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Evaluation of the implementation quality of the Augmented Reality project at the National University of Chimborazo, based on the Neutrosophic SERVQUAL model

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Abstract. This work explores the integration of contemporary educational practices, highlighting Augmented Reality (AR) as an innovative tool at the National University of Chimborazo, La Dolorosa campus, Ecuador. An AR environment based on QR codes has been developed to improve campus navigation. The state of the art was studied to obtain location requirements, create the environment with CoSpaces and Autodesk Maya, and verify user satisfaction through a survey. A usability test was conducted at the end of the product. The ADDIE methodology (Analyze, Design, Develop, Implement, and Evaluate) was used to create the product, where each phase contributed to the implementation of Augmented Reality. In analysis, innovative ideas were investigated and generated; in design, the immersive environment was structured; in development, Autodesk Maya was used for 3D modeling and CoSpaces for programming; in implementation, a QR code was generated to share the product, and it was evaluated through user feedback. The proposal offered an immersive environment that allowed a better understanding of the blocks of the UNACH La Dolorosa campus. Specifically, in this article we address the problem of evaluating the quality of the product. To do so, we conducted a survey of 30 students about their satisfaction with this product and its usefulness for student life. We agreed that this presents the challenges (1) There is indeterminacy and uncertainty in the opinions, (2) It is necessary to use a widely accepted method of quality evaluation. That is why we applied the Neutrosophic SERVQUAL model for higher education found in the literature.

Keywords: Higher Education, Augmented Reality (AR), SERVQUAL, single-valued triangular neutrosophic number, Neutrosophic SERVQUAL model, Likert Scale.

1 Introduction

Traditional education has only been founded on the principle of teaching for centuries, but how does it compare to our current practices? Traditional education focuses on teaching, not learning. It assumes that the student learns as they are taught, but this is not always right. There are often difficulties in applying strategies and there is a lack of understanding of the content given in class.

Current education has changed and step by step we must choose to take the benefits and incorporate them into education. The current reality responds to a complex system that works in a network, and in which a multitude of processes, learning, and discoveries occur in a combined way between a human and a non-human entity.

Nowadays, it is clear that the digital world surrounds us and our entire environment is surrounded by technology. We see a computer, tablet, or smartphone everywhere. This makes it increasingly necessary for these types of tools to be considered and incorporated into educational systems.

Immersive environments have become part of education. Experiential immersive learning is represented by various activities that allow students to immerse themselves in a place that resembles reality and is artificially constructed (virtual world).

Augmented Reality (AR) has become an innovative technology with the potential to transform the way we interact with our environment. AR continues to evolve in different areas every day. AR is a technology that is being presented as truly useful and with different possibilities to facilitate learning by students in different curricular areas, but it must be recognized that more technological analyses are being carried out than research on its application in the educational field.

The use of markers such as QR codes utilizing innovative technologies such as AR has provided us with several applications. QR codes are an easy way to read information on mobile devices and allow direct or indirect access to information resources. For libraries, this element allows extending services and access to mobile users simply and inexpensively; resource guides, practical information, direct download of documentation, and access to multimedia information.

This project had as its first phase the development of an Augmented Reality environment based on markers for the La Dolorosa Campus of the National University of Chimborazo (UNACH in Spanish). Through the use of this technology, the aim is to provide an interactive and enriched experience that improves orientation, facilitates the location of classrooms, laboratories, and services, and provides information about the offices and classrooms located in the different blocks. In addition, it is expected that this project will promote the development of technological skills and foster innovation in the educational environment of UNACH.

Our purpose with this paper is to assess the quality of the project implementation or, in other words, the satisfaction of students and workers with the results obtained. As an evaluation tool, we use the Neutrosophic SERVQUAL model that appears in [1]. The SERVQUAL model is used to evaluate the quality of services. However, if Higher Education is considered a service to students, and more specifically the service provided to them by using Augmented Reality on the university campus, then it makes sense to evaluate the quality of this service based on the satisfaction of students with this implementation [2-6]. The use of Neutrosophy associated with SERVQUAL has to do with the presence of uncertainty and indeterminacy that is part of any evaluation of human behavior, which is full of subjectivity [1, 7, 8].

This paper is divided into three main sections; first, Preliminaries contains the basic notions of the SERVQUAL model and Neutrosophy. The Results section contains the fundamental elements used in the implementation of Augmented Reality at the La Dolorosa Campus of the National University of Chimborazo, in Ecuador. Then, in this section, we explain the results of applying the Neutrosophic SERVQUAL model that appears in [1], in addition, we recall the fundamental theoretical elements of this model. The last section contains the conclusions.

2 Preliminaries

This section contains the basic concepts about the SERVQUAL model and Neutrosophy, in particular, the single-valued triangular neutrosophic numbers. We will base ourselves on the Neutrosophic SERVQUAL model that appears in [1].

2.1. SERVQUAL model

Two models are known that can be used to measure the quality of service. The first of them is the SERVPERF model, which only works under the results of perceptions, and the second one is the SERVQUAL model, which allows expectations to be compared with perceptions [2-6].

The SERVQUAL model is one of the main tools for measuring service quality. This model attempts to answer three essential questions: When is a service perceived as being of quality? What dimensions make up quality? And, what questions should be included in the quality questionnaire? The model was illustrated so that consumers' perceptions of quality are influenced by five gaps that occur in organizations as described further.

The SERVQUAL model comes from business research, which aims to measure customer satisfaction regarding a service provided [2-6]. This measurement is made as the difference between the customer's perception of the quality of the service and their expectation before receiving it. This method is based on the results of a survey carried out, where customers are asked to evaluate the quality of the service about five dimensions. They are asked to state their degree of agreement or disagreement with each of these dimensions.

The gaps identified in SERVQUAL indicate differences between important aspects of a service, such as customer needs, the service experience itself, and the perceptions that company employees have regarding customer requirements. In the case studied, students and teaching staff are considered equivalent to the business sector's customers. It is clear that they are not the same, however, this method is feasible to use, since the quality of teaching is also a desired state for all actors who are part of the teaching-learning process. In addition, it is an aspect that needs to be measured to advance the effectiveness of this process.

The five dimensions that make up the method are: response capacity, reliability, security, empathy, and tangibility. Reliability refers to the ability to provide a careful and reliable service. Response Capacity is the willingness of the staff providing the service to quickly help with customer requirements. Security consists of the trust generated by the service received. Empathy focuses on identifying alternatives to provide the customer with personalized attention. Tangibility has to do with the appearance and functionality of physical facilities, equipment, personnel, material, and communication channels.

2.2. The single-valued triangular neutrosophic numbers

Definition 1: ([1, 9-15]) The *Neutrosophic set* N is characterized by three membership functions, which are the truth-membership function T_A, indeterminacy-membership function I_A, and falsity-membership function F_A, where U is the Universe of Discourse, $\forall x \in U$, $T_A(x), I_A(x), F_A(x) \subseteq]^-0, 1^+[$, and $^-0 \leq \inf T_A(x) + \inf I_A(x) + \inf F_A(x) \leq \sup T_A(x) + \sup I_A(x) + \sup F_A(x) \leq 3^+$.

See that according to Definition 1, $T_A(x), I_A(x), F_A(x)$ are real standard or non-standard subsets of $]^-0, 1^+[$ and hence, $T_A(x), I_A(x), F_A(x)$ can be subintervals of $[0, 1]$.

Definition 2: ([1, 9-15]) The *Single-Valued Neutrosophic Set* (SVNS) N over U is $A = \{< x;\ T_A(x), I_A(x), F_A(x) >: x \in U\}$, where $T_A: U \to [0, 1]$, $I_A: U \to [0, 1]$, and $F_A: U \to [0, 1]$, $0 \leq T_A(x) + I_A(x) + F_A(x) \leq 3$.

The *Single-Valued Neutrosophic number* (SVNN) is symbolized by $N = (t, i, f)$, such that $0 \leq t, i, f \leq 1$ and $0 \leq t + i + f \leq 3$.

Definition 3: ([1, 9-15]) The *single-valued triangular neutrosophic number* $\tilde{a} = \langle (a_1, a_2. a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, is a neutrosophic set on $\mathbb{R}$, whose truth, indeterminacy, and falsity membership functions are defined as follows, respectively:

$$T_{\tilde{a}}(x) = \begin{cases} \alpha_{\tilde{a}\left(\frac{x-a_1}{a_2-a_1}\right)}, & a_1 \leq x \leq a_2 \\ \alpha_{\tilde{a}}, & x = a_2 \\ \alpha_{\tilde{a}\left(\frac{a_3-x}{a_3-a_2}\right)}, & a_2 < x \leq a_3 \\ 0, & \text{otherwise} \end{cases} \tag{1}$$

$$I_{\tilde{a}}(x) = \begin{cases} \frac{\left(a_2 - x + \beta_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \leq x \leq a_2 \\ \beta_{\tilde{a}}, & x = a_2 \\ \frac{\left(x - a_2 + \beta_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \leq a_3 \\ 1, & \text{otherwise} \end{cases} \tag{2}$$

$$F_{\tilde{a}}(x) = \begin{cases} \frac{\left(a_2 - x + \gamma_{\tilde{a}}(x - a_1)\right)}{a_2 - a_1}, & a_1 \leq x \leq a_2 \\ \gamma_{\tilde{a}}, & x = a_2 \\ \frac{\left(x - a_2 + \gamma_{\tilde{a}}(a_3 - x)\right)}{a_3 - a_2}, & a_2 < x \leq a_3 \\ 1, & \text{otherwise} \end{cases} \tag{3}$$

Where $\alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \in [0, 1]$, $a_1, a_2, a_3 \in \mathbb{R}$ and $a_1 \leq a_2 \leq a_3$.

Definition 4: ([1, 9-15]) Given $\tilde{a} = \langle (a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$ and $\tilde{b} = \langle (b_1, b_2, b_3); \alpha_{\tilde{b}}, \beta_{\tilde{b}}, \gamma_{\tilde{b}} \rangle$ two single-valued triangular neutrosophic numbers and λ any non-null number in the real line. Then, the following operations are defined:

1. Addition: $\tilde{a} + \tilde{b} = \langle (a_1 + b_1, a_2 + b_2, a_3 + b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$,
2. Subtraction: $\tilde{a} - \tilde{b} = \langle (a_1 - b_3, a_2 - b_2, a_3 - b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}} \rangle$,
3. Inversion: $\tilde{a}^{-1} = \langle ({a_3}^{-1}, {a_2}^{-1}, {a_1}^{-1}); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle$, where $a_1, a_2, a_3 \neq 0$,
4. Multiplication by a scalar number:
$$\lambda\tilde{a} = \begin{cases} \langle (\lambda a_1, \lambda a_2, \lambda a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda > 0 \\ \langle (\lambda a_3, \lambda a_2, \lambda a_1); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}} \rangle, & \lambda < 0 \end{cases}$$
5. Division of two triangular neutrosophic numbers:

$$\frac{\tilde{a}}{\tilde{b}} = \begin{cases} \langle\left(\frac{a_1}{b_3},\frac{a_2}{b_2},\frac{a_3}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, a_3 > 0 \ and\ b_3 > 0 \\ \langle\left(\frac{a_3}{b_3},\frac{a_2}{b_2},\frac{a_1}{b_1}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, a_3 < 0 \ and\ b_3 > 0 \\ \langle\left(\frac{a_3}{b_1},\frac{a_2}{b_2},\frac{a_1}{b_3}\right); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, a_3 < 0 \ and\ b_3 < 0 \end{cases}$$

6. Multiplication of two triangular neutrosophic numbers:

$$\tilde{a}\tilde{b} = \begin{cases} \langle(a_1b_1, a_2b_2, a_3b_3); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 > 0 \ and\ b_3 > 0 \\ \langle(a_1b_3, a_2b_2, a_3b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 < 0 \ and\ b_3 > 0 \\ \langle(a_3b_3, a_2b_2, a_1b_1); \alpha_{\tilde{a}} \wedge \alpha_{\tilde{b}}, \beta_{\tilde{a}} \vee \beta_{\tilde{b}}, \gamma_{\tilde{a}} \vee \gamma_{\tilde{b}}\rangle, & a_3 < 0 \ and\ b_3 < 0 \end{cases}$$

Where, $\wedge$ is a t-norm and $\vee$ is a t-conorm.

Let $\tilde{a} = \langle(a_1, a_2, a_3); \alpha_{\tilde{a}}, \beta_{\tilde{a}}, \gamma_{\tilde{a}}\rangle$ be a single-valued triangular neutrosophic number, then,

$$S(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} - \gamma_{\tilde{a}}) \quad (4)$$

$$\mathbf{A}(\tilde{a}) = \frac{1}{8}[a_1 + a_2 + a_3](2 + \alpha_{\tilde{a}} - \beta_{\tilde{a}} + \gamma_{\tilde{a}}) \quad (5)$$

They are called the score and accuracy degrees of ã, respectively.

Let $\{\tilde{A}_1, \tilde{A}_2, \cdots, \tilde{A}_n\}$ be a set of n SVTNNs, where $\tilde{A}_j = \langle(a_j, b_j, c_j); \alpha_{\tilde{a}_j}, \beta_{\tilde{a}_j}, \gamma_{\tilde{a}_j}\rangle$(j = 1, 2 , …, n), then the *weighted mean of the SVTNNs* is calculated with the following Equation:

$$\tilde{A} = \sum_{j=1}^{n} \lambda_j \tilde{A}_j \quad (6)$$

Where λ_j is the weight of A_j , $\lambda_j \in [0, 1]$ and $\sum_{j=1}^{n} \lambda_j = 1$.

3 Results

This section contains the results obtained in this project. Especially the evaluation of the quality of the implementation of the Augmented Reality product carried out at UNACH. The following subsection contains some elements of the obtained final Augmented Reality product. Subsection 3.2 contains the details of the Neutrosophic SERVQUAL model proposed in [1]. In addition, we offer the results of the application of such a model in the problem we address in this article.

3.1. Details of the developed Augmented Reality Project

Initially, studies on Intelligent Systems were minimal, because the implementation of these alternative systems had high costs due to the devices required, but they grew thanks to the massification of technology and technological advances in mobile devices and cloud resources, as well as solutions to reduce the cost of the devices such as Google Cardboard, where the affordable price has allowed to increase the possibilities of applying the resources for educational purposes.

Augmented Reality is an interactive technology that enriches the physical environment with superimposed virtual elements. This virtual layer, which is placed between the physical environment and the user, adds textual information, images, videos, or other virtual elements to the person's perception of the physical environment.

Virtual Reality (VR) is an immersive technology that creates simulated environments in which users can interact intuitively and realistically. This technology is transforming diverse fields, from entertainment to education and vocational training.

VR is one in which the participating observer is fully immersed in a completely synthetic world, which may or may not mimic the properties of a real-world environment, whether existing or fictional, but which may also surpass the limits of physical reality by creating a world in which the physical laws governing gravity, time and material properties no longer apply.

Some authors propose a classification method for mixed reality based on three criteria: immersion, interaction, and information. A paradigm that combines technologies that, by mapping the user's space, display virtual content embedded in 3D and recorded in space and time. Virtual objects can be positioned around the real environment, the user, or any other virtual or physical object. In addition, the mixed reality experience must be user-centered and offer natural and immediate interactions.

Figure 1 represents these relationships schematically:

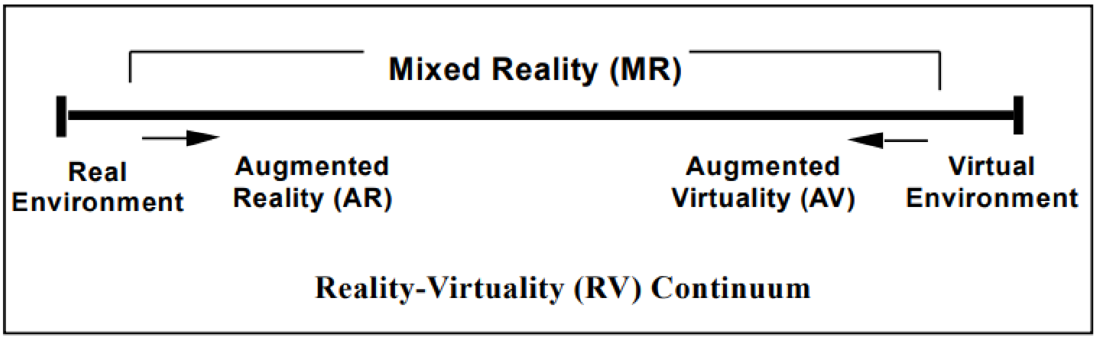

Figure 1. Augmented reality: a class of displays on the reality-virtuality continuum.

Note that the graph in Figure 1 represents what the process of mixed reality, VR, and AR looks like. Adapted from "Augmented Reality: A class of displays on the reality- virtuality continuum" (p.283), by Milgram et al.

An immersive environment has been created in augmented reality, which consists of sound and images and a representation of the UNACH campus La Dolorosa in 3D with a pleasant interface, thus capturing the attention of the student. On the other hand, the use of QR codes allows the augmented reality product to be easily accessible to both internal and external users of the campus.

Figure 2 contains the proposed QR code:

Figure 2. Code to share the final product.

Some visual elements of the final product obtained are shown in Figures 3, 4, and 5.

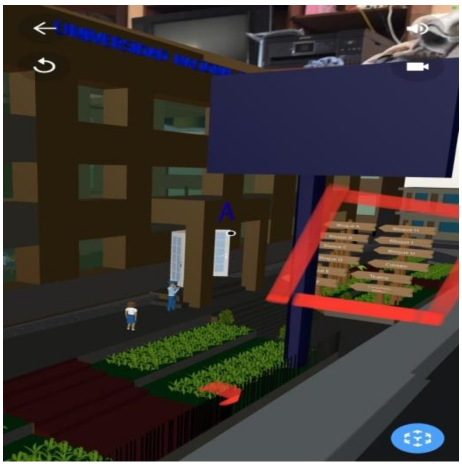

Figure 3. Block A shows the campus location signs according to the product obtained from AR.

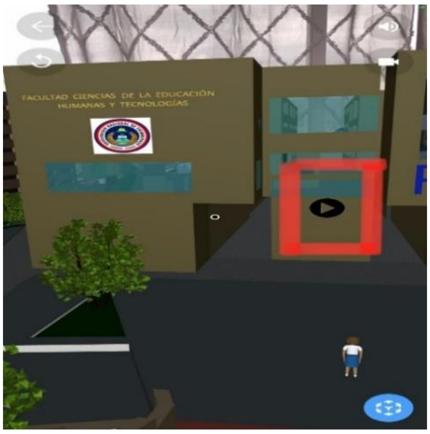

Figure 4. Play black to listen to the offices of the selected block.

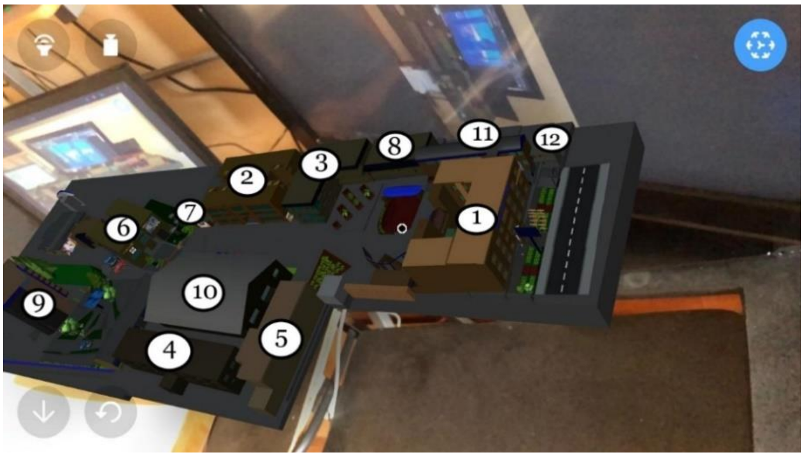

Figure 5. UNACH campus la Dolorosa in Augmented Reality detailing the location of the blocks.

3.2. Neutrosophic SERVQUAL model and results

In this subsection, we consider the Neutrosophic SERVQUAL model proposed in [1]. The model used is based on the idea that there is a staff that provides the service, which is why we must adapt it to the conditions established in the product we provide, where there is a combination of human staff that indicates to the student and workers the steps and conditions to use the Augmented Reality product and the product itself that provides a service.

Specifically, for the evaluation, a usability test is created in Google Forms. Once the test is designed, 30 users are chosen at random at UNACH, La Dolorosa campus, and the users are asked to test the product and complete the usability test. They are then asked to answer the following questions shown in Table 1.

	Dimension	Question
Q_1	Tangibility	Premises and facilities in good condition
Q_2	Tangibility	State-of-the-art equipment and product
Q_3	Tangibility	Properly uniform and impeccable staff
Q_4	Tangibility	Enough attractive and explicit advertising
Q_5	Reliability	The staff shows interest in solving requirements
Q_6	Reliability	The staff and the AR product undertake to comply in the shortest time and do so
Q_7	Reliability	The staff and the AR product offer good service at all times
Q_8	Reliability	The staff and the AR product comply with the service in the established time
Q_9	Response Capacity	The solution/response time of the request is adequate
Q_{10}	Response Capacity	Service is provided promptly
Q_{11}	Response Capacity	The staff and the AR product are always ready to help

12	Response Capacity	Staff and the AR product are always available to help with requirements
Q_{13}	Security	The staff and the AR product transmit confidence
Q_{14}	Security	One feels secure when carrying out a procedure
Q_{15}	Security	The staff and the AR product are friendly
Q_{16}	Security	Trained personnel to give reliable answers to requirements. Also, do it with the AR product.
Q_{17}	Empathy	The staff gives you personalized attention.
Q_{18}	Empathy	Adequate staff to offer personalized attention.
Q_{19}	Empathy	Customer service hours are appropriate.
20	Empathy	The staff cares about offering well-being.
Q_{21}	Empathy	The staff understands the requirements.

Table 1. Questions asked in the Neutrosophic SERVQUAL model, are classified according to the corresponding dimensions. Modified from [1].

The items that make up the SERVQUAL model questionnaire were measured on a Likert scale where the respondent had to indicate his/her agreement or disagreement with the statement presented to him/her [16, 17, 18]. To this end, an orderly and one-dimensional scale from 1 to 7 is used. In the case of the expectations questionnaire, it is assumed that a score of 7 corresponds to "Extremely important" and 1 to "Extremely unimportant". For the questionnaire on perceptions, a score of 7 represents "that the evaluation is always fulfilled" and 1 that "it is never fulfilled."

The numerical results in the Likert scale[19,20] were using the single-valued triangular neutrosophic numbers scale in Table 2.

Likert scale	Linguistic terms for expectations	Linguistic terms for perceptions	SVTNN
1	Extremely unimportant (EU)	Never fulfilled (NF)	$\langle(0,0,1); 0.00, 1.00, 1.00\rangle$
2	Not very important (NVI)	Few times fulfilled (FTF)	$\langle(0,1,3); 0.17, 0.85, 0.83\rangle$
3	Not important (NI)	Sometimes fulfilled (STF)	$\langle(1,3,5); 0.33, 0.75, 0.67\rangle$
4	Medium (M)	Medium (M)	$\langle(3,5,7); 0.50, 0.50, 0.50\rangle$
5	Important (I)	More fulfilled than not (MF)	$\langle(5,7,9); 0.67, 0.25, 0.33\rangle$
6	Very important (VI)	Most of the time fulfilled (MTF)	$\langle(7,9,10); 0.83, 0.15, 0.17\rangle$
7	Extremely important (EI)	Always fulfilled (AF)	$\langle(9,10,10); 1.00, 0.00, 0.00\rangle$

Table 2. Linguistic variables and their associated SVTNNs for expectations and perceptions. Source: [1].

For processing the data we proceed with collecting the responses to the survey. Let us suppose for the questions Q_i (i =1,2,…, 21) in Table 1, we have both, $\upsilon_{ij} = \frac{\#\{Respondents\ having\ response\ Likert=j\}}{30}$ and $\omega_{ij} = \frac{\#\{Respondents\ having\ response\ Likert=j\}}{30}$, for j = 1,2,…,7 the answers in the Likert scale concerning i dimension, where υ_{ij} is expectation and ω_{ij} is perception.

The results obtained from the survey were as follows as summarized in Table 3:

Question	Dimension	Expectation	Perception	Gap
Q_1	Tangibility	8.1129	9.9864	1.8735
Q_2	Tangibility	8.7823	9.8493	1.067
Q_3	Tangibility	8.2602	9.3978	1.1376
Q_4	Tangibility	8.8268	9.5435	0.7167
Q_5	Reliability	8.0223	9.7935	1.7712
Q_6	Reliability	8.8561	9.8893	1.0332
Q_7	Reliability	8.7942	9.8064	1.0122
Q_8	Reliability	8.1815	9.0854	0.9039
Q_9	Response Capacity	8.0443	9.4716	1.4273
Q_{10}	Response Capacity	8.5306	9.5598	1.0292
Q_{11}	Response Capacity	8.9116	8.5943	-0.3173
Q_{12}	Response Capacity	8.1399	8.3401	0.2002

Q_{13}	Security	8.9996	7.6565	-1.3431
Q_{14}	Security	8.1226	7.3309	-0.7917
Q_{15}	Security	8.1591	7.6691	-0.49
Q_{16}	Security	8.0154	7.8279	-0.1875
Q_{17}	Empathy	8.1221	8.6111	0.489
Q_{18}	Empathy	8.2798	8.3606	0.0808
Q_{19}	Empathy	8.5181	8.9459	0.4278
Q_{20}	Empathy	8.2234	8.8669	0.6435
Q_{21}	Empathy	8.1256	8.1298	0.0042

Table 3. Results of processing the de- neutrosofied data from the survey.

Note that the results in Table 3 are de-neutrosophied. The average of all gaps is 0.5089, which is a positive result. Although some aspects still need improvement that yielded negative results. In others, the expectation was exceeded[21].

Conclusion

This article consisted of the evaluation of the quality of the Augmented Reality product implemented at the La Dolorosa campus of the National University of Chimborazo in Ecuador. This is a new experience that allows students, workers, and visitors to locate themselves within the different places on campus and learn about the functions and history of each place. It is also an experience that can be enriched with more resourses and extended to other campuses of the university and other universities in the country. A group of 30 randomly selected students were asked to answer a set of 21 questions about the quality of this product and the associated service after living the experience. The Neutrosophic SERVQUAL model proposed in [1] was used. This model was adapted to the conditions of the study carried out. In general, a positive acceptance result was obtained. However, must be working on improving the aspects that turned out negative such as: “The staff and the AR product are always ready to help”, “The staff and the AR product transmit confidence”, “One feels secure when carrying out a procedure”, “The staff and the AR product are friendly” and “Trained personnel to give reliable answers to requirements. Also, do it the AR product". The use of a neutrosophic tool made it possible to take into account indeterminacy and uncertainty in the evaluation, thus achieving greater accuracy.

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