	26.4%	32.1%	58.5%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%
	I am willing to use Virtual Reality if the teacher implements this technology in future learning activities	Disagree	Count	2	0	2
			% of the total	3.8%	0.0%	3.8%
		Neutral	Count	2	1	3
			% of the total	3.8%	1.9%	5.7%
		Agree	Count	6	2	8
			% of the total	11.3%	3.8%	15.1%
		Totally agree	Count	20	20	40
			% of the total	37.7%	37.7%	75.4%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%
	I would actively participate in the learning process if the teacher implements Virtual Reality in the classrooms	Disagree	Count	1	0	1
			% of the total	1.9%	0.0%	1.9%
		Neutral	Count	7	1	8
			% of the total	13.2%	1.9%	15.1%
		Agree	Count	6	6	12
			% of the total	11.3%	11.3%	22.6%
		Totally agree	Count	16	16	32
			% of the total	30.2%	30.2%	60.4%
		Total	Count	30	23	53
			% of the total	56.6%	43.4%	100.0%

personal interest. Furthermore, a solid 86.8% perceived the information provided about the places visited as enriching and relevant, while 83% considered that the possibility of exploring real places through VR contributed to making the experience meaningful for them. It is important to highlight that the percentages mentioned are mostly attributable to university students, indicating that the experience may resonate differently depending on the educational level. The above shows that, being an enriching and attractive experience and taking place in a calm and positive environment, students' relevance to these new and innovative learning spaces increases. On the other hand, a high degree of confidence was obtained from the students participating in the experience, given that many expressed feeling confident before, during, and after the experience. This is attributed to the delivery

of precise instructions on the use of platforms and devices, achieving an accumulation of positive opinions that reached 83%. In addition, the above gives security and comfort to the students, with a percentage of positive expressions of 79.2%, which in turn allows the development of greater confidence and adaptability in the face of new technologies and learning environments (81.2%). All the strengthening of confidence translates into a greater ability of students to obtain better results at the end of each educational process, with 41.5% and 38.5% in agreement. The results affirm that trust was consolidated through effective communication, as proposed by Keller [45] in his motivational model; this communication not only provided security and comfort in the use of technological tools and new learning spaces but also promoted students' greater confidence in their abilities to achieve success in any training process. In this sense, the confidence gained by students through learning experiences

will be crucial for the development of Self-Efficacy [67]. This refers to students' beliefs about their ability and the resources available to carry out tasks and achieve goals successfully, both in academic and professional settings. A student with a strong sense of self-efficacy will demonstrate initiative in acquiring academic skills, setting realistic yet challenging goals, and selecting learning strategies appropriate to task demands. This ability to adapt and employ effective strategies is not only beneficial in the academic realm [68], [69], but it is also highly transferable and valuable in professional environments.

Regarding the last variable of the ARCS model, the results indicate that generalized satisfaction and positive perceptions were achieved at both educational levels concerning the consequences generated by this Virtual Reality experience, which is reflected in the sum of the percentage (83.1%) of students who stated that this experience improved their learning capacity and that it also completely exceeded their expectations (83%), favorably increasing the feeling of satisfaction. We must also highlight that providing positive feedback and recognition during and after the experience contributes even more to the above, with 77.4% affirmation.

The above corroborates what was mentioned in the ARCS model, where the achievement of positive results by students during the learning process, with the delivery of incentives and positive feedback, achieves a significant increase in their satisfaction in educational spaces. In conjunction with the above, the findings also support the effectiveness of implementing new technologies in educational environments to generate higher satisfaction levels in both high school and university students. To know more accurately the general motivation obtained after the experience, the "motivation" variable was included, given that ARCS is a motivational model, where teachers were included since they are a fundamental part of implementing strategies that encourage motivation. The results demonstrate significant positivism towards implementing VR technology in the learning process, stating that if this is implemented, it will increase commitment and motivation for the study, with 83% in agreement, in addition to actively participating in the learning processes that use this tool, with 83% approval. In this way, it is confirmed that designing effective strategies, such as implementing Virtual Reality, can capture attention, generate relevance, increase confidence, and increase student satisfaction in learning environments.

Continuing with the findings, we move on to the variables that make up the TAM model, which suggests that users' attitudes and intentions toward technology are mainly influenced by their perceived usefulness and ease of use. These attitudes and intentions, in turn, predict actual usage behavior. The results show that VR was perceived as easy to use by most participants, where a large part of the students (79.2%) learned to use the VR glasses quickly, stating that the tool consisted of intuition, with 77.4% agreeing, so in general, most students perceived the ease of use of VR technology, approving and simplifying its implementation in

future learning processes. This perception supports the idea that ease of use is a key factor in technology acceptance, as the TAM model postulates. The perceived usefulness of VR also received a positive response. 64.7% of the participants consider that this technology can be useful in the teaching process and that they would continue using it in the future as a learning method if it were applied in the classroom by teachers; in addition, 68.6% expressed having enjoyed this technology in the teaching process. These results support the central premise of the TAM model that perceived usefulness is critical in influencing attitude and intention to use. The aforementioned aligns with the guidelines of accessibility and universal design for implementing educational experiences with attention to diversity [70]. That is to say, the intuitive use of the tool combined with simple instructions allows the student to have a favorable learning experience, removing barriers that may arise from its operation.

Regarding the variable Attitude Towards Use and based on the results obtained, there is a positive reception on the part of the students towards the use of VR, since, in general, it caused enthusiasm, motivation, curiosity, fascination, and enjoyment during the course learning process. Although the experience generally caused positive feelings in the students, the percentages show that university students were more susceptible to responding favorably. In conclusion, the use of variables and the findings allows us to appreciate a substantial interest on the part of the students in the intention to use Virtual Reality technology in the future. This tool is perceived by students as a viable and preferable option for learning spaces, with a total approval percentage of 86.2%, pushing students to experience great interest in the use of this tool in educational spaces and as a learning method, with a total passing percentage of 88.3% and 92.2% respectively.

To conclude the findings regarding the TAM model, it can be said that if students perceive virtual reality technology as an easy-to-use tool that increases their efficiency when acquiring knowledge, the more positive their attitude toward this mechanism will grow and achieve the intention to use Virtual Reality in the future and for a long time. To conclude the learning results, we would like to highlight that most of the students obtained good results in the questionnaire that contained questions about the places visited during the experience since of the 51 students who answered the questionnaire, 37 received a score of 4 or more correct answers. Despite having obtained an average of 4, it is expected that the results will improve if this type of learning space is carried out more frequently since some students when participating for the first time in an experience such as the Reality workshop Virtually, experienced greater amazement and, therefore, some distraction.

A. IMPLICATIONS AND LIMITATIONS OF THE STUDY

This study applied the ARCS (Attention, Relevance, Confidence, and Satisfaction) and TAM (Technology Acceptance Model) frameworks to assess the impact of Virtual Reality (VR) as a pedagogical tool. While the results are promising

and suggest that VR can enhance student motivation and engagement, it is crucial to recognize the specific context in which this study was conducted. Although the ARCS model, developed in the 1980s, provides a strong foundation for understanding motivation in educational settings, we acknowledge the need to integrate this model with more recent developments in UX design and pedagogical theory. Modern UX practices, such as user-centered design and iterative testing, align well with the principles of the ARCS model, emphasizing the importance of creating relevant and engaging user experiences. Furthermore, recent pedagogical advances, including adaptive learning technologies and gamification strategies, offer further support to the ARCS framework by improving learners' attention, relevance, confidence, and satisfaction. These integrations not only validate the continued relevance of the ARCS model but also provide a more comprehensive approach to evaluating the effectiveness of Virtual Reality (VR) in education.

The application of the ARCS model allowed us to examine the motivational aspects of VR in a controlled educational setting. The positive responses from students regarding attention, relevance, confidence, and satisfaction highlight the potential of VR to create immersive and engaging learning experiences. However, the effectiveness of the ARCS model in this context does not automatically imply its applicability across all educational environments or with different student demographics. Future research should explore the adaptation of ARCS to other settings, investigating how different types of content or skills influence the model's effectiveness.

Similarly, the use of the TAM model provided insights into students' perceptions of the usefulness and ease of use of VR technology. While the findings indicate a generally favorable attitude toward VR, it is essential to consider that these perceptions were shaped by the specific conditions of the study, including the type of VR technology used and the nature of the content delivered. The generalization of these findings to other educational contexts or with different technological tools should be approached with caution.

Moreover, the experiment presented here, while carefully designed, represents only a single application of VR in a specific educational context. As such, it is not possible to make broad generalizations about the efficacy of VR in diverse educational fields or to teach different types of content. The results should be considered indicative rather than conclusive. More studies are needed to validate these findings in different contexts, including multiple disciplines, heterogeneous student cohorts, and diverse educational levels.

We acknowledge that the study's small sample size (53 participants) and the nonrandom selection of participants represent limitations. Furthermore, the experimental conditions were not fully controlled, which could affect the generalizability of the findings. However, despite these limitations, the results obtained are significant and align with previous research on the benefits of Virtual Reality (VR) in education. Statistical analyses reveal clear and significant positive trends in the impact of VR on student motivation and learning. The

diversity within our sample adds robustness to the findings, suggesting that the observed effects of VR may be generalizable at different educational levels. In addition, qualitative feedback from participants supports the quantitative results, highlighting the substantial positive impact of VR on students' perceptions and motivation. Therefore, while the limitations of the study are acknowledged, the evidence presented strongly supports the potential of VR as a valuable pedagogical tool.

In summary, while this study provides valuable information on the potential of VR as an educational tool, it is essential to contextualize these findings within the specific scope of the research. The application of ARCS and TAM models has provided a framework for understanding student engagement and technology acceptance in this context, but more research is needed to explore their broader applicability. These limitations should guide future investigations, ensuring that new research continues to refine and expand our understanding of the role of VR in education.

VI. CONCLUSIONS

This study offers a detailed vision of adopting Virtual Reality technology in learning environments and how the motivational aspects considered by the ARCS model (attention, relevance, trust, and satisfaction) influence the acceptance of said technology. Significant results were obtained in the educational area in conjunction with technology, where the ARCS and TAM models played a fundamental role in the definition of learning strategies. The study showed and confirmed that it is effective to implement strategies that include new technologies in learning processes, since it considerably increases the motivational aspects of students face this. In addition, this significantly influences the acceptance of the the said technology, given that students positively relate to obtaining better results in learning processes with VR technology.

This tool played a fundamental role in the motivational aspects of the students in general since, during the experience, it was possible to capture their attention significantly. At the same time, it was relevant to them, and it generated great confidence and gave them a high degree of satisfaction so that they managed to feel motivated and enthusiastic during the use of Virtual Reality throughout the learning process. This success confirms theories based on the ARCS model, which propose that when these four aspects are met in the learning strategies, the student's motivation and commitment to study will be victoriously achieved. By achieving the above, students' perception of this technology will be positive, as demonstrated by this study. The strategy implemented for the experience considers Virtual Reality at all times, including it in each variable of the ARCS model. In this case, the students felt comfortable and confident in using the technology, directly influencing the perceived ease of use. Then, they recognize the tool's relevance and information, perceiving the usefulness of Virtual Reality technology. Finally, the above causes a critical positivism that influences students'

attitudes toward technology in the educational field, leading to a greater intention to use it.

The successful implementation of Virtual Reality (VR) in educational settings has significant implications for academia. First, VR offers an innovative and engaging tool that can transform the learning experience. It captures students' attention differently and differentiates itself from traditional methods that often fail to maintain students' attention at times successfully prolonged. Universities can enrich teaching and facilitate the understanding of complex concepts by providing immersive virtual environments. It should be noted that a critical aspect is preparing students for a digital future; integrating this type of technology is essential in an increasingly digitalized world that allows them to develop valuable skills useful in various professional fields. In summary, universities should place a significant focus on implementing VR in education due to its ability to improve the quality of learning, foster student autonomy, and prepare students for future technological challenges.

Although the study produced significant results, limitations must be considered when interpreting the findings. First, the sample was limited to university students and students in their final years of high school in the Antofagasta region, which could restrict the generalization of the results to other student populations or geographic contexts. Furthermore, the rapid evolution of Virtual Reality glasses technology, with frequent launches of new devices such as Oculus and Apple Vision, could influence the perception and acceptance of VR in educational environments, considering that the glasses used were Google Cardboard for this study, one of the most basic on the market, since they are made with cardboard and focal length lenses. However, the impact of the pandemic context on the perception of Virtual Reality in education was not specifically evaluated, which could have influenced the disposition and receptivity of students towards new educational technologies. These limitations underscore the need to carefully consider the scope and conditions of the study when applying its conclusions.

Additionally, they suggest specific areas for future research that address these constraints and expand the understanding of the implementation of Virtual Reality in educational settings. Another limitation is that the analysis was simply descriptive due to the sample size (53 students), so the research has likely missed the opportunity to explore deeper relationships between the variables and examine possible correlations or causalities. The lack of a more advanced analysis could have limited the understanding of the complexities and interactions between the different factors evaluated. In future research, more advanced analytical methods, such as multivariate analysis or predictive models, could provide a more complete and detailed view of the relationships between the variables studied. This would allow us to understand how some specific factors can influence the perception and adoption of Virtual Reality in educational environments, which would be valuable for both academia and professionals in decision-making and implementing strategies. Finally,

a significant limitation was the low workshop registration rate and student willingness to participate, causing potential bias in the results. The sample may not fully represent the diversity of perspectives and experiences of the students. This problem can be due to various factors, such as lack of interest, time limitations, or misinformation. Finally, experienced virtual reality users have reported lower screen quality with Google Cardboard compared to more advanced headsets [7]. In future research, it would be valuable to explore strategies that increase the number of participants, such as improving the communication and promotion of the workshop, making schedules more flexible, or implementing incentives to encourage registration. This would allow for broader and more diverse participation, enriching the external validity of the findings, and providing a complete view of the perception and acceptance of Virtual Reality in different educational contexts.

Future research exploring options for remote implementation of virtual reality could address the sample's limitation of being restricted to the in-person experience. This would allow participation to be expanded to people from diverse geographic locations, increasing the representativeness and diversity of the sample. Regarding lens choice due to budgetary restrictions, future studies could seek additional funding or collaborations with technology companies to access more advanced devices. This would allow us to explore how the quality of the experience with high-end devices could influence students' perceptions. Regarding the limitation of the analysis due to the amount of data, future research could implement more efficient data collection and management strategies. Advanced analytical tools, such as machine learning, could facilitate deeper and more detailed analysis even with large data sets, offering a more complete view of the relationships between the variables evaluated.

This research suggests that the implementation of virtual reality in educational settings promotes favorable learning experiences. However, to project and replicate these experiences in the future, it is crucial to consider extrapolating the use of virtual reality to various aspects such as learning environments, teaching strategies, learning assessment, and attention to diversity, among other factors. Additionally, these results and application of Virtual Reality (VR) tools guided by the ARCS paradigm (Attention, Relevance, Confidence, Satisfaction) could have substantial potential in a number of fields outside of education such as healthcare and medical training, corporate training, tourism, mental health and therapy, and others.

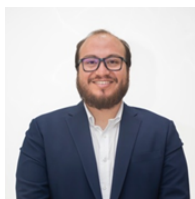
This consideration aims to ensure a more integrated analysis of the effect of virtual reality use in educational settings.

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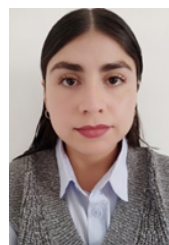


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