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Measurement of the level of knowledge of augmented reality in regular basic education teachers of the computer course in Metropolitan Lima after the first year of the health emergency caused by the COVID-19 virus

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Abstract*– Augmented reality offers an innovative platform for education as it allows students and teachers a meaningful learning experience, benefiting teachers by allowing them to create interactive content that can be accessed by students from anywhere. The objective was to determine the level of knowledge of augmented reality (and its dimensions) in regular basic education teachers of the computer course in Metropolitan Lima after the first year of the health emergency caused by the COVID-19 virus. As for the methodology, the approach was quantitative, cross-sectional and with a non-experimental design. The sample consisted of 58 teachers working in regular basic education institutions in Metropolitan Lima, in charge of computer courses. A questionnaire was used to measure knowledge about AR in the teaching-learning process. The instrument consists of 3 dimensions: experience with technology, teaching practice with ICT and educational experience. This instrument had 15 items and was validated by three experts; it is highly reliable (Cronbach's alpha = 0.8). As a result, knowledge about augmented reality was as follows: 48.3% of the respondents are at high level, 22.4% at medium level, and 29.3% at low level. The results obtained show that teachers have a high level of knowledge of augmented reality in most cases, but its application in the classroom is not widespread due to some factors (which could be professional, personal or specialized training), which could limit the use of technological resources in their sessions. It is concluded that AR allows teachers to teach with greater interactivity, improves student information retention, and provides memorable educational experiences.

Keywords*— augmented reality, basic education, teachers, computer course, COVID-19.

I. Introduction

Augmented reality in the educational classroom offers immense opportunities to improve educational outcomes. It is used to allow students to have deeper and more interactive access to specific topics. Content can be displayed dynamically, with a variety of multimedia and interactive videos integrated. Augmented Reality allows students to view content from multiple viewpoints, which increases understanding of the subject matter.

Most faculty are not using augmented reality in the classroom because they find it easier to stick with traditional teaching methods. This is mainly due to one or two reasons: the cost of the devices to use augmented reality is high and there is a lack of adequate training to know how to use them correctly.

The faculty has experience with technology, has experience with ICT, and has educational experience [1], [2], but having theoretical knowledge differs from the application and that is where the problem or the break that is observed arises. There is a faculty eager to learn, to apply their knowledge, to experiment and develop successful experiences with students, but the surrounding reality makes them stop and continue with traditional teaching.

The reality in Latin America, and particularly in Peru, is that there are no specialized laboratories or laboratories implemented in such a way that they can be used by the educational community, including students and teachers who remain in the facilities for a large number of hours.

Efforts are needed to help teachers better understand the use of augmented reality in various disciplines, not only for the exact sciences but also for the social sciences.

Generally, the focus has been on engineering education but they should experiment with other pedagogies and forms of assessment [3]. It is also necessary to indicate that augmented reality has become a driving force for future learning, even when teachers and students are not geographically together [4].

Reality is defined as a system that combines the real and the virtual, is interactive in real time and recorded in 3D [5]–[7].

To develop augmented reality activities, it is necessary to have elements that help the development of the activity such as

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a device with a camera, a software that will develop the transformations, and an information activator. In this way, the students will show interest and acceptance to the use of technology [8]–[10].

There are some augmented reality tools, such as Google Expeditions, which allows teachers to take students on journeys through 3D content, as well as Google ARCore, which allows the creation of interactive and visual content to provide immersive experiences. These tools provide new ways to incorporate augmented reality content into the classroom in a user-friendly way [11].

Augmented reality is a technology installed in our lives, as every day new applications and ideas appear or emerge that are implemented thanks to it [12]–[14].

Augmented reality technology serves to improve educational practice, the development of content, new services, the understanding of certain aspects of reality by the students [15]–[17].

Current research affirms that augmented reality can be used in education, exact sciences, marketing, communications, art among other disciplines, television media and even in children's literature [2], [6], [16], [18].

In relation to education, this is plausible from the first years of a student's life [19]. A case of its application is the teaching of mathematics through the use of card games to increase the competence of the discipline, becoming a successful method [20].

Even, research on augmented reality indicates that it can be taught to elementary school students, a level where successful experiences have been developed in learning about microorganisms [21].

Not only in education but also in other disciplines such as health, where parents, children and teachers are involved, then the need for joint participation arises to address the health of those involved [22].

Likewise, through a research developed in Taiwan, the feasibility of AR for learning content, internal components of a computer, focused on the processes of motivation, understanding, learning and thinking in the construction of new knowledge was demonstrated [23].

Another research conducted in Colombia on augmented reality concluded that it is an emerging technology, a tool that improves teaching-learning processes in an interactive way [24].

In this way, students significantly improve their learning compared to traditional models at any level of study [6], [25]. From the above, it is determined that teachers use technology in a general way, linking the real and virtual worlds, but with certain limitations that prevent their use in the classroom [26].

The knowledge of augmented reality comprises three dimensions: "experience with technology", "teaching practice with ICT" and "educational experience". These dimensions were identified from the literature explored [2], [16], [27], [28].

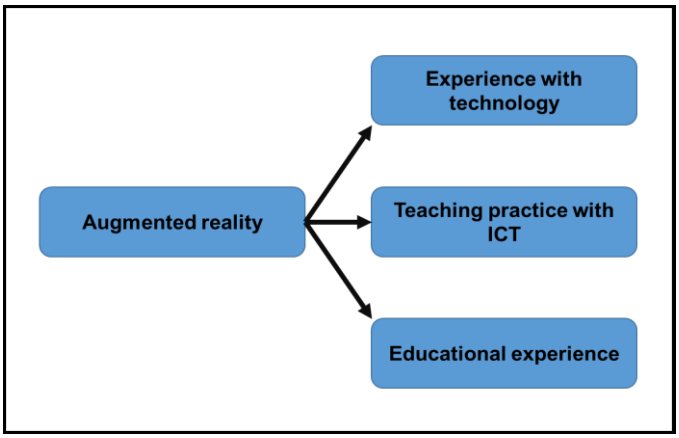

Fig. 1 Dimensions of "augmented reality".

The dimension "experience with technology" determines several aspects related to teachers, including commitment to students and themselves, being professionally prepared to provide quality teaching and digital literacy [2], [27], [29]. Although there is research that shows results indicating that teachers have skills in the use of ICT, but reduced to what is added that most teachers lack space that contributes to technological teaching and access to the Internet.

The proposal for this dimension is to create a teaching-learning taxonomy [6]. One of the aspects to deepen can be the use of geolocation, such as global positioning system known as GPS, compasses, Quick Response codes, known as QR codes.

QR coding is easy to use, it does not require special knowledge and skills. There are several QR, among them: Qrmania.ru, Creambee.ru, Goqr.me and Keremerkan.net that allow you to create QR codes, resize, change background and change text color. Decoding requires a cell phone with a camera and a code recognition program. The decoded texts are immediately stored in the memory of each electronic support [30].

Regarding the dimension "teaching practice with ICT", it is important to analyze the concept of STEAM methodology [31]–[34]. It unites the approaches of both arts and science. STEAM comprises science, technology, arts and mathematics [35], [36]. Ideally, this methodology should be integrated into the school curriculum and thus the training of the future teacher should also contain training in technology [1], [16]. The integration would be less complex but more sustainable in relation to pedagogical innovations [37].

Finally, the dimension "educational experience" is strengthened with the emergence of the pandemic, which shows teachers and students as protagonists in the development of virtual classes.

The students belong to the computer world, that is to say, the teacher is the one who has a great challenge to get their attention in the development of the classes, where perhaps the students know more than the teachers about computer issues [28].

In this context, the research question was: What is the level of knowledge of augmented reality (and its dimensions) in regular basic education teachers of the computer course in Metropolitan Lima, after the first year of the health emergency caused by the COVID-19 virus?

This research is theoretically justified since it is evident that it is necessary and essential to train teachers in specialized technologies such as augmented reality, generating more literature that contributes to the knowledge of the subject and favoring its application in the classroom.

Finally, the research objective was to determine the level of knowledge of augmented reality (and its dimensions) in regular basic education teachers of the computer course in Metropolitan Lima after the first year of the health emergency caused by the COVID-19 virus.

II. Methodology

The research was developed under the quantitative approach. To measure teachers' knowledge, the data collection instrument (questionnaire) was applied only once; therefore, it is cross-sectional.

The level of research is descriptive and with a non-experimental design (See Fig. 2).

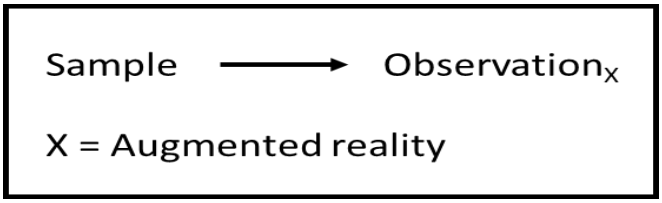

Fig. 2 Study design.

The sample consisted of a total of 58 teachers working in regular basic education institutions in Metropolitan Lima, in charge of computer courses. This work condition facilitates questions about technology, although not necessarily about augmented reality.

A questionnaire was used whose items were oriented to measure knowledge about augmented reality, with response options on a Likert-type scale with answers: "always" (3 points), "sometimes" (2 points), "rarely" (1 point), "never" (0 points). This made it possible to measure the variable "knowledge of augmented reality" and its dimensions "experience with technology", "teaching practice with ICT" and "educational experience" by means of 15 items. The items referred to geolocation, QR codes, bookmarks, Markerless recognition objects or image recognition.

The instrument was validated by four experts in methodology and specialization in educational technology, who measured content, criterion and construct validity. Reliability was calculated through the Cronbach's Alpha coefficient, whose result was 0.80 (highly reliable).

Likewise, the questionnaire responds to general and specific questions. These were created with the purpose of establishing filters and creating a subsample of teachers who have a relationship or experience with technology.

The identification questions were exclusive to the question if they applied any augmented reality media in their daily life, when answering NO, two additional questions were asked such as the use of Google maps, or filters in their Instagram or Snapchat images and if the answer was YES, it was an invalid questionnaire since they did not know the topic of augmented reality.

The instrument was applied through email, using the Google form. The inclusion criteria considered were that they should be regular basic education teachers, with experience of more than 1 year; for this purpose, the authors were assisted in the dissemination of the link and the average time of three months to collect the information.

III. Results

Table I shows the percentage of the three levels established by the scale (high, medium, low) for the variable "knowledge of augmented reality" perceived by regular basic education teachers with the characteristics mentioned in the methodology section.

TABLE I
FREQUENCY DISTRIBUTION OF THE VARIABLE "KNOWLEDGE OF AUGMENTED REALITY"

Level	Frequency	Percentage
Low	46	48.3%
Medium	24	22.4%
High	0	29.3%

Knowledge about augmented reality was as follows: 48.3% of the respondents are at high level, 22.4% at medium level, and 29.3% at low level. This result can be seen more clearly in Fig. 3.

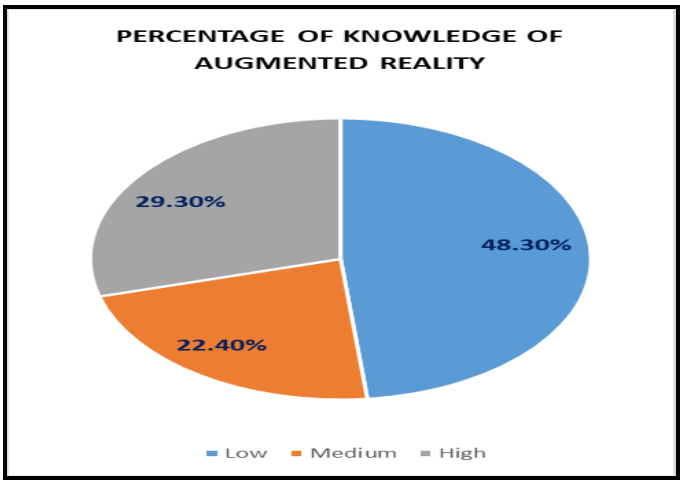

Fig. 3 Percentage of knowledge of augmented reality.

Table II shows the results of the application of the instrument to 58 teachers with emphasis on the three dimensions of the variable "augmented reality" ("experience with technology", "teaching practice with ICT" and "educational experience").

TABLE II
FREQUENCY DISTRIBUTION OF THE DIMENSIONS OF "KNOWLEDGE OF AUGMENTED REALITY"

Level	Level	Frequency	Percentage
Experience with technology	Low	6	10.3%
	Medium	8	13.8%
	High	44	75.9%
Teaching practice with ICT	Low	4	6.9%
	Medium	14	24.1%
	High	40	69.0%
Educational experience	Low	16	27.6%
	Medium	19	32.8%
	High	23	39.7%

Fig 4 graphically details the percentage of knowledge of the dimensions of augmented reality. In this sense, it is important to emphasize that the highest levels were found in the dimensions "teaching practice with ICT" and "educational experience".

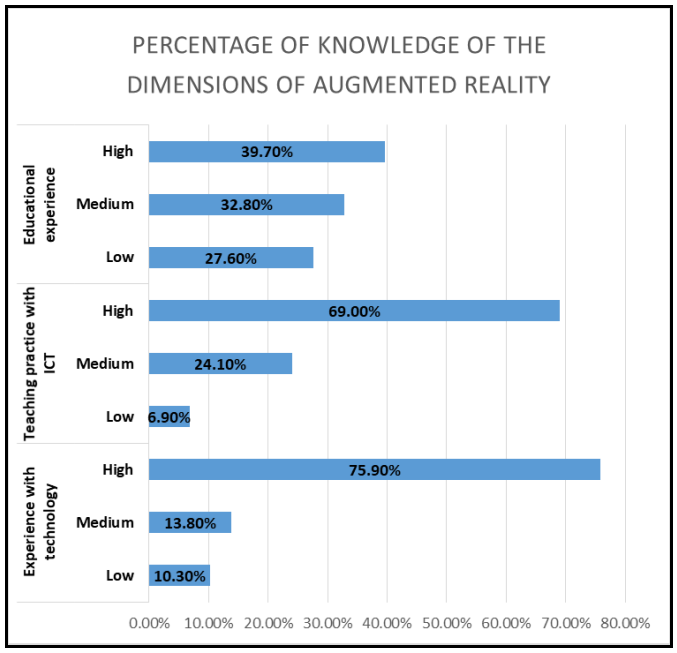

Fig. 4 Percentage of knowledge of the dimensions of augmented reality.

IV. CONCLUSIONS AND DISCUSSION

Augmented reality is a technological resource incorporated in the educational field, which provides interest and motivation to students.

The results obtained show that most teachers have a high level of knowledge about this resource.

Augmented reality is a technology that encompasses the exact sciences and social sciences in a meaningful way, thus conveying knowledge in an interactive way [17].

It follows the need to consider the need for teachers to inquire about the use of ICT. However, the lack of economic support and specialized training are limiting factors for the use of this tool to apply it to students.

This is an opportunity for improvement and, above all, for innovation and encouragement for both teachers and students [19].

The excluding reasons for this research was the lack of knowledge of the term augmented reality, although this remains in the daily work and according to the results, although they have high knowledge in augmented reality, there are 51.7% who have medium or low levels cumulatively. Therefore, it is necessary to analyze these results as worrying. Since teachers specialized in technology must be at the forefront, to offer alternatives to the user, which in this case is the students who apply it in their daily work. Also, knowledge and application must be parallel [19].

The technology used by teachers in classrooms reinforces the teaching process, where teachers and students build a complete thinking of different topics within their academic development, this given by the link between the knowledge that the teacher brings and the technology that is innate to the students [1].

Finally, it is important to consider that teachers have the ability and willingness to improve their professional skills and competencies, which is why they are self-taught. However, the lack of material and economic resources and the implementation of technology in the classroom hinder or limit educational quality. From the results, the need for updated information, search for digital information and the academic use of digital technologies can be deduced [20].

In this way, the taste for learning, better development of academic tasks, effective and efficient interactivity are perceived. Augmented reality should be implemented in all institutions, with the intention of improving learning processes for the benefit of the students themselves and the country.

The difficulties encountered in the research were the creation of digital content, lack of applicable knowledge, lack of research to help innovate the existing resources.

V. RECOMMENDATIONS

We recommend that teachers, not only those in charge of computer courses, be trained in the various virtual teaching methodologies, especially augmented reality. This methodology, which is characterized by offering interactive experiences to the

user from the combination of the virtual and physical dimension with the use of digital devices, gives good results in the educational environment.

On the other hand, we suggest to the leaders of public and private educational institutions to constantly monitor through measurements the levels of knowledge about augmented reality of their teachers.

Also, in order to further deepen scientific knowledge about this study variable and generate academic discussion, we recommend other researchers in the educational sciences and organizations to conduct similar studies, in other contexts both geographically and temporally.

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