

## Scale to measure the uses of CAT tools in university teachers during the COVID-19 pandemic in segregated territories

Víctor del Carmen Avendaño Porras<sup>1</sup>, Iris Alfonzo Albores<sup>2</sup>

<sup>1</sup>*Universidad de Boyacá*  
[vcavendano@uniboyaca.edu.co](mailto:vcavendano@uniboyaca.edu.co)

<sup>2</sup>*Centro Regional de Formación Docente e Investigación Educativa*  
[iris.alfonzo@cresur.edu.mx](mailto:iris.alfonzo@cresur.edu.mx)

### Abstract

At the beginning of the year 2020, the educational sector in Mexico was forced to suspend face-to-face classes to avoid contagion by the COVID-19 pandemic, and higher education had to migrate entirely to virtual classes. As a result of this, teachers put into practice the digital competencies they possessed, which revealed a digital illiteracy. The main objective of this research was to develop an instrument to measure the use of digital tools in higher level teaching, as well as to know the diversity of technologies that were adapted during the pandemic. For this purpose, the instrumental methodology of Hernández (2011) was used, applying the validation of experts, using the focus group method with a value of .75 that is considered a good degree of validity. Reliability was also analyzed using *Cronbach's Alpha*, which showed a value of .78, which is considered adequate. The questionnaire is composed of 55 items, 28 of which are integrated by means of a 5-level *Likert* scale (1: never; 5: always) composed of 7 categories. Therefore, it is considered to be a valid and reliable instrument. The instrument proposes clearly defined categories which will allow: to know in a precise way the performance of teachers and will contribute to the improvement and professional development of students.

**Keywords:** virtual learning, digital divide, higher education, educational technology, information technology.

### Introduction

After the spread of the global pandemic caused by coronavirus named COVID-19, at the end of March 2020, higher education institutions in Mexico faced a forced change, leaving the classroom and moving to the digital world, since the usual teaching and learning model had to be rethought, orienting it to a virtual modality, where synchronous and asynchronous activities were combined, with the help of educational technology, such as computer programs, social networks, Virtual Learning Environments - VLE-. Salinas (2011) considers the latter as an educational space hosted on the web, consisting of a set of computer tools that enable didactic interaction, where the new role of the teacher is as facilitator in learning environments, so he/she must apply strategies and be equipped with competencies, skills and abilities to fulfill the functions inherent to his/her tutoring.

In this sense, Dulac (2003, cited in Sánchez, 2018) states that teachers have to be facilitators of learning, managers of knowledge, and must be willing to permanent training for becoming a user of ICT. The teaching professionals must also know new codes, must be agile and flexible to rapid and intense changes, willing to curricular integration, and able to select resources and to design and produce media; that is, to be creative and innovative. In this sense, Llorente (2006) indicates that the virtual tutor fulfills five functions: technical, academic, organizational, guiding and social. Thus, he/she exercises a technical function when he/she makes sure that the students understand the technical functioning of the telematic training environment, giving advice and technical support, managing the formation of learning groups and maintaining contact with the human resource administrator of the system.

As stated by Almenara (2006, cited in Ortiz et al., 2021), the main support for these changes that are taking place today in most of teaching is provided by Information and Communication Technologies (ICT), which allow the configuration of teaching processes to the characteristics of the student, the adaptation of learning styles, the possibility of greater, faster and more synchronous interaction, and the implementation of quality models, not only focused on the technological variable but also on the didactic, organizational and pedagogical variables of teaching in its broadest sense.

Gómez et al., (2021) propose that the virtual learning modality is undoubtedly an essential part of the teaching-learning process, since the current context has led society down the path of technology and education is not exempt from this as ICTs have now become the teaching-learning process.

When speaking of virtualization, within the context of higher education, it can be composed of the representation of processes and objects associated with teaching, learning, research, extension and management activities, as well as objects whose manipulation allows the user to perform various operations through the Internet, such as: learning through interaction with electronic courses, enrolling in a course, consulting documents in an electronic library, communicating with students and professors, and others (Silvio, 2000).

Currently, access to ICT has been one of the solutions that educational institutions have used to transform their teaching-learning methodologies, migrating to virtual education. As Pacheco and Martinez (2021) argue, digital technologies are defining the new forms of education, and as a consequence they need a much deeper analysis, to review whether the use is adequate and correct to achieve learning in students.

These technologies have been constantly changing, to name a few: blogs, wikis, search engines such as Google, *YouTube* audio and video files or *WhatsApp* instant messaging.

For Vargas et al. (2021), blogs are spaces for publishing in an easy way, that have a variety of contents and their use has renewed old technologies. Blogs have two characteristics: community and conversation, because they allow individual orderly publications, but at the

same time feedback on a specific topic, achieving an analysis as a whole.

Area (2010) mentions that wikis could be defined as an online tool for group writing, also considered as a tool that facilitates the planning, resolution, compilation, revision and improvement of exercises (Pérez et al., 2008).

Another widely used tool in the virtual educational environment are search engines, which although they are a platform that allows retrieving files stored on an Internet server, in research that has been developed, it is considered that they have the ability to scan through different electronic networks; some of the most used search engines are *Google* or *Windows Live*, as fundamental tools in the activities developed by teachers and students in daily teaching practice (Castrillón et al., 2008).

According to Ramirez (2016), the *YouTube* tool presents all the communicative attributes that describe the theory built for Computer Mediated Communication (CMC). It has a complex media particularity, which is typified and classified as an asynchronous tool, primarily transmissive, secondarily interactive, for sharing videos and creating communities around shared resources.

This tool is mostly used by teachers to complement their planning or activities that are developed virtually and to achieve learning in their students. In relation to social networks, there are several applications that are used for interaction between teachers and students. As mentioned by Perez (2021), technological advances cause students to be absorbed in their cell phones, computers and other instruments of the same nature, where teachers must take advantage of this situation and the influence currently exerted by the different hybrid genres that exist, such as instant messaging as a pedagogical resource.

Mueses (2021) explains that effective communication is a fundamental characteristic between teachers-students and teachers-parents and, therefore, education system can make use of ICT, and one of the tools that contribute to strengthen communication is the Smartphone and its different applications such as *WhatsApp*, which is a free and multiplatform application.

Digital competencies in the current era are all the fundamental abilities and skills needed by teachers, students, professionals and other actors

to develop and improve their teaching, learning, research, professional activities, among others. It is worth noting the importance of digital literacy in teachers. Silvera (2005) defines it as that which often involves the appropriation of new knowledge from learning to use hardware components, applications and programs, search mechanisms and information available in electronic environments, as an end in itself.

Vargas (2019) states that the knowledge and application of digital competence has the purpose of promoting the critical use of digital resources and tools in educational, scientific and participatory processes. Digital tools are the complement for the development of digital competencies.

It is extremely important to take into account some characteristics and consequences that are a product of the information and knowledge society and that are reflected in the creation of new types of inequalities or in the enhancement of existing ones. One example of these inequalities is the digital divide, which Serrano and Martínez (2003) define as the separation that exists between people (communities, states, countries...) who use ICTs as a routine part of their daily lives and those who do not have access to them and, even if they do, do not know how to use them.

According to Hu et al. (2018, cited in Alvarez and Garcia, 2021), the digital divide can be at three levels: ICT access, ICT use and ICT knowledge. According to this, it is well known that rural regions present greater difficulty in connectivity or having technological resources than urban regions, so there is a greater gap between teachers and students. In Mexico, unfortunately, the material, social and educational conditions in which millions of Mexicans live reveal that there is a large digital divide. This is attributable to reasons as diverse as the lack of teacher training in the use of ICT, the non-existence of teaching materials designed

for distance or online teaching, insufficient coverage of internet services, and limited access to mobile devices or computers, among others, (Fernández et al., 2020).

The present study is based on this context, which seeks to analyze the use of various digital tools by teachers at the higher education level during an emerging educational situation.

**Method**

The type of study was instrumental with the objective of proposing the creation of a new instrument that measures the use of digital tools in higher education, as well as to know the diversity of technologies that were adapted during the pandemic; the instrument was subjected to the content validity of Hernandez (2011) and the reliability of *Cronbach's Alpha* during the months of July and August 2021.

This instrument was developed *ad hoc* to learn about the characteristics of a teaching-learning model for virtuality in technologically marginalized regions and to determine the advantages and disadvantages of higher education with the use of Virtual Learning Environments.

A review of the literature on educational technologies, ICT use, technological competencies, implementation of Virtual Learning Environments, and similar instruments applied in environments with significant digital divides and that revealed the uses of technological tools during the COVID-19 pandemic was developed.

Subsequently, a proposal was designed based on instruments already applied, which can be seen in Table 1.

**Table 1.**

Authors who have designed instruments regarding the use of digital tools in the COVID-19 pandemic.

Authors	Title of the instrument
UNESCO (2020)	Higher Education Institutions of Latin America and the Caribbean (ESALC) on educational continuity during the COVID-19 crisis.

Baptista, Almazán and Loeza (2020)	National Teacher Survey before COVID-19.
Enriquez and Gargiulo (2020)	Survey on virtual education in times of COVID-19
School Education Gateway (2020)	Online and distance learning survey.
Ricardo (2013)	Training and Development of Intercultural Competence
Sobrino (2004)	Online training satisfaction questionnaire.

*Note:* from each of these instruments, the most relevant items were selected to be considered for the objective of the instrument: to measure the use of digital tools in higher education teaching, as well as to know the diversity of technologies that were adapted during the pandemic.

To analyze the content validity, a first version of the instrument was designed with 75 items, and the questionnaire was analyzed by two groups of experts, as described in Table 2.

**Table 2**

Experts who validated the questionnaire.

Focus group	Features	Expert profiles.
Focus group 1: composed of 8 experts.	Specialists in methodology with profiles in common of doctors in education, who have a wide and varied professional experience, have theoretical and practical knowledge.	1 upper secondary education teacher, 1 university professor, 1 counselor, 3 teachers in preschool and elementary education and 2 postgraduate teachers.
Focus group 2: composed of 4 experts.	They have experience in making judgments and assessments, and in the application of ICT in the classroom and/or in the implementation of knowledge management processes.	4 experts in the use of digital tools.

*Note:* in order to issue the critical analysis of the instrument, both groups of experts met in person for a 5-hour session, at the beginning of which each was informed of the methodology proposed by Hernández (2011) that would be used to validate the instrument.

All the experts issued a critical analysis of the indicators of adequacy and relevance of the

items (taking into consideration a scale of values from 1 to 6) indicating the level of agreement or disagreement using a Likert-type scale: 1) strongly disagree, 2) disagree, 3) disagree more than agree, 4) agree more than disagree, 5) agree, 6) strongly agree in relation to each of the categories being analyzed.

Once the scores of all the experts attributed to the sections of the instrument were obtained, these scores were transferred to the validity matrix to obtain the average and check the validity, obtaining a validity of .75, so it is considered to be an instrument with good validity. As a result of this procedure, 20 items were eliminated because there was no consensus on the part of both groups of experts and modifications were made in the wording of some items to improve their clarity and comprehension, until the final version of the instrument was configured with 55 items.

To check the reliability of the instrument, *Cronbach's Alpha* coefficient was calculated, a measure of internal consistency, which, as Welch and Comer (1998, cited in García and Cantón, 2020) point out, assumes that the items measure the same construct and that they are highly correlated; therefore, a pilot test was conducted with 5 teachers from various

undergraduate programs in public and private institutions to obtain the reliability of *Cronbach's Alpha* coefficient, which yielded a value of  $\alpha=.780$ , which shows a high reliability.

**Results**

In order to analyze the results obtained from the validation and reliability of the instrument, next tables present the scores collected by all the experts and participants in the sampling, which were classified by the 7 categories contained in the instrument, in order to obtain the average and check the validity at first.

In order to show an optimal presentation of the results, the data were broken down into different tables, taking into consideration the categories mentioned.

**Table 3**

*Validated items of the categories: Basic data and technological solutions*

<b>Basic data and technological solutions</b>						
N. Item	Sum	Mx	VC	P	Validity	Category
1		4.69048	0.58631	5.96046E-08	0.5863095	<i>Data basics</i>
		4.66667	0.58333	5.96046E-08	0.5833333	
		4.95238	0.61905	5.96046E-08	0.6190476	
	205	4.88095	0.61012	5.96046E-08	0.610119	
5	279	6.64285714	0.83035714	5.9605E-08	0.83035708	
	214	5.09524	0.6369	5.96046E-08	0.6369047	<i>Solutions technology</i>
	284	6.76190476	0.8452381	5.9605E-08	0.84523804	
	254	6.04761905	0.75595238	5.9605E-08	0.75595232	
	279	6.64285714	0.83035714	5.9605E-08	0.83035708	
	282	6.71428571	0.83928571	5.9605E-08	0.83928565	
		5.33333	0.66667	5.96046E-08	0.6666666	
	277	6.5952381	0.82440476	5.9605E-08	0.8244047	
	272	6.47619048	0.80952381	5.9605E-08	0.80952375	
	265	6.30952381	0.78869048	5.9605E-08	0.78869042	
	275	6.54761905	0.81845238	5.9605E-08	0.81845232	

	230	5.476190476	0.68452381	5.96046E-08	0.68452375
		6.66666667	0.83333333	5.9605E-08	0.83333327
	264	6.28571429	0.78571429	5.9605E-08	0.78571423

*Note:* the validated items of the categories - Basic data and technological solutions- can be observed: Basic data and technological solutions, where the number of items is specified, and the validity they had when evaluated by all the experts, most of these items had a good validity, with a score higher than .80. The objective of both categories is to gather information that allows to know the different technological solutions used by teachers during the pandemic, such as: if the institution where they work used or has virtual platforms and the characteristics they have, as well as the technological resources they used to teach their classes, the use and frequency of internet use and the computer devices they have for their classes,

among others. It is worth mentioning that the items that presented an acceptable validation were adapted to improve clarity and coherence in their wording.

To learn about the management, communication, teaching and pedagogical activities that teachers developed during the pandemic, a battery of items was proposed to gather information regarding these processes that are vital in a classroom, which were affected during the COVID-19 pandemic and are presented in Table 4.

**Table 4.**

*Validated items of the categories: Management and communication activities, Teaching and pedagogical activities.*

<b>Management and communication activities, Teaching and pedagogical activities</b>						
N. Item	Sum	Mx	VC	P	Validity	Category
	281	6.6904762	0.8363095	5.96046E-08	0.8363095	<i>Management and communication activities</i>
	292	6.952381	0.8690476	5.96046E-08	0.8690476	
	264	6.2857143	0.7857143	5.96046E-08	0.7857142	
	297	7.0714286	0.8839286	5.96046E-08	0.8839285	
		6.0714286	0.7589286	5.96046E-08	0.7589285	
	241	5.7380952	0.7172619	5.96046E-08	0.7172618	
	261	6.2142857	0.7767857	5.96046E-08	0.7767857	
	262	6.2380952	0.7797619	5.96046E-08	0.7797618	
	231	5.5	0.6875	5.96046E-08	0.68749994	
	231	5.5	0.6875	5.96046E-08	0.68749994	
	264	6.2857143	0.7857143	5.96046E-08	0.7857142	<i>Teaching and pedagogical activities.</i>
	286	6.8095238	0.8511905	5.96046E-08	0.8511904	
	287	6.8333333	0.8541667	5.96046E-08	0.8541666	

		6.4285714	0.8035714	5.96046E-08	0.8035714
	278	6.6190476	0.827381	5.96046E-08	0.8273809
	263	6.2619048	0.7827381	5.96046E-08	0.782738
		6.4285714	0.8035714	5.96046E-08	0.8035714
	267	6.3571429	0.7946429	5.96046E-08	0.7946428
	266	6.3333333	0.7916667	5.96046E-08	0.7916666
		6.6666667	0.8333333	5.96046E-08	0.8333333
	294		0.875	5.96046E-08	0.8749999
	272	6.4761905	0.8095238	5.96046E-08	0.8095237
	277	6.5952381	0.8244048	5.96046E-08	0.8244047

*Note:* These are the items corresponding to management and communication activities, teaching and pedagogical activities, intended to obtain information regarding the use of digital tools that each teacher used to have communication with their students, managers and other teachers; also to identify their perception regarding the use that students make of virtual platforms, as well as the activities and didactic resources that they develop in their virtual counseling, and finally to know the challenges, opinions or strategies that they have implemented in the virtuality of their teaching practice; managing to observe that most of the items present a high validation greater than .80

and those with lower scores were adapted accordingly.

In order to collect information regarding the use of technological resources to improve teaching and facilitate access to education, the barriers faced by teachers in the classroom, as well as the opinion they have regarding the use of the platforms and finally their relationship with the intercultural processes that teachers developed during the pandemic, a block of questions was proposed that obtained the following results.

**Table 5.**

*Validated items of the categories: Technological and pedagogical support, Difficulties and teacher perception, Interculturality and general average.*

<b>Technological and pedagogical support, Difficulties and teachers' perceptions, Interculturality</b>						
N. Item	Sum	Mx	VC	P	Validity	Category
42		5.952381	0.7440476	5.96046E-08	0.7440476	<i>Technological and pedagogical support</i>
	266	6.3333333	0.7916667	5.96046E-08	0.7916666	
	245	5.8333333	0.7291667	5.96046E-08	0.7291666	
45		5.523809524	0.69047619	5.96046E-08	0.690476131	
	229	5.452380952	0.681547619	5.96046E-08	0.681547559	
	236	5.6190476	0.702381	5.96046E-08	0.7023809	
	277	6.5952381	0.8244048	5.96046E-08	0.8244047	

	245	5.8333333	0.7291667	5.96046E-08	0.7291666	
	284	6.7619048	0.8452381	5.96046E-08	0.845238	
	254	6.047619	0.7559524	5.96046E-08	0.7559523	
	235	5.595238095	0.699404762	5.96046E-08	0.699404702	
	252		0.75	5.96046E-08	0.7499999	<i>Difficulties and teacher perception</i>
		5.952381	0.7440476	5.96046E-08	0.7440476	
	252		0.75	5.96046E-08	0.7499999	
		5.952381	0.7440476	5.96046E-08	0.7440476	
	269	6.4047619	0.8005952	5.96046E-08	0.8005952	
58	231	5.5	0.6875	5.96046E-08	0.68749994	
	241	5.7380952	0.7172619	5.96046E-08	0.7172618	
	238	5.6666667	0.7083333	5.96046E-08	0.7083333	
	259	6.1666667	0.7708333	5.96046E-08	0.7708333	
	231	5.5	0.6875	5.96046E-08	0.68749994	
	238	5.6666667	0.7083333	5.96046E-08	0.7083333	
		4.666666667	0.583333333	5.96046E-08	0.583333274	
	217	5.166666667	0.645833333	5.96046E-08	0.645833274	
		5.333333333	0.666666667	5.96046E-08	0.666666607	
	249	5.9285714	0.7410714	5.96046E-08	0.7410714	
	231	5.5	0.6875	5.96046E-08	0.68749994	
	245	5.8333333	0.7291667	5.96046E-08	0.7291666	
	231	5.5	0.6875	5.96046E-08	0.68749994	
	248	5.9047619	0.7380952	5.96046E-08	0.7380952	
	273	6.5	0.8125	5.96046E-08	0.8124999	
	254	6.047619	0.7559524	5.96046E-08	0.7559523	
	277	6.5952381	0.8244048	5.96046E-08	0.8244047	
	268	6.380952381	0.797619048	5.96046E-08	0.797618988	
				CVC	0.755992	

*Note:* the purpose of these items is to obtain information with which to detect the alternatives that teachers have to feel supported and motivated in their educational work by their directors and administrators, as well as to know the progress obtained during the contingency

period on: the didactics of virtual education and their interest in training in virtual teaching. In the same way, items are proposed to collect data on the accessibility problems presented by the students to take their virtual classes.



A Content Validity Coefficient (CVC) of 0.75 was obtained for this instrument, so it is considered to be an instrument with good validity.

As a result of this procedure, 20 items were discarded (see Table 6) because the expert focus

groups did not agree, and modifications were made to the wording of some items to improve their clarity and comprehension, until the final version of the proposed instrument was configured with 55 items (see Table 7).

**Table 6.**

*Deleted and modified items.*

Deleted and modified items						
N. Item	Sum	Mx	VC	P	Validity	Result
1		4.69047619	0.58630952	5.9605E-08	0.58630946	Unacceptable
		4.66666667	0.58333333	5.9605E-08	0.58333327	Unacceptable
		4.95238095	0.61904762	5.9605E-08	0.61904756	Deficient
	205	4.88095238	0.61011905	5.9605E-08	0.61011899	Deficient
	214	5.0952381	0.63690476	5.9605E-08	0.6369047	Deficient
		5.33333333	0.66666667	5.9605E-08	0.66666661	Deficient
	230	5.47619048	0.68452381	5.9605E-08	0.68452375	Deficient
	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient

	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient
45		5.52380952	0.69047619	5.9605E-08	0.69047613	Deficient
	229	5.45238095	0.68154762	5.9605E-08	0.68154756	Deficient
52	235	5.5952381	0.69940476	5.9605E-08	0.6994047	Deficient
58	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient
	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient
		4.66666667	0.58333333	5.9605E-08	0.58333327	Unacceptable
	217	5.16666667	0.64583333	5.9605E-08	0.64583327	Deficient
		5.33333333	0.66666667	5.9605E-08	0.66666661	Deficient
	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient
	231	5.5	0.6875	5.9605E-08	0.68749994	Deficient
		5	0.625	5.9605E-08	0.62499994	Deficient

Note: the questions that had a validity lower than 0.70 are presented, and according to Balbinotti (2004, cited in Pedrosa, Suárez and García,

2013), who recommends criteria to keep only those items with a *Content Validity Coefficient*

higher than 0.70, thus, the decision was made to eliminate them from the original questionnaire.

The final version of the questionnaire for measuring the use of digital tools for university

teachers during the covid-19 pandemic in technologically marginalized regions consisted of 7 categories and 55 items, as shown in Table 7.

**Table 7.**

*Final ranking of accepted items.*

Category	Item	Number of Items
Basic data	1-4	
Technological solutions	5-14	
Management and communication activities	15-21	
Teaching and pedagogical activities	22-33	
Technological and pedagogical support	34-42	
Difficulties and teacher perception	43-49	
Interculturality	50-55	

*Note:* from the category -Basic data-, sociodemographic data of the teachers will be obtained (name and regime of the institution of origin, age, average number of students attended, previous virtual experience). Subsequently, the category of -Technological solutions-, refers to the type of platforms, digital tools, technological resources and applications used for teaching during the COVID-19 pandemic. The category of Management and communication activities, collects information on the use of digital tools for communication between students, teachers, directors, as well as the connectivity times that the advisors remained in their virtual classrooms, followed by the items that make up the category of Teaching and pedagogical activities where the authors inquire about the activities and resources they used to teach their virtual classes, as well as the challenges they have faced, then they integrate the items related to Technological and pedagogical support, where it is intended to know: The items related to Technological and pedagogical support, where the aim is to know the support for online learning that teachers had during the closure of the educational centers and continuing with the questions on Difficulties and teacher perception that allow identifying the barriers faced by teachers to teach their virtual classes and finally the items on Interculturality

are presented, which will allow identifying the teachers' own knowledge and whether they practice it in the classroom.

Subsequently, the questionnaire was applied to 5 teachers from public and private institutions in the Chiapas Highlands, chosen intentionally because of the possibilities of access to them, so that the degree of understanding of the items could be investigated.

The items that measure the teachers' perception of the use of digital tools were analyzed using a Likert scale of 5 levels 1: never; 5: always, of which 28 correspond to the total of 55 contained in the questionnaire, integrating each category as follows: Technological and pedagogical support (2 items), Management and communication activities(5 items), Teaching and pedagogical activities (2 items), Technological and pedagogical support (7 items), Teaching difficulties and perception (7 items), Interculturality (5 items), as shown in Table 8.

The rest of the items that were not considered for the reliability analysis were proposed with multiple-choice answers, because they are specific data on the names of digital tools, applications, educational technologies, among others.

**Table 8.**

*Rating of items to validate reliability.*

Category	No. of items	Number of Items
Technological solutions	5-14	
Management and communication activities	15-21	5
Teaching and pedagogical activities	22-33	
Technological and pedagogical support	34-42	
Difficulties and teacher perception	43-49	
Interculturality	50-55	5
Total		

*Note:* to achieve the internal consistency reliability obtained through the *Cronbach's Alpha* reliability coefficient, it was determined to use only the items that met the criteria in their responses according to the *Likert scale*, which is ideal for measuring reactions, attitudes and behaviors of a person, in this case, to indicate their opinion about the use of digital tools during the COVID-19 pandemic.

After the application of the questionnaires to the teachers in the pilot test, the results obtained are shown in Table 9: the variances of the categories can be observed: Technological solutions, Management and communication activities, Teaching and pedagogical activities and Technological and pedagogical support.

**Table 9.**

*Variance of the categories: Technological solutions, Management and communication activities, Teaching and pedagogical activities, and Technological and pedagogical support.*

Categories	Technological solutions	Management and communication activities	Teaching and pedagogical activities	Technological and pedagogical support												
	Variables (questions)															
Respondents	5															
E1	1	5	5	5	5			5			1			5		
E2	5	5	5	5	5		5		5	5				5		
E3		5	5	5	5	5	5	5	5	5			5	5		
E4		5	5	5				5								
E5	1	5	5	5	5			5				5	5		5	
Variance	2.56	0.00	0.00	0.00	0.16	0.16	0.56	0.64	1.36	0.56	1.20	0.16	0.24	0.24	0.40	0.64

*Note:* For the calculation of *Cronbach's Alpha*, it was determined using MS Excel, which makes it possible to easily calculate this formula by creating a Data Table in which the columns represent the variables (questions), classified by categories: Technological solutions, Management and communication activities, Teaching and pedagogical activities and Technological and pedagogical support. The rows represent the individuals and the value indicated by the respondent, according to the *Likert Scale* employed, as well as the variances obtained by each item.

Next, the calculation of the variances of the categories was performed: Difficulties and teacher perception, Interculturality and also the sum of scores of all the items answered by the respondents, in order to obtain the sum of the variances and the variance of the total of the items, data necessary for the calculation of the internal consistency reliability, by means of *Cronbach's Alpha* coefficient, as pointed out by Cronbach, (1951, cited in González and Pazmiño, 2015).

**Table 10.**

*Variances of the categories: Difficulties and teacher perception, Interculturality and reliability statistics.*

Cat.	Difficulties and teacher perception							Interculturality					Sum of items
Respondents	Variables (questions)												
			45						52				
E1	5							5					
E2		5				5		5	5	5			
E3		5				5	5	5	5	5	5		
E4	5												
E5	5						5						
Variance	1.60	0.24	0.16	0.00	0.16	1.36	0.24	0.24	0.56	0.24	0.16	0.00	
Sum of variances	13.840												
Variance of the sum of the items	55.760												
Number of items of instrument K:	28												
Questionnaire reliability coefficient	<b>.780</b>												
$\alpha = \frac{K}{K-1} \left[ 1 - \frac{\sum S_i^2}{S_T^2} \right]$													

*Note:* the columns represent the variables (questions), classified by the categories of - Difficulties and teacher perception and interculturality used in the questionnaire; the rows represent the subjects and the value indicated by them, according to the *Likert Scale* used, as well as the variances obtained for each

item, also showing the results of the sum of the variances with a value of 13.840 and the calculation of the variance of the sum of the items of the questionnaire of 55.760.

To check the reliability of the instrument, the authors calculated *Cronbach's Alpha* coefficient, this being, as mentioned by González and Pazmiño (2015), a simple and reliable way to validate the construct of a scale and as a measure that quantifies the correlation between the items that compose it, therefore, Table 10 shows the results achieved for the questionnaire under validation, where *Cronbach's Alpha* coefficient yielded a value of  $\alpha = .780$ , which shows excellent reliability.

### Discussion and conclusions.

Based on the stated objective and the results obtained, it should be noted that the Questionnaire to Measure the use of digital tools for teaching at the higher education level is reliable and valid. The *Cronbach's Alpha* test, as well as the analysis of the validity matrix by the experts yield high results, which show the strength of the instrument.

Among the documents reviewed on the use of digital tools during the COVID-19 pandemic, all have in common the use of surveys or questionnaires, for being the most frequently used, however, they coincide in their use. The difference in this proposal is that it focuses on different categories, which will allow to know the practical work of each of the digital tools used by teachers in their professional practice. In the first place, it will allow identifying the devices used during the pandemic and the times they were used at; secondly, it is intended to be an instrument for reviewing and improving the teaching given, regardless of the subject. Thirdly, it is an instrument that is not used for institutional evaluation, but rather to learn about and improve pedagogical, teaching, management and communication activities among university advisors. Finally, a section is added on teaching limitations and perception, as well as the concept of interculturality.

A Likert scale instrument allows the application to be faster and less laborious compared to instruments with open-ended questions, so it cannot be affirmed that this instrument is the only one to propose the collection of information regarding the use of digital tools in times of COVID-19, however, it proposes clearly defined categories, which will allow to know which virtual tools were used by higher

education teachers, as well as to know the diversity of technologies that were adapted during the pandemic. Only through this type of instrumental proposals, it will be possible to identify with greater precision the uses of technological tools and to go deeper into the subject.

### References

- [1] Hernández, R. (2011). *Data collection instruments in social sciences and biomedical sciences*. Universidad de Los Andes.
- [2] Salinas, M. (2011). Virtual learning environments at school: types, didactic model and teacher's role. Catholic University of Argentina.
- [3] Sánchez D. (2018). *Objetos Virtuales de Aprendizaje como estrategia didáctica de enseñanza aprendizaje en la educación superior tecnológica* (Master's Thesis). Technical University of Ambato, Ecuador.
- [4] Llorente M. (2006). The tutor in E-learning: aspects to take into account. *EduTec*, 20, 1-24.
- [5] Ortiz, A., Olmos S., and Sánchez, J. (2021). Quality in e-Learning: Identification of its dimensions, proposal and validation of a model for its evaluation in Higher Education. *RIED. Revista Iberoamericana de Educación a Distancia*, 24(2), 225-244.
- [6] Gómez, E., Lagunes, A., & Torres, C (2021). Digital literature review of evaluative instruments for virtual learning modality. *Pädi Boletín Científico De Ciencias Básicas E Ingenierías Del ICBI*, 9(Especial), 68-73.
- [7] Silvio, J. (2000). The virtualization of the university: How to transform higher education with technology? Caracas, Venezuela: IESCALC.
- [8] Pacheco, D., and Martínez, M. (2021). "Perceptions of the incursion of ICT in higher education in Ecuador. " *Estudios pedagógicos (Valdivia)*, 47(2), 99-116.
- [9] Vargas, L., Romero, L., Rodríguez, E., Moyano, L., & Adrian, F. (2021). *Blogging as a digital tool in portfolios. New scope of teaching practice*.
- [10] Area Moreira, M. (2010). "Wikis in my teaching experience. From the subject dictionary to the class diary". *Revista de Educación a Distancia (RED)*.

- [11] Pérez, P., Gayo, D., Labra, J., Redondo, J., Fernández, C., & Prado, M. (2008). Use of Wikis as support in collaborative development of exercises. *II Conference of Exchange of Experiences in University Teaching at the University of Oviedo. University of Oviedo.*
- [12] Castrillón, J., Domínguez, J., Anaya, M., Rodríguez, D., De la Rosa, D., and Caballero, C. (2008). Databases, search engines and subject indexes: fundamental tools for medical practice. *Salud Uninorte*, 24(1), 95-119.
- [13] Ramirez, M. (2016). "Possibilities of the educational use of youtube", 12(6). *Ra Ximhai*, 537-546.
- [14] Pérez, R. (2021). "Instant messaging in the teaching of literature in the Secondary classroom: WhatsApp Messenger". WhatsApp Messenger. " *Lenguaje y Textos*, (53), 103-117.
- [15] Mueses, I. C. (2021). "Whatsapp a tool for communication and education. " *Revista Universitaria De Informática RUNIN*,8(11), 53-58.
- [16] Silvera, C. (2005). "Digital literacy: a tool for achieving development and equity in Latin American and Caribbean countries. " *ACIMED*, 13(1), 1-1.
- [17] Vargas, G. (2019). "Digital competencies and their integration with technological tools in higher education. " *Cuadernos Hospital de Clínicas*, 60(1), 88-94.
- [18] Serrano, A., and Martinez, E. (2003). *The digital divide. Myths and realities*. Mexicali, Baja California, Mexico: Editorial Universitaria Autónoma de Baja California.
- [19] Álvarez, M., and García, F. (2021). Digital divide and new academic forms in Spanish rural schools during confinement.
- [20] Fernández, M., Herrera N, Hernández, D, Nolasco, R., De la Rosa, R. (2020). Lessons from covid-19 for the Mexican educational system, Nexos. *Distance for times. Education blog*.
- [21] UNESCO (2020). "IESALC survey on formative strategies during the COVID-19 pandemic."
- [22] Baptista, P., Almazán, A., and Loeza, C. (2020). "Encuesta Nacional a Docentes ante el COVID-19. Retos para la educación a distancia. " *Revista Latinoamericana De Estudios Educativos*, 50(especial), 41-88.
- [23] Gargiulo, S., and Gómez, F. Blog of the virtual community of practice "Docentes en línea". Pandemic and virtual education.
- [24] School Education Gateway. (2020). Online and distance learning survey results.
- [25] Ricardo C. (2013). Training and development of intercultural competence.
- [26] Sobrino, Á., and Reparaz, C. (2004). Questionnaire of satisfaction with online training.
- [27] García, S., and Cantón, I. (2020). Validation of a questionnaire to assess the use of technologies. *Revista fuentes*, 13-23.
- [28] Pedrosa, I., Suárez and García, E. (2013). Evidencias sobre la Validez de Contenido: Avances Teóricos y Métodos para su Estimación [Content Validity Evidences: Theoretical Advances and Estimation Methods]. *Psychological Action*, 10(2), x-xx.
- [29] González, J., and Pazmiño, M. (2015). Calculation and interpretation of Cronbach's Alpha for the case of validation of the internal consistency of a questionnaire, with two possible Likert-type scales. *Revista Publicando*, 2(1), 62-67.