Teaching skills, an innovation in virtual learning Environments in higher education

Competencias docentes, una innovación en ambientes virtuales de aprendizaje en educación superior

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Keywords
Virtual learning environments; educational quality criteria; teaching skills; higher education

ABSTRACT

The emergency closure of educational institutions, in the face of the health contingency due to Covid-19, has prompted the rethinking of the models of teaching competencies to adapt to virtual learning environments (VLE). The objective of this study is to design and validate a model of teaching competencies in VLE, with the support of virtual laboratories, to ensure the quality of higher education during the covid-19 pandemic. A quantitative and correlational methodology was used in a case study. The research is divided into two methodological moments: the design of the model and its validation. The instruments used were a comparative analysis matrix and a Likert-type scale. 5 650 students and 41 teachers participated in the validation cap. The results highlight the need for teacher development, mainly in digital and research skills. One weakness of the study is the lack of weighting of the quality indicators. The proposed model represents an innovation in the definition of indicators, in the form of competencies, for the assurance of educational quality in VLE. It is concluded that the proposed model is pertinent for the assurance of educational quality in VLE.

Palabras clave
Ambientes virtuales de aprendizaje; criterios de calidad educativa; competencias docentes; educación superior

RESUMEN

El cierre de emergencia de las instituciones educativas ante la contingencia sanitaria por la covid-19 ha apremiado el replanteamiento de los modelos de competencias docentes para adaptarse a los ambientes virtuales de aprendizaje (AVA). El objetivo de este estudio fue diseñar y validar un modelo de competencias docentes en AVA, con el soporte de laboratorios virtuales, a fin de asegurar la calidad de la educación superior en este contexto. Se empleó una metodología cuantitativa y correlacional en un estudio de caso. La investigación se dividió en dos momentos metodológicos: el diseño del modelo y su validación. Los instrumentos utilizados fueron una matriz de análisis comparativo y una escala tipo Likert. En la etapa de validación participaron 5 650 estudiantes y 41 profesores. Los resultados destacan la necesidad del desarrollo docente, principalmente en las competencias digitales y de investigación. Una debilidad del estudio es la falta de ponderación de los indicadores de calidad. El modelo propuesto representa una innovación en la definición de indicadores, en forma de competencias, para el aseguramiento de la calidad educativa en los AVA. Se concluye que el modelo propuesto es pertinente para el aseguramiento de la calidad educativa en AVA.

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INTRODUCTION

The quality of education at the higher educational level

Educational institutions have become increasingly aware of the importance of offering high quality education to meet the needs of a diversity of students, as well as global changes and adaptation to the context of the Covid-19 pandemic. This, coupled with the different educational modalities existing in higher education (face-to-face, online or mixed), requires that innovative ways of guaranteeing and systematizing quality in these institutions be proposed.

Recent studies on quality in higher education (Kundu, 2017) have focused mainly on: a) quality models based on TQM (Total Quality Management), b) quality based on results, c) quality seen as a system d) service quality from the stakeholders' perspective, e) quality gaps in international higher education, f) quality from the students' perspective, g) quality of e-learning systems, and h) critical factors that determine success in educational quality.

Other reviews (Prakash, 2018) indicate that the constructs of learning quality, service quality, and student satisfaction have received the most attention, followed by total quality management, quality assurance, and comprehensive evaluation in student performance. In turn, the methodological aspects mostly used have been the empirical method, surveys and individual case studies. Europe leads in research on the quality of higher education institutions (HEIs), followed by North America and Asia.

Furthermore, HEIs have opted to obtain national and international accreditation to guarantee the quality of their programs and institutions. In a context of globalization, accreditation is a quality assurance tool that attests that an institution or program has undergone a rigorous external evaluation process (Kumar, Shukla and Passey, 2020). Educational quality accreditations have made it possible to implement a culture of accountability, under the idea that they are tools for development and economic well-being (Jimenez, 2019). For this reason, for the development of the proposed model, the teaching quality criteria considered by seven accrediting agencies, five international and two national, were reviewed, as well as the analysis of the substantive quality indicators of six educational models, both national and international (see Table 1).

Table 1. Quality accrediting agencies and educational models analyzed

LIST OF QUALITY ACCREDITATION BODIES ANALYZED TO COMPARE THEIR INDICATORS IN VIRTUAL LEARNING ENVIRONMENTS
United States • Council for Higher Education Accreditation (CHEA) • Association to advance Collegiate Schools of Business (AACSB) • Accreditation Board for Engineering and Technology (ABET)
European union • Higher Education Funding Council for England (HEFCE) • European Quality Improvement System (EQUIS)
Mexico • National Council of Science and Technology (CONACyT, by its Spanish acronym) • Inter-institutional Committees for the Evaluation of Higher Education (CIEES)
LIST OF EDUCATIONAL MODELS ANALYZED FOR PURCHASING THEIR INDICATORS IN VIRTUAL LEARNING ENVIRONMENTS
UNED: Model of the Universidad Estatal a Distancia, Universidad Pública de Madrid, España UOC: Model of the Universitat Oberta de Catalunya, España CSU: California State University – Chico State Unesco: Unesco ICT Competence Standards for Teachers T-PACK: Technological Pedagogical Content Knowledge SEP: Guidelines for regulating higher education programs in non-school and blended modalities

Due to the Covid-19 pandemic, the challenge for HEIs was to adapt or innovate their academic quality models to the virtual modality, in the totality of their educational offerings. Teachers, for their part, have faced difficulties such as inadequate access to the Internet, lack of infrastructure (access gap), management of virtual classes and the distance education process itself (digital competencies gap) (García-Peñalvo, Corell, Abella-García and Grande, 2020; Sari and Nayir, 2020; Barrón, 2020).

Given the impact of the so-called post-pandemic "new normal", virtual or hybrid forms of education are likely to prevail for a long time (Cabero-Almenara and Llorente-Cejudo, 2020). This makes it necessary to innovate teaching profiles that underpin the competencies to perform in virtual learning environments. In this sense, the model presented here addresses this emerging need.

QUALITY ASSESSMENT FROM A STUDENT SATISFACTION PERSPECTIVE

By considering students as the direct beneficiaries of higher education, educational quality can be defined as "a direct relationship between expectations and perceptions of lived experiences" (Herrera, Souza, & De Quadros, 2018, p. 73). It is appropriate to assess it from the students' perception of satisfaction, through the generation of meaningful experiences.

Thus, in order to provide educational services of academic quality, institutions must understand the needs of their students. In addition to providing an efficient and satisfactory service, universities can contribute to encourage positive behavior in students, generate loyalty and motivation, improve permanence, learning outcomes, academic performance, service recommendation and, consequently, the sustainability of the institution (Herrera *et al.*, 2018). Additionally, positive student perceptions of service quality can lead to a better institutional image, so it is vital for HEIs to monitor service quality and identify the needs of their student population (Yong-Sik and Yung Kyun, 2019).

Student satisfaction is an important dimension, which few studies have examined, to verify the quality of higher education (Allam, 2018). From this starting point, some of the categories that have been found to be significant in assessing the quality of higher education are: academic services, academic facilities, administrative and student services (El Alfy and Abukari, 2020). Other categories in the same vein are: curriculum content, educational resources, institutional factors, and teaching-learning experiences (Allam, 2018).

VIRTUAL LEARNING ENVIRONMENTS

The closure of classrooms during the pandemic caused by Covid-19 "led to a forced migration to non-face-to-face modalities at all educational levels" (Aguilar, 2020, p. 47). Thus, non-face-to-face educational modalities, mediated by information and communication technologies (ICT), made it possible to better cope with the situation. This context makes it relevant to consolidate what in the last decade has been called virtual learning environments (VLE), also called virtual teaching-learning environments. A VLE combines physical and virtual spaces to provide users with a sense of face-to-face in a virtual environment (Peterson-Ahmad, Pemberton, & Hovey, 2018).

Initially, it can be understood that VLEs integrate ICT and the educational, created with the purpose of facilitating teaching and promoting learning (Cocunubo-Suárez, Parra-Valencia, & Otálora-Luna, 2018); however, providing teachers and students with electronic platforms, synchronous videoconferencing and digitized content does not guarantee meaningful learning (Kundu, 2017; García-Peñalvo *et al.*, 2020). In addition, institutional commitment and support is necessary to clearly establish the dimensions of quality in this educational modality. This makes it possible to accompany, evaluate and motivate teachers - in contexts such as the current one, which has been impacted by the pandemic - when many of them do not feel prepared for this transition to non-face-to-face (Scherer, Howard, Tondeur and Siddiq, 2020).

Achieving quality in VLEs depends fundamentally on the teacher's action as a designer of educational scaffolds that place the learner in a central and active role. This can be achieved through active methodologies such as problem- and context-based learning (Phungsuk, Viriyavejakul, & Ratanaolarn, 2017), challenge-based learning (Sanchez, 2020), and collaborative learning (Garcia-Chitiva & Suarez-Guerrero, 2019).

VLEs encompass a wide range of resources including websites, learning management systems, and three-dimensional learning environments (Khlaisang and Songkram, 2019). Prominent among the latter are virtual laboratories as an innovation to address the fact that, because of the pandemic, students are unable to access laboratories in person within universities (Luna, Costales, & Cordovez, 2021).

A virtual laboratory can be defined as an interactive environment for creating and conducting simulated experiments. Some advantages of implementing them are: a) the student can face situations that could be unsafe in other contexts, b) he/she can experiment without risks, and c) the time and space for practices is more flexible than in physical environments (Salmerón Manzano and Manzano-Agugliaro, 2018). Likewise, virtual laboratories have been shown to be optimal for achieving knowledge transfer in various disciplines (Bonilla, Villamil, & Montes,

2019; González & Victoria, 2019; Nechypurenko, Selivanova, & Chernova, 2019).

TEACHING AND DIGITAL COMPETENCIES IN HIGHER EDUCATION

Along with the pandemic situation due to covid-19, there are other forces that are driving the modification of the teaching role, among which we can mention the fourth industrial revolution, innovative pedagogies, the explosion of information due to the use of the Internet, artificial intelligence and the shift towards massive open education modalities (Ally, 2019). However, forces coexist that slow down the necessary innovation of the teaching role; for example, most teachers lack specialized training in higher education, students are mostly familiar with traditional classes, curricula and exams are designed from traditional teaching (Zempoalteca, Barragán, González, & Guzmán, 2016). Despite this, it is necessary that the teaching profile moves away from traditional educational models and transitions towards innovative roles. The various competencies of this profile should include the educational use of ICTs, the application of pedagogical innovations and research skills, among others.

Competencies are understood as the complex processes of performance with suitability in certain contexts, based on the integration of different knowledge (knowing how to be, knowing how to do, knowing how to know and knowing how to live together) to carry out activities and solve problems with a sense of challenge, motivation, flexibility, creativity, understanding and entrepreneurship, within a perspective of metacognitive processing, continuous improvement and ethical commitment. This, with the goal of contributing to personal development, the construction and strengthening of the social fabric, the continuous search for sustainable economic-entrepreneurial development, as well as the care and protection of the environment (Tobón, 2008). The competency-based approach facilitates the evaluation of the quality of education (or training) and the quality of performance, and can also guide the certification of professional competencies.

There are several studies and proposals about which generic teaching competencies are required at the higher education level, which include instructional design, didactic strategies, educational assessment, communication, leadership and research as the most frequent (Villarroel and Bruna, 2017; MacíasCatagua, 2018; Clavijo, 2018). Competencies for the use of digital technologies have become a requirement for higher education teachers globally. In this regard, Albrahim (2020) concluded that the competencies required for effective teaching in online learning environments can be classified into six categories: a) pedagogical skills, b) content management, c) for design, d) technological, e) administrative, and f) institutional, social and communication skills.

RESEARCH DESIGN AND METHODOLOGY

The research was conducted between March 2020 and March 2021, had a quantitative and correlational approach to the case study. The objective was to design and validate a teaching competencies model organized in four dimensions (pedagogical, professional, digital and research) in VLEs, including the support of virtual laboratories to ensure the quality of higher education in the Covid-19 health contingency. The development of the teaching competencies model considered four stages, from its construction to its validation, as shown in Figure 1.

Phase 1 Identification of the current context	**Phase 2** Dimensions and indicators in quality assessment	**Phase 3** Development of the model with the inclusion of virtual laboratories	**Phase 4** Model evaluation
• Contextualization and research supports • Review of projects • Diagnosis of indicators by entities of evaluation and certification of educational quality	• Identification of model dimensions • Professionals • Pedagogical • Digitals • Investigative • Teaching competencies by dimension • Integration of indicators • Incorporation of certification category • Development of instruments for data collection and evaluation of indicators.	• Pilot application of information collection instruments • Pilot application of indicator assessment tools • Inclusion of virtual laboratories • Model construction • Applicability of the model • Case study	• Model validation • Validation by specialists • Case study validation • Application of quality satisfaction surveys • Analysis of results • Feedback and improvement

Figure 1. Schematic diagram of the construction of the teaching competencies model in VLE.

In the first stage of the model, the current context was identified and diagnosed. Theoretical references were analyzed and related projects and research were reviewed. From this, four dimensions were identified in which the different teaching competencies can be agglutinated: pedagogical dimension, professional dimension, digital dimension and research dimension. This is the motivation of the study, which focuses on highlighting the main indicators within each dimension to ensure quality in VLEs.

In addition, the educational quality assurance indicators of seven certifications, accreditation and quality assessment organizations in Mexico and internationally were reviewed, as well as the quality assurance indicators of six educational models. We also integrated our own experience in the implementation of VLE projects and courses.

In the second stage of the model, indicators were integrated for each dimension defined in the previous stage. This was achieved through the construction of a comparative matrix of quality assurance indicators (see Table 2). The indicators of accreditation agencies and national and international educational models related to VLEs were evaluated.

Table 2. Comparative matrix of quality assurance indicators in accreditation agencies, related to

Dimension	Teaching competencies	Educational models						Accreditation agencies						
		UNED	UOC	CSU	Unesco	T-PAC K.	SEP	CHEA	AACSB	HEFCE	EQUIS	CONACv.	CIEES	ABET
Pedagogical	Content planning	x	x	x	x	x	x		x	x	x	x		x
	Teaching-learning strategies	x	x	x	x	x	x	x	x	x	x	x	x	x
	Learning assessment	x	x	x	x	x	x	x	x	x	x	x	x	x
	Effective communication	x	x	x	x	x	x	x	x			x		x
	Leadership	x		x		x	x		x	x	x			
	Knowledge generation and transfer	x	x			x		x		x		x		
	Customized instruction	x	x	x	x		x	x		x	x	x	x	x
Profesional	Track record in teacher training	x	x	x		x	x	x	x	x	x	x	x	x
	Professional Experience	x	x	x	x	x	x	x	x	x	x			x
	School and academy membership		x	x	x		x	x	x			x	x	x
Digital	Training in the use of ICT and digital tools	x	x	x	x	x	x	x		x	x	x	x	x
	Experience in distance education courses using digital media	x	x	x	x	x	x	x	x	x	x	x	x	x
	Experience in multimodal and hybrid environments	x	x	x	x		x				x	x		x
Research	Academic production		x	x				x	x	x		x	x	
	Scientific production		x	x					x	x		x	x	
Certification	Competencias de enseñanza	x				x	x	x						
	Digital competencies	x			x	x	x	x						
	Professional competencies	x						x				x		
	Research competencies									x		x		

As a result of the comparative analysis in the thirteen instances, a comparative tabular table was integrated with the indicators and the

selected organizations (the results are reflected in Table 2 and are broken down in Table 1), showing the quality indicators used by each organization, grouped into four dimensions (pedagogical, professional, digital and research) and a certification category. The quality indicators provided the guideline for identifying teaching competencies. The experience, work and feedback in VLE collaborative networks - in addition to the results of the comparative analysis - made it possible to carry out an initial validation and piloting of the model through feedback from specialists and three focus groups.

In order to ensure consistency in the factors selected for the dimensions of teaching competencies, their indicators and implementation mechanisms were analyzed in national and international evaluation and accreditation entities, for their incorporation into the tabulator in a standardized manner. A reliability coefficient with a Cronbach's alpha of 91% was obtained.

Indicators related to pedagogical teaching-learning processes are included in most evaluation agencies, but not all of them use indicators to evaluate the generation and transfer of knowledge. The professional dimension is a substantive category that allows validating the level of quality in the knowledge and professional experience of teachers, in addition to their affiliation and participation in schools and academies.

It is noteworthy that accreditation agencies use almost all the indicators of the digital dimension, but not all of them evaluate the academic and scientific production of the professors or facilitators, nor those referring to the research dimension developed in the courses. These findings allow us to identify areas of opportunity and highlight the importance of including factors related to the certification of competencies in the four dimensions identified as part of the quality indicators.

In this phase of reliability analysis, a satisfaction survey was developed and applied to 100 students, divided into twelve groups, from five university academic programs to validate the correct integration of the dimensions. The academic programs considered were from the educational, technological, biological, business and social disciplines. Likewise, an instrument for monitoring educational quality was designed for monitoring by research professors, which we call monitoring links.

In the third stage, the model of teaching competencies for virtual learning environments was constructed. The results of the information obtained in the previous stages, the review of theoretical references and the results of a comparative analysis of academic quality indicators for VLE were synthesized, as well as the analysis of information obtained through the instruments designed and applied in the previous stage.

The construction of the model made it possible to integrate teaching competencies in each dimension. In the same way, the requirement of teaching certifications was established as another element of educational quality assurance. For the implementation of the case study, the entire student population (9,980 students) was considered, which makes up the higher education level in all modalities and academic programs of the Universidad Popular Autónoma del Estado de Puebla (UPAEP, by its acronym in Spanish), during the spring, summer and fall periods of 2020, as well as spring of 2021.

The implementation allowed assessing the incorporation of the competencies and indicators of the model in the VLEs, which included the articulation of virtual laboratories to strengthen training, with educational quality standards. This stage ended with feedback from focus groups and specialists to enrich the model and its final presentation.

The complete model of teaching competencies in VLE is shown in Figure 2. In the central part of this model is the pedagogical mediation environment, focused on student learning, supported by the academic, administrative and service areas, and supported by educational quality. In this model, the student not only plays an active role, but also emphasizes the active participation of the teacher, who requires various competencies to perform in the VLEs.

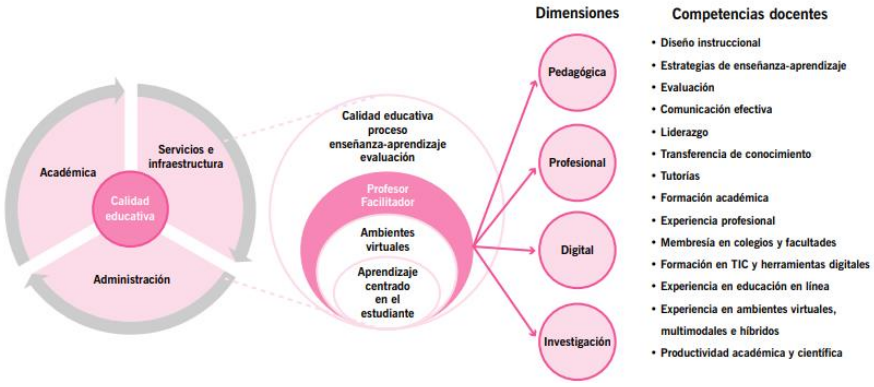

Figure 2. Model of teaching competencies for VLEs.

These competencies make it possible to create a comprehensive teaching profile, with the definition of clear indicators that ensure educational quality in VLEs (see Table 3). In addition, these elements allow the development of training, evaluation, monitoring and quality improvement programs in higher education.

Table 3. Indicators of teaching competences for quality assurance in VLEs

DIMENSION	TEACHING COMPETENCE/ EVALUATION INDICATOR	CERTIFICATIONS
PEDAGOGICAL	Diseño instruccional	Certified pedagogical competencies
	Estrategias de enseñanza - aprendizaje	
	Assessment and feedback	
	Effective communication	
	Leadership	
	Transfer of knowledge	
	Tutoring	
Professional	Academic background	
	Professional experience	
	Memberships in colleges and academies	
Digital	ICT training and tools	Certified digital skills
	Experiences in virtual learning environments	
	Experience with virtual laboratories	
Research	Academic productivity	Research competences
	Scientific productivity	

In the fourth stage, the validation of the model was carried out, which includes feedback by specialists, the results of the case study obtained from a quality satisfaction survey (see Figure 3) applied in the four academic periods between March 2020 and March 2021, with a participation of more than 20% of the student population, as well as a process of monitoring and evaluation of educational quality with 41 research professors as quality liaisons.

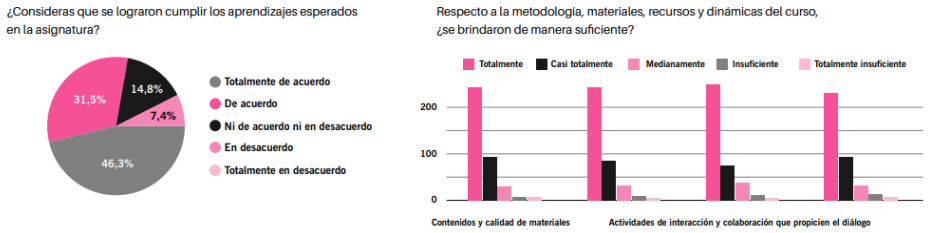

Figure 3. Examples of the results of the quality satisfaction survey.

The main steps for the validation of the model are described below.

a) Educational context: virtual learning environments

In comparison with the development of the model, the context in which its validation was carried out was the implementation of all VLE courses at UPAEP, as a result of the Covid-19 pandemic. Thus, learning assurance guidelines were defined for practical and laboratory subjects, during which educational platforms, video sessions, synchronous conferences and specialized simulators (virtual laboratories) were used. The latter were used mainly in the areas of business, biological sciences, engineering and medical sciences. In addition, their operation was ensured through the design of video recordings of the practical training activities of each subject.

Figure 4 shows one of the simulation activities with specialized software for production processes.

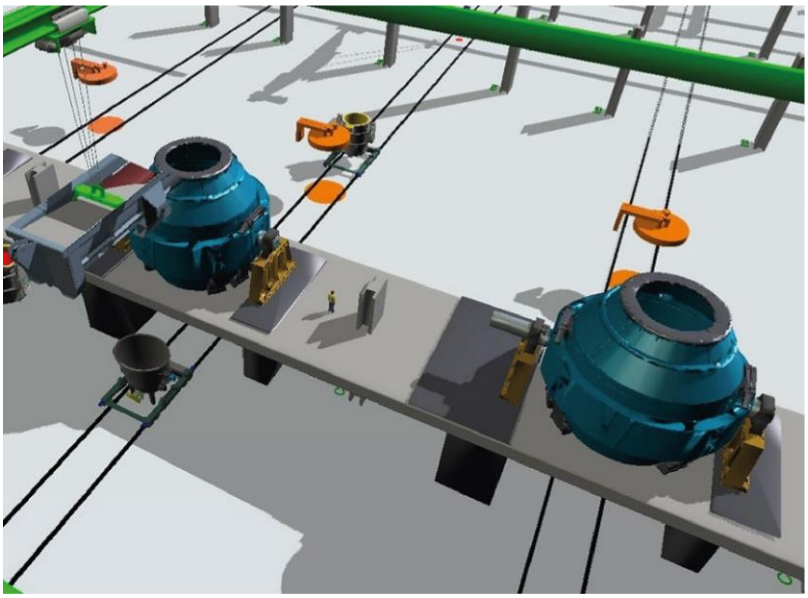

Figure 4. Manufacturing simulation laboratory.
Source: laboratory practice image of the manufacturing process in the SolidWorks platform.

b) Participants

Satisfaction surveys were administered to all groups, in each of the academic periods indicated, with a total participation of 5,650 students.

c) Variables and instrument

The first instrument applied was a student satisfaction survey, with a Likert-type questionnaire, whose main purpose was to validate the four dimensions of the model as central variables of the study. The instrument consisted of 19 items, distributed as follows: six in the pedagogical dimension, six in the digital dimension, four in the professional dimension and three for the research dimension. The second instrument for validation of the implementation of the educational quality model in VLE was the virtual classroom monitoring form, which included more than 700 groups observed on average, per academic period.

RESULTS

Application of the assessment instrument, which evaluated the pedagogical, professional, digital and research dimensions, yielded the following results based on the indicators of each dimension. As shown in Figure 1, integration of the quality indicators of teaching practices in terms of content planning, effective communication, tutoring and learning assessment, requires considering the skills and comprehensive teaching competencies, so as to emphasize leadership in the classroom, as well as the generation and transfer of knowledge.

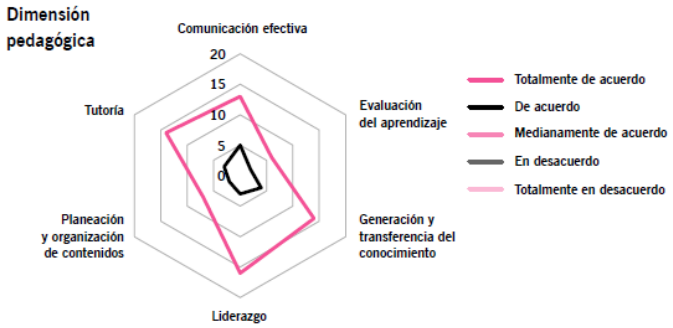

Figure 1. Results of the university student satisfaction survey on the pedagogical dimension in technology-supported environments.

Figure 2 shows some lower scores in the categories of planning and organization of subject contents in the technological platform, management and exploitation of digital tools, incorporation of teaching-learning strategies in VLE and evaluation of learning through digital media. The factors with the highest scores are instructional design and the generation and transfer of knowledge, which explains the favorable perception of integrating these aspects in the virtual classroom.

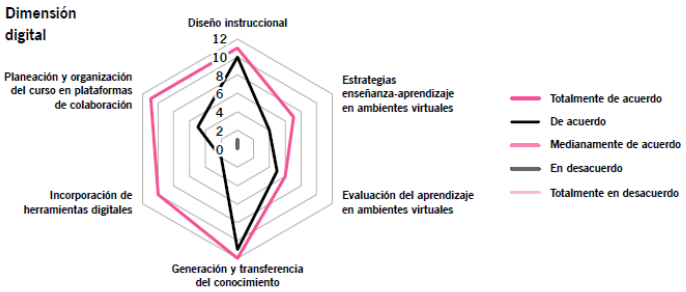

Figure 2. Results of the student satisfaction survey on the digital dimension in technology-supported environments.

Figure 3 shows that certifications and professional experience are the criteria highly valued by students, followed by school membership and academic training, which implies a good integration of indicators to evaluate the professional dimension in teachers.

Figure 3. Results of the student quality satisfaction survey on the professional dimension in technology-supported environments.

Figure 4 shows a congruent relationship between academic and scientific productivity, mainly. It also identifies the need to reinforce teacher training to strengthen this research dimension.

Figure 4. Results of the student satisfaction survey on the research dimension in technology-supported environments.

DISCUSSION

Different studies on educational quality agree that there are no universally accepted dimensions of quality in higher education. In this regard, numerous dimensions have been proposed that are difficult to assess in a single study; moreover, there is an inability to capture the views of different stakeholders (faculty, administrative staff, heads, students, among others) (Kumar *et al.*, 2020; Prakash, 2018; Kundu, 2017). This seems to suggest the need for HEIs to develop their own models, systematically and rigorously, based on specific quality assessment needs, while contemplating international quality requirements.

The results of the validation of this study allow affirming that the dimensions selected to be integrated into the model are relevant to the current context, as well as adequate to indicate the quality characteristics required by VLEs, according to the criteria and indicators of national and international certifying agencies and the educational models analyzed. In addition, institutional strengths and weaknesses were identified with respect to their own quality indicators during the Covid-19 health contingency.

Regarding the pedagogical dimension, our findings coincide with studies such as that of Zempoalteca *et al.* (2016), in that it is necessary to strengthen teaching skills, such as instructional design and learning assessment, explainable due to the fact that HEI teachers lack specialized and certified teacher training for the most part.

Likewise, regarding the digital dimension, we agree with other studies (Scherer *et al.*, 2020) that more accompaniment and training is required for teachers regarding content planning, the use of teaching-learning and evaluation tools in digital environments. It was also detected that advanced training in digital competencies is required for the entire teaching staff, in addition to implementing continuous monitoring and evaluation of quality throughout each academic period.

Regarding the professional dimension, the need to strengthen professional competencies with certification and recognition of practical experience in the sectors was identified. Regarding the research dimension, the need to generate strategies that promote the development of research projects with strong methodological standards was identified.

A strength of the proposed model is that its design is based on national and international educational quality standards, in an attempt to respond to the forced educational changes implied by the international health crisis. In addition, it represents an innovation and fills a gap with respect to studies of educational quality based on student perception, as well as models for evaluating teaching quality in VLEs.

As part of the weaknesses of the model that were identified, it is found that the weighting of indicators and categories needs to be developed. This could be done by replicating the implementation of the model in other educational institutions through the use of VLEs. It is also feasible to integrate the opinion of the teachers themselves in the improvement of the model in a more robust way.

CONCLUSIONS

This study provides a model of teaching competencies in VLE to ensure the quality of higher education during the covid-19 health contingency. The validation of the model indicates its relevance for assessing educational

quality, based on the perception of students. The results of the validation made it possible to confirm the relevance of the model in each of its dimensions, as well as to identify strengths and weaknesses in the competencies of teachers.

This model could be the basis for similar proposals and studies that test these and other dimensions to evaluate the educational quality of VLEs in higher education institutions. It is necessary to advance in the investigation of relevant strategies to accompany teachers to overcome their gaps in the educational use of ICTs and other digital tools.

REFERENCES

Aguilar, N. J. (2020). Continuidad pedagógica en el nivel medio superior: acciones y reacciones ante la emergencia sanitaria. En *IISUE, Educación y pandemia. Una visión académica* (pp. 47- 54). México: UNAM. https://www.iisue.unam.mx/investigacion/textos/educacion_pandemia.pdf

Albrahim, F. A. (2020). Online teaching skills and competencies. *Turkish Online Journal of Educational Technology-TOJET*, *19*(1), pp. 9-20. https://eric.ed.gov/?q=source%3A%22Turkish+Online+Journal+of+Educational+Technology+%22&id= EJ1239983

Allam, Z. (2018). Students' perception of quality in higher education: An empirical investigation. *Management Science Letters*, *8*(5), pp. 437-444. https://doi.org/10.5267/j.msl.2018.4.002

Ally, M. (2019). Competency profile of the digital and online teacher in future education. *International Review of Research in Open and Distributed Learning*, *20*(2). https://doi.org/10.19173/irrodl.v20i2.4206

Barrón Tirado, M. C. (2020). La educación en línea. Transiciones y disrupciones. En *IISUE, Educación y pandemia. Una visión académica* (pp. 66-74). México: UNAM. http://www.iisue.unam.iisue/covid/educacion-y-pandemia

Bonilla Trujillo, D.; Villamil Reyes, V. V. y Mora Montes, J. F. (2019). Uso de simuladores 3D como estrategia tecnopedagógica para la transferencia de conocimiento en el aprendizaje de la anatomía animal. *Documentos de Trabajo ECAPMA*, (1). https://doi.org/10.22490/ECAPMA.3414

Cabero-Almenara, J. y Llorente-Cejudo, C. (2020). Covid-19: transformación radical de la digitalización en las instituciones universitarias. *Campus Virtuales*, *9*(2), pp. 25-34. http://www.uajournals.com/ojs/index.php/campusvirtuales/article/view/713

Clavijo, D. (2018). Competencia del docente universitario en el siglo XXI. *Revista Espacios*, *39*(20). https://www.revistaespacios.com/a18v39n20/a18v39n20p22.pdf

Cocunubo-Suárez, J. I.; Parra-Valencia, J. A. y Otálora-Luna, J. E. (2018). Propuesta para la evaluación de entornos virtuales de enseñanza aprendizaje con base en estándares de usabilidad. *TecnoLógicas*, *21*(41), pp. 135-147. https://doi.org/10.22430/22565337.732

El Alfy, S. & Abukari, A. (2020). Revisiting perceived service quality in higher education: Uncovering service quality dimensions for postgraduate students. *Journal of Marketing for Higher Education*, *30*(1), pp. 1-25. https://doi.org/10.1080/08841241.2019 .1648360

García-Chitiva, M. D. P. y Suárez-Guerrero, C. (2019). Estado de la investigación sobre la colaboración en entornos virtuales de aprendizaje. *Píxel-Bit: Revista de Medios y Educación*, (56), pp. 169-191. https://doi.org/10.12795/pixelbit.2019.i56.09

García-Peñalvo, F. J.; Corell, A.; Abella-García, V. y Grande, M. (2020). La evaluación *online* en la educación superior en tiempos de la covid-19. *Education in the Knowledge Society*, 21. https://doi.org/10.14201/eks.23013

González Hernández, N. Y. y Victoria Uribe, R. (2019). Nuevas alternativas para transferencia de conocimiento sustentable: el uso de interfaces de realidad virtual. En J. A. Vargas Castro y G. A. García Luna Villagrán (comps.), *Diseño Estratégico e Incluyente para un Desarrollo Sostenible*. México: Universidad Autónoma del Estado de México. http://coloquio2019.faduaemex.org.mx/wp-content/uploads/2019/11/design-estrategicweb.pdf#page=10

Herrera, L.; Souza, M. R. y de Quadros, J. F. (2018). Evaluación de la calidad en la educación superior: una revisión de la literatura a partir de la satisfacción del alumnado. *Cadernos de pesquisa*, *25*(2), pp. 71-89. http://dx.doi.org/10.18764/2178-2229.v25n2p71-89

Jiménez Moreno, J. A. (2019). La evaluación y acreditación de la educación profesional en México: ¿la legitimación y competitividad como fin de la universidad? *Revista de la educación superior*, *48*(189), pp. 55-72. https://doi.org/10.36857/resu.2019.189.614

Khlaisang, J. & Songkram, N. (2019). Designing a virtual learning environment system for teaching twenty-first century skills to higher education students in ASEAN. *Technology, Knowledge and Learning*, *24*(1), pp. 41-63. http://dx.doi.org/10.1007/s10758-017-9310-7

Kumar, P.; Shukla, B. & Passey, D. (2020). Impact of Accreditation on Quality and Excellence of Higher Education Institutions. *Investigación Operacional*, *41*(2), pp. 151-167. https://eprints.lancs.ac.uk/id/eprint/141916

Kundu, G. K. (2017). Quality in higher education from different perspectives: a literature review. *International journal for quality research*, *11*(1), pp. 17-35. http://dx.doi.org/10.18421/IJQR11.01-02

Luna Encalada, W.; Costales, P. M.; Cordovez Machado, S. P. & Guaiña Yungán, J. (2020). Virtual Laboratories in Virtual Learning Environments. En *The International Conference on Advances in Emerging Trends and Technologies* (pp. 114-126). Springer, Cham. https://doi.org/10.1007/978-3-030-63665-4_9

Macías-Catagua, O. W. (2018). El desarrollo de competencias genéricas en el docente universitario. *Dominio de las Ciencias*, *4*(3), pp. 240-252. http://dx.doi.org/10.23857/dc.v4i3.806

Nechypurenko, P. P.; Selivanova, T. V. & Chernova, M. P. (2019). Using the cloud-oriented virtual chemical laboratory lab in teaching the solution of experimental problems in chemistry of 9th grade students. En *Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications. Integration, Harmonization and Knowledge Transfer* (pp. 968- 983). CEUR Workshop Proceedings.

Peterson-Ahmad, M. B.; Pemberton, J. & Hovey, K. A. (2018). Virtual learning environments for teacher preparation. *Kappa Delta Pi Record*, *54*(4), pp. 165-169. https://doi.org/10.1080/00228958.2018.1515544

Phungsuk, R.; Viriyavejakul, C. & Ratanaolarn, T. (2017). Development of a problem-based learning model via a virtual learning environment. Kasetsart *Journal of Social Sciences*, *38*(3), pp. 297-306. https://doi.org/10.1016/j.kjss.2017.01.001

Prakash, G. (2018). Quality in higher education institutions: insights from the literature, *The TQM Journal*, *30*(6), pp. 732-748. https://doi.org/10.1108/TQM-04-2017-0043

Salmerón-Manzano, E. & Manzano-Agugliaro, F. (2018). The Higher Education Sustainability through Virtual Laboratories: The Spanish University as Case of Study. *Sustainability*, *10*(11), p. 4040. https://doi.org/10.3390/su10114040

Sánchez Cuevas, M. (2020). Chapter 19. Challenge Based Learning (CBL). En Education Applications & Developments V. Lisboa: inScience Press. Sari, T. & Nayir, F. (2020). Challenges in Distance Education During the (Covid-19) Pandemic Period. *Qualitative Research in Education* (2014-6418), *9*(3), pp. 328-360. http://dx.doi.org/10.17583/qre.2020.5872

Scherer, R.; Howard, S. K.; Tondeur, J. & Siddiq, F. (2020). Profiling teachers' readiness for online teaching and learning in higher education: Who's ready? Computers in Human Behavior, 118, 106675. https://doi.org/10.1016/j.chb.2020.106675

Tobón, S. (2008). Gestión curricular y ciclos propedéuticos. Bogotá: ECOE. Villarroel, V. A. y Bruna, D. V. (2017). Competencias pedagógicas que caracterizan a un docente universitario de excelencia: un estudio de caso que incorpora la perspectiva de docentes y estudiantes. *Formación universitaria*, *10*(4), pp. 75-96. http://dx.doi.org/10.4067/S0718-50062017000400008

Yong-Sik, H. & Yung Kyun, C. (2019). Higher education service quality and student satisfaction, institutional image, and behavioral intention. *Social Behavior & Personality: An International Journal*, *47*(2), pp. 1-12. https://doi.org/10.2224/sbp.7622

Zempoalteca Durán, B.; Barragán López, J. F.; González Martínez, J. y Guzmán Flores, T. (2016). Formación en TIC y competencia digital en la docencia de instituciones públicas de educación superior. *Apertura*, *9*(1), pp. 80-96. http://dx.doi.org/10.32870/Ap.v9n1.922

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