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Design and Study of the Psychometric Properties of a Professors' Expectations of Virtual University Education Questionary

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Abstract: This work describes the design and validation of a questionnaire to assess the expectations of higher education professors regarding virtual education (CEDVES). The sample included 546 professors, 299 men (54.66%) and 247 women (45.23%), from different scientific disciplines of a university in Chile. The final version consisted of 38 items answered using a five-point Likert scale. Nine factors were identified from the exploratory factor analysis. This configuration accounts for 75% of the variance. The structure of the instrument was studied using confirmatory factor analysis. It was found that nine factors produced a good fit, derived from a hierarchical solution in which all these factors depend on a factor of second general order. Each of the scales, like the general factor, present good indicators of reliability. The analysis indicates that this questionnaire has adequate validation and could be broadly used in higher education.

Keywords: *Expectations toward virtual education, higher education, professors, psychometric properties, validation.*

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Introduction

In December 2019, the first cases of COVID-19 were identified in the city of Wuhan in the People's Republic of China. By January 30, 2020, the World Health Organization (WHO) Emergency Committee classified it as a global health emergency (Velavan & Meyer, 2020). Due to the crisis generated by COVID-19, the world's governments implemented multiple measures to reduce the number of infections, one of which was confinement, generating a drastic change in people's daily routine (Huarcaya-Victoria, 2020).

Confinement implied the closure of universities. Thus, an important challenge for universities around the world has been to support the need to stay at home due to this health crisis (Crawford et al., 2020), requiring a rapid response and an unprecedented effort from administrators and the higher education community for implementing remote teaching to guarantee the right to education (Giannini, 2020; Xarles & Samper, 2020). Despite the crisis and difficulties, one of the main goal of universities has been to deliver the best possible experience for students in an incredibly turbulent time (Oranburg, 2020). In this context, educational administrators have adopted measures and promoted actions to favor student learning during the temporary closure of educational institutions (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2020).

The success of distance education training due to the COVID-19 pandemic is supported by the capacity of adaptation and involvement of both, professors, and students, to the tools and resources offered by virtual classrooms and other online teaching devices (Ramirez-Anormaliza et al., 2017). The COVID-19 pandemic has tested the flexibility and willingness of educators around the world to change, a change lead by institutions and educational leaders, requiring all stakeholders, to act quickly to develop an online plan together (Quezada et al., 2020).

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The use of technology has been mandatory for the continuity of learning processes in higher education. E-learning is defined as learning that occurs through the Internet to provide interaction between the teacher and students with the distribution of classroom materials occurring in a dynamic and interactive way (Abreu, 2020). One of the most important innovations of online educational environments has been learning management systems (LMS). These integrated didactic systems allow Internet-based learning through the organization of course materials, monitoring of students' participation and tasks compliance, and the establishment of communication between peers and instructors (Godwin-Jones, 2012). This provides a space to create and deliver content, and to monitor students' participation through interactive features such video conferences and discussion forums (Ashrafi et al., 2020). One of the advantages of using these platforms is the increased quality of student experiences and learning outcomes due to the versatility of educational materials and strategies, as well as their organization (Kim et al., 2019).

The adoption of e-learning involves several challenges. In this context, numerous factors hindering the effective implementation of this teaching modality have been reported, such as teachers' expectations about online teaching (Van Der Spoel, et al., 2020), difficulties for developing competencies for adopting and using this modality, as well as lack of technological literacy (Rasheed et al., 2020).

Teaching expectations are defined as assumptions made by educational professionals about students' present and future academic performance and overall behavior during the learning process (Rubie-Davies et al., 2006). Teachers' expectations influence students through the behaviors by which they engage with their students, subsequently affecting their outcomes (Hornstra, et al., 2018).

Several reports have shown that the initial expectations of elementary and secondary school teachers can be an important factor in improving students' academic performance (Friedrich, et al., 2015; Gentrup, et al., 2020; Zhu et al., 2018;). However, research regarding the effects of university professors' expectations is scarce (Li & Rubie-Davies, 2018).

A recent systematic review summarizing the past thirty years of research on the subject describes factors related to students, teachers, classes, and institutions that influences the development of teaching expectations. This study highlights the fact that, although student characteristics have been widely studied, research on teaching, contextual, and relationship factors have been less developed (Wang et al., 2018).

In higher education, research on professors' expectations has suggested that student's variables, such as previous academic achievement, motivation, study skills, and discipline in carrying out academic activities, are relevant. In addition, professors' attributes are another important source of expectations, including previous online teaching experience, teacher self-efficacy, and technological literacy (Li & Rubie-Davies, 2018).

Considering the previous reports, it is relevant to analyze the processes by which online education has been carried out during the sanitary emergency. For this purpose, it is relevant to design valid and reliable measurement instruments to assess the current state of key aspects, such as teaching expectations, since it impacts the effectiveness of teaching and learning processes in universities. The unprecedented scenario due to the pandemic revealed a lack of instruments to assess important issues, such as a questionnaire assess the perception of university professors about their expectations regarding online education. Thus, this study reports the design and validation of a questionnaire to assess the expectations of higher education professors of virtual education. This instrument will allow exploring the effects of teaching expectations. Therefore, it has the potential of contributing to the improvement of performance and adaptation of university students.

Methodology

Research Design

To design and validate a Questionnaire of Expectations regarding Virtual Education in Higher Education for Teachers (CEDVES) an instrumental design was used. In this type of design, the aim is to develop actions focused on the identification and description of the internal-structural validity of a measurement instrument (Montero & León, 2007).

Sample and Data Collection

A non-probability type sampling was used. 546 professors from a Chilean university participated in the validation of the questionnaire, 299 (54.66%) men and 247 (45.23%) women, of which 324 (59.34%) were employed full-time (44 hours per week). Table 1 describes the sample according to their faculty or unit and their type of contract.

The Construction of the Questionnaire CEDVES

Based on an empirical theoretical literature review regarding teaching expectations, and with the purpose of having a sufficient repertoire of questions to select the best items in the following step, fifty reagents were elaborated. These reagents were constructed considering five dimensions related to aspects of virtual education that have been reported of interest for university teaching. The validity of the content was studied through expert judgment of six professionals, who were selected using two criteria: (1) master's and/or doctorate degree, and (2) scientific production linked to

university education.

Table 1. Description of the Participating Professors According to Their Faculty or Unit and Their Type of Contract

Faculty	Workshop				Total	% of participation
	Up to 11 hours per week	12 to 22 hours per week	23 to 33 hours per week	34 to 44 hours per week		
Institute of Applied Economic Geology	0	0	0	3	3	30.00
Environmental Science	0	0	0	4	4	16.67
Forestry Science	1	0	0	8	9	19.57
Chillán Campus	1	4	1	5	11	23.91
School of Education	2	2	0	9	13	11.82
Economic and Administrative Sciences	2	3	0	9	14	21.21
School of Science and Technology	1	2	1	11	15	24.59
Pharmacy	0	0	1	15	16	20.51
Agricultural Engineering	3	2	0	12	17	34.69
Natural and Oceanographic Sciences	0	0	0	17	17	23.94
Agronomy	2	2	1	15	20	32.26
Architecture, Urbanism and Geography	0	8	0	12	20	34.48
Veterinary Science	1	1	0	18	20	28.99
Social Science	7	3	3	9	22	15.49
Chemical Sciences	2	4	0	18	24	31.58
Legal Sciences	11	8	5	2	26	16.67
Biological Sciences	2	3	0	23	28	24.56
Nursing	2	11	5	11	29	21.48
Education	0	7	0	23	30	42.86
Physical Science and Mathematics	14	0	0	20	34	20.36
Humanities and Art	4	6	3	26	39	21.67
Medicine	5	13	8	15	41	07.04
Dentistry	5	15	17	4	41	33.06
Engineering	8	8	2	35	53	22.94
Total	**73**	**102**	**47**	**324**	**546**	

As a result, 38 of the original 50 items were selected. Eight of the eliminated items were considered not to respond to the theoretical dimension for which they were constructed, while four items were eliminated based on lack of clarity. On the other hand, four items were rearranged in a different dimension than the one originally proposed by the authors, while eight items were slightly modified in their writing for better understanding.

Table 2. Description of CEDVES Dimensions

Dimension	Description
Institutional engagement	Professors' expectations regarding technical and pedagogical institutional support provided by the university for an effective virtual classroom implementation.
Quality of teaching and learning processes	Teachers' perception regarding the development of his or her class, concerning the resources and activities he or she will use.
Quality of educational planning	Teachers' expectations about the possibility of complying with the planning of the courses, the class schedules, office hours to support students, and assessment.
Quality of the relationship with the students	Teachers' expectations about whether the virtual classroom will favor the academic social relationship with their students.
Perceived self-efficacy for virtual education	Belief of his/her ability to face the challenges of online education.

The resulting version was applied to 10 professors to assess the clarity of the language and appropriate reading of instructions. The main reported difficulty was confusion due to the use of several concepts to refer to the same construct,

such as the terms "virtual education", "e-learning education," and "remote education" to convey the same notion in different items. The "virtual education" concept was selected since it is most frequently cited in literature to refer to the educational process implemented through technological tools without the physical presence of the participants. Table 2 describes the proposed dimensions of the questionnaire. The final version of the instrument resulted in seven items for institutional engagement, nine items for the quality of teaching and learning processes, seven for the quality of educational planning, six for the quality of the relationship with the students, and nine for the perceived self-efficacy for virtual education.

Instruments

The CEDVES was designed to determine the expectations of university professors regarding virtual education. Its initial version consisted of 38 items distributed in dimensions related to the teacher's expectations about virtual education answered with a five-point Likert-type scale, in which 1 means "very much in disagreement" and 5 means "very much in agreement." Table 2 describes each of the dimensions considered in the construction of the scale.

Analyzing of Data

The resulting instrument was implemented in electronic format and sent via institutional mail to the entire teaching population of the participating university. The form was available for a period of two weeks during March 2020. The average response time to complete the form was 11 minutes.

To generate two similar samples, the answered questionaries (n = 546) were divided into two parts randomly, stratified by gender, academic discipline, and type of contract (22 hours or less, or more than 22). In the first subsample (n = 273), an exploratory factor analysis was performed, while in the second subsample (n = 273), a confirmatory factor analysis was applied. In both cases, a descriptive analysis preceded the exploratory or the confirmatory factorial analysis. Both univariate and bivariate plots were used to detect possible outliers, ruling out their presence. Finally, a reliability analysis was applied to the complete sample and the distribution of the scales resulting from the factorial analysis was analyzed, establishing differences by sex, disciplinary area, type of contract, and experience, using non-parametric tests.

Since the items were answered using a five-point scale, the poly-correlation matrix was used for the exploratory factor analysis. The suitability of this matrix for the exploratory factor analysis was verified using Bartlett's sphericity test and the KMO index. Subsequently, the number of factors was established using Horn's parallel analysis with 5,000 samples. Exploratory factor analysis was performed using generalized least-squares extraction and obliminal rotation. The solution was optimized by eliminating items in an iterative manner until a simple structure was achieved, in which each item had only one factor with a load equal to or greater than 0.4. Considering that the solution had nine interrelated factors, it was decided to explore a second-order factor structure, which proved satisfactory.

In the confirmatory subsample, confirmatory factor analysis was performed analyzing three models using structural equation modeling (SEM), in order of restriction: (a) one-dimensional structure for all items, (b) one-factor second-order hierarchical structure comprising the nine factors of first order, and (c) nine-factor first-order solution correlated. WLSMV estimation was used, which is suitable for item-level scales at the ordinal level of 5 points or less. Each model was evaluated using chi-square ($\chi 2$), normalized $\chi 2$ ($\chi 2/df$), CFI, TLI, and RMSEA. The criteria used to evaluate the model as adequately were as follows: (a) $\chi 2/df < 3$, (b) CFI and TLI greater than 0.9 correspond to an acceptable fit and greater than .95 to a good fit, (c) RMSEA with values less than 0.08 indicate an acceptable fit, while less than 0.06 a good fit (Hu & Bentler, 1999).

The reliability of the scales in the two subsamples was analyzed using ordinal alpha, based on the polychoric correlation of the items, and total omega, for the first-order factors and the sum of the total items. Since the latter indicator considers the variance of both, the general factor and the first-order factors, a hierarchical omega was calculated for the general second-order factor, which only considers the variance attributable to the second-order factor, excluding the variance attributable to the first-order factors. All analyses were performed using R software (version 3.6).

Findings / Results

The aim of this work was to design and validate a questionnaire regarding the expectations of professors of higher education of virtual education. Table 3 presents the descriptive results of the scale of teaching expectations about virtual education. It can be observed that 12 items present asymmetries and/or kurtosis outside the range [-1, +1], which in the case of eight items (32, 9, 30, 31, 7, 35, 11, and 1) is explained by means higher than 4.05, with high kurtosis and negative asymmetries, indicating a high degree of agreement with these statements. The item with the lowest mean (M = 2.37) was 4, "I think my online teaching will be self-taught."

Table 3. Description of the Items (Applied Version) That Make up CEDVES

N° items	Dimension	M	SD	Skewness	Kurtosis
1	Institutional Engagement	4.25	0.82	-1.30	2.09
2		4.02	0.92	-0.94	0.74
3		3.98	0.92	-0.82	0.41
4 [a]		2.37	0.97	0.33	-0.56
5		3.68	0.96	-0.50	-0.35
6		3.66	1.00	-0.55	-0.19
7		4.16	0.88	-1.08	1.26
8	Quality of teaching and learning processes	3.83	0.83	-0.73	0.84
9		4.10	0.70	-0.93	2.41
10		3.96	0.83	-0.83	1.15
11		4.21	0.78	-1.06	1.73
12		3.25	1.04	-0.20	-0.43
13		3.55	0.95	-0.52	0.05
14[b]		2.54	1.31	0.27	-0.74
15[b]		3.45	1.34	-0.30	-0.81
16[b]		2.73	1.60	0.25	-1.40
17	Quality of educational planning	3.69	0.91	-0.80	0.51
18		3.91	0.80	-0.74	0.89
19		3.85	0.88	-0.74	0.47
20		3.97	0.97	-0.91	0.38
21		4.01	0.88	-0.97	0.97
22		3.36	1.07	-0.37	-0.50
23		3.88	0.87	-0.92	1.17
24	Quality of the relationship with the students	2.66	1.14	0.30	-0.76
25		2.96	1.09	0.02	-0.73
26		3.33	1.01	-0.47	-0.35
27		3.39	1.05	-0.43	-0.36
28		3.26	0.96	-0.39	-0.16
29[b]		2.52	1.35	0.33	-0.83
30	Perceived self-efficacy for virtual education	4.13	0.71	-1.02	2.64
31		4.13	0.69	-0.90	2.27
32		4.05	0.74	-0.90	1.80
33		3.85	0.87	-0.69	0.53
34		3.82	0.87	-0.72	0.68
35		4.20	0.78	-1.03	1.57
36		3.56	1.09	-0.62	-0.30
37		3.46	1.15	-0.49	-0.66
38		3.53	0.71	-0.56	1.17

Note: All items were answered on a scale from 1 to 5; [a] Is encoded in reverse; [b] the three categories are encoded as 1, 3, and 5, respectively. The English version is presented in appendix 1.

CEDVES Exploratory Factor Analysis

The KMO index = 0.78 and Bartlett's sphericity test, $X^2(703) = 10548$, $p < 0.001$, indicated that the correlation matrix was suitable for factorial analysis. Horn's parallel analysis using 5,000 samples indicated that the appropriate factorial solution was a nine factor. The initial solution, which explains 72% of the variance, was not observed to be adequate because items 34 and 38 did not show loads greater than 0.4 on any factor and items 33 and 12 were cross loaded. We proceeded to optimize the solution by sequentially eliminating items 33, 34, and 38 according to what is specified in Table 4. The final solution of 35 items and 9 factors explains 75% of the variance (see Table 4 and 5).

Table 4. Iterative Process of Improvement of the CEDVES Factorial Solution

Solution	No. of items	Variance explained	Detected problems	Item deleted
1	38	74%	Without sufficient loading: 38, 34	33
2	37	74%	Cross-loading: 33, 12	34
3	36	75%	Without sufficient loading: 38, 34	38
4	35	75%	Cross-loading: 12	--

The first factor, "Institutional engagement," comprises items 1, 2, 3, 4, 5, 6, and 7 and refers to items that indicate the degree of support in pedagogical and technological resources that the university is expected to provide to the teacher. The second factor, "Teacher self-efficacy for online education," includes items 30, 31, 32, and 35 and accounts for the perceived capacity to perform pedagogical, evaluative, and administrative processes on the platform. The third factor, "Interactions with students," comprises items 24, 25, 26, and 29 and corresponds to items related to the expectations of achieving adequate communication and personal relationships with students. The fourth factor, "Learning resources and activities," comprises items 8, 9, 10, and 11 and considers the teacher's expectation of whether the use of learning management systems, activities, and virtual resources will contribute to the achievement of the expected learning in their students.

Table 5. Factorial Solution for the Exploratory Analysis of CEDVES Items

Item	F1	F2	F3	F4	F5	F6	F7	F8	F9
2	**0.84**	0.02	0.06	-0.06	0.08	0.04	0.00	-0.08	0.12
3	**0.82**	0.12	0.00	-0.02	-0.08	-0.03	-0.05	0.15	0.09
6	**0.74**	0.06	-0.01	0.19	0.07	-0.01	0.02	0.12	-0.16
4	**0.63**	-0.20	-0.02	-0.24	-0.07	0.16	0.08	-0.08	0.09
5	**0.57**	0.06	0.03	0.22	0.20	-0.07	0.11	0.08	-0.24
7	**0.55**	0.03	-0.09	0.35	0.13	0.03	0.00	0.03	0.03
1	**0.53**	-0.03	-0.08	0.27	0.38	0.04	0.02	-0.11	-0.08
31	0.02	**0.85**	0.03	0.09	0.04	-0.03	0.09	-0.02	-0.04
32	-0.05	**0.83**	-0.13	0.00	0.03	0.01	0.09	0.17	0.10
30	0.07	**0.80**	0.07	0.06	0.10	-0.03	0.07	-0.06	-0.05
35	0.05	**0.70**	0.00	-0.02	0.05	0.19	-0.21	-0.16	0.14
24	-0.01	-0.05	**0.87**	0.04	0.02	-0.01	0.01	0.04	-0.03
25	-0.07	0.02	**0.80**	0.16	0.12	-0.06	-0.02	-0.05	0.07
29	0.04	-0.03	**0.65**	-0.08	0.02	0.06	0.38	-0.03	0.01
26	0.07	0.09	**0.63**	0.10	0.05	0.07	0.06	0.05	0.24
9	0.12	0.13	0.12	**0.70**	0.04	0.07	-0.02	0.06	0.02
10	0.02	0.12	0.15	**0.67**	0.07	0.10	0.02	-0.01	0.13
11	0.10	0.22	0.18	**0.65**	-0.06	0.10	0.04	-0.09	0.01
8	-0.02	-0.05	0.02	**0.61**	0.06	0.10	0.17	0.30	-0.06
17	-0.13	0.07	0.14	-0.02	**0.80**	-0.02	0.05	0.10	-0.11
18	0.15	0.10	0.02	0.02	**0.76**	0.04	0.00	-0.03	0.09
19	0.19	0.04	0.06	-0.04	**0.68**	0.18	-0.07	-0.05	0.03
23	-0.06	0.19	-0.12	-0.05	**0.45**	0.22	0.09	0.39	0.03
21	0.04	0.01	-0.10	0.14	0.08	**0.76**	0.03	-0.03	0.12
20	-0.10	0.00	-0.05	0.21	0.22	**0.69**	0.17	-0.17	0.06
37	0.12	0.12	0.28	-0.13	0.02	**0.58**	-0.15	0.30	-0.17
36	0.09	0.26	0.18	-0.05	-0.04	**0.52**	-0.01	0.31	-0.20
14	0.03	0.03	0.05	0.06	0.09	-0.10	**0.74**	0.13	0.17
15	0.04	0.22	0.01	-0.06	-0.08	0.12	**0.72**	-0.15	-0.20
16	-0.06	-0.08	0.24	0.10	0.05	0.10	**0.59**	0.08	0.23
22	0.11	0.01	0.02	-0.02	0.20	0.04	0.09	**0.56**	0.15
12	0.17	-0.04	0.10	0.35	0.11	-0.01	-0.01	**0.55**	0.12
13	0.18	0.14	0.06	0.26	0.01	0.00	0.06	**0.49**	0.26
27	0.04	0.13	0.21	0.09	-0.03	0.02	0.18	0.14	**0.58**
28	0.12	0.18	0.35	0.00	0.00	0.06	0.06	0.13	**0.54**

Note: Factor loadings greater than 0.4 are set in bold; F1: Institutional engagement, F2: Teacher self-efficacy for online education, F3: Interactions with students, F4: Learning resources and activities, F5: Academic planning, F6: Teacher teleworking for in a crisis context, F7: Comparison with face-to-face, F8: Online evaluation and F9: Monitoring learning.

The fifth factor, "Academic planning," includes items 17, 18, 19, and 23 refers to the expectations regarding the communication and execution of the relevant milestones of the course according to the syllabus. The sixth factor, "Teacher teleworking in a crisis context," corresponds to items 20, 21, 36, and 37 and accounts for the expectation of being able to make home life coexist with the demands of online education (physical space at home, time for preparing educational materials, compliance with synchronous class schedules, and support students).

The seventh factor, "Comparison with face-to-face," considers items 14, 15, and 16, which compare the degree to which the online education experience will be better or worse than the traditional face-to-face experience in terms of performance, learning, and teaching. Factor 8, "Online assessment," comprises items 12, 13, and 22, all of which refer to

the capacity of virtual environments to generate effective assessment that support the teaching/learning process. Finally, factor 9, "Monitoring learning," comprises items 27 and 28, which refer to the capacity that learning management platforms provide to monitor students' learning.

Table 6. Correlations Between Factors and Factor Loadings in the Second-Order Factor of CEDVES

	F:1	F:2	F:3	F:4	F:5	F:6	F:7	F:8	F:9	Factor loading
F:1	1.00	0.29	0.16	0.36	0.38	0.24	0.05	0.24	0.11	0.48
F:2	0.29	1.00	0.25	0.35	0.40	0.41	0.23	0.25	0.14	0.61
F:3	0.16	0.25	1.00	0.31	0.24	0.24	0.36	0.27	0.31	0.51
F:4	0.36	0.35	0.31	1.00	0.43	0.18	0.25	0.23	0.18	0.60
F:5	0.38	0.40	0.24	0.43	1.00	0.40	0.21	0.22	0.08	0.64
F:6	0.24	0.41	0.24	0.18	0.40	1.00	0.14	0.16	0.06	0.49
F:7	0.05	0.23	0.36	0.25	0.21	0.14	1.00	0.13	0.19	0.38
F:8	0.24	0.25	0.27	0.23	0.22	0.16	0.13	1.00	0.16	0.41
F:9	0.11	0.14	0.31	0.18	0.08	0.06	0.19	0.16	1.00	0.28

Note: F1: Institutional engagement, F2: Teacher self-efficacy for online education, F3: Interactions with students, F4: Learning resources and activities, F5: Academic planning, F6: Teacher teleworking in a crisis context, F7: Comparison with face-to-face, F8: Online assessment and F9: Monitoring learning via confirmatory factor analysis.

When analyzing the correlations between the factors (see Table 6), we can see that the mean is r = 0.24, with the range of mean correlations per factor between 0.15 for Factor 9 and 0.29 for Factor 5. For this purpose, an exploratory factor analysis of a second-order factor was adjusted, which explains 25% of the variance of the first-order factors. Seven of the nine loads are above 0.4, and of the remaining two are 0.38 and 0.28, suggesting it is a suitable solution.

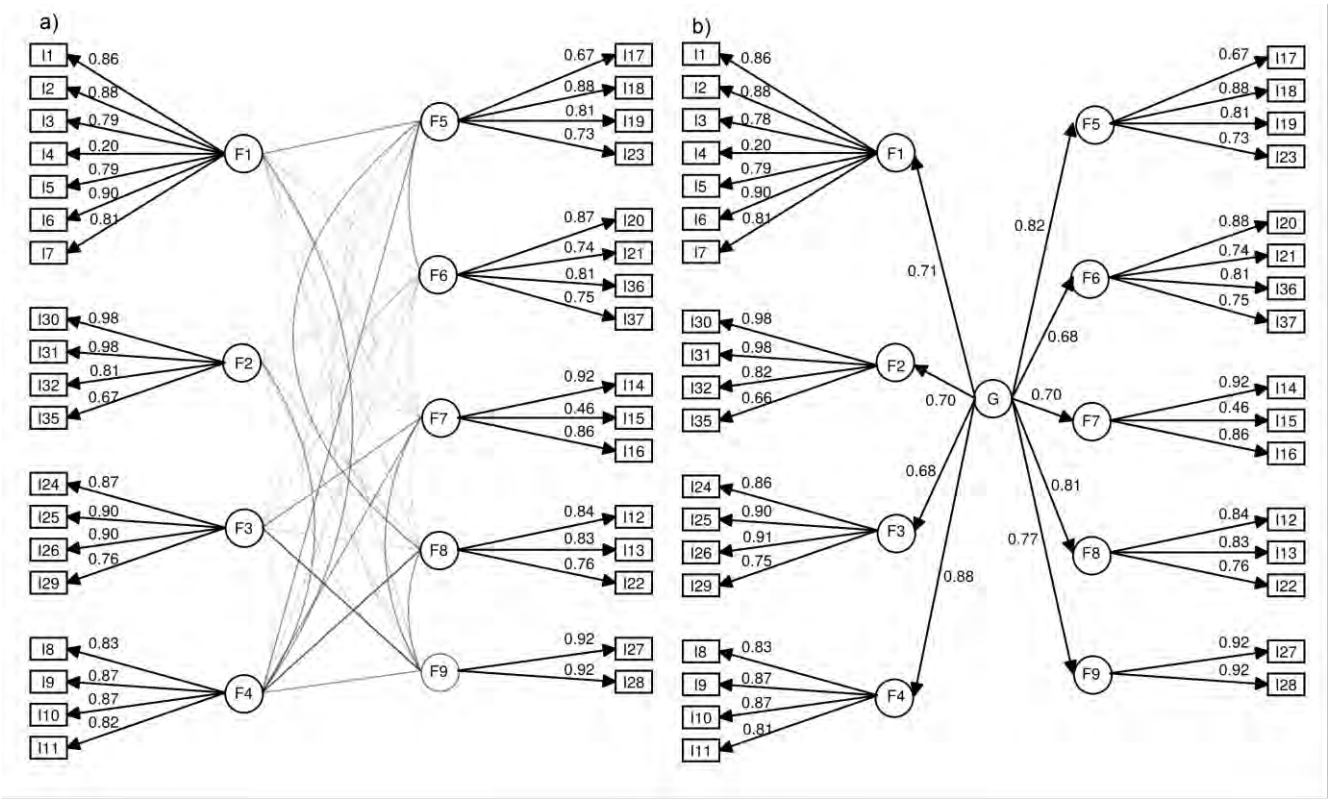
Three models were tested on the confirmatory subsample: the one-dimensional model (M0), the hierarchical model with a general factor of second order with nine related factors (M1), and the model of nine related factors (M1). As shown in Table 7, the one-dimensional model (M0) is clearly unacceptable, since $X^2/df > 3$, CFI, and TLI < 0.9, as well as RMSEA > 0.8. The hierarchical model (M1) is an acceptable model given that $X^2/ df < 3$, CFI, and TLI are above 0.90, and RMSEA < 0.8. The 9-factor model (M1) is a model with good fit indicators, since in addition to $X^2/ df < 3$ CFI and TLI are above 0.95. Despite there are confidence interval RMSEA values bellow 0.06, overall RMSEA is above 0.06. In all models, the confidence interval for RMSEA shows that the population value of this index would be above 0.05.

Table 7. CEDVES Confirmatory Factor Analysis

Model	X^2	X^2/df	CFI	TLI	SRMR	RMSEA [CI 90%]	Sig.
M0: One-dimensional	$X^2(560)=3786.47$, p<0.001	6.762	0.812	0.801	0.139	0.146 [0.141, 0.150]	p<0.001
M1: Hierarchical	$X^2(551)=1426.40$, p<0.001	2.589	0.949	0.945	0.082	0.076 [0.071, 0.081]	p<0.001
M2: Nine related factors	$X^2(524)=1069.27$, p<0.001	2.041	0.968	0.964	0.062	0.062 [0.056, 0.067]	p<0.001

Figure 1 shows the nine-factor model and the hierarchical model. All factor loadings between the items and their first-order factors are greater than 0.4, except F1 on Item 4, which is still statistically significant. In the case of the factor loadings between the general factor and the first-order factors, they are all higher than 0.68, indicating that all the factors are related strongly to each other.

Figure 1. Nine-Factor Correlated and Hierarchical Model



Note: [a] 9-factor correlated model. Correlations greater than 0.6 are marked with greater intensity. [b] Hierarchical model.

CEDVES Reliability Analysis

Table 8 shows the internal consistency indicators of total alpha and omega for all scales of the nine-factor solution. All scales have a reliability above 0.7, which is the minimum acceptable value. If we exclude Factor 7, the reliability levels are higher than 0.8 in both subsamples at all scales. Although both, the total alpha and omega exceed 0.95 for the total sum of items, this indicator accounts for the variance attributable to the overall factor, as well as to the first-order factors.

Table 8. Internal Consistency Indicators for Factors in Subsamples 1 and 2 of CEDVES

Dimensions	Subsample 1		Subsample 2	
	α	ω_t	α	ω_t
Institutional engagement	0.8959	0.875	0.8921	0.8757
Teacher self-efficacy for online education	0.9085	0.8619	0.8820	0.8719
Interaction with students	0.8963	0.8845	0.9040	0.8961
Learning resources and activities	0.9129	0.8688	0.9024	0.8571
Academic planning	0.8715	0.8495	0.8158	0.8027
Teacher teleworking in the context of crisis	0.8513	0.8611	0.8262	0.8338
Comparison with face-to-face	0.7796	0.7286	0.7911	0.7400
Online assessment	0.8403	0.8072	0.8267	0.8157
Monitoring of learning	0.9065	0.8632	0.9125	0.8657
Total	0.9556	0.9672	0.9548	0.9653

Note: α_o: alfa ordinal. ω_t: omega total.

Distribution of the Scales

Table 9 shows the descriptions for the nine scales resulting from the factorial analysis. The scales with the lowest scores were F3 (student interaction) and F7 (comparison with face-to-face), while the highest score was for F2 (teacher self-efficacy for online education). Using a non-parametric ANOVA multivariate test based on 1,000 permutations, no differences were observed in the set of scales for gender, F(3.34, 1849.96) = 1.10, p = .301; discipline, F(15.34, 1316. 95) = 1.325, p = .167; day, F(3.42, 1618.46) = 0.8, p = .461; number of courses taken in virtual classroom, F(6.8, 1746.9) = 0.618, p = .0.740; or in the level of perceived ability, F(4.823, 71.4698) = 0.852, p = .0.528.

Table 9. Descriptive for the Nine Factors of CEDVES

Dimensions	Mean	SD	Skew	Kurtosis
Institutional engagement	3.73	0.68	-0.57	0.06
Teacher self-efficacy for online education	4.13	0.61	-0.93	3.07
Interaction with students	2.87	0.96	0.08	-0.53
Learning resources and activities	4.02	0.66	-0.85	2.10
Academic planning	3.84	0.68	-0.63	0.98
Teacher teleworking in the context of crisis	3.75	0.80	-0.51	-0.05
Comparison with face-to-face	2.91	1.12	0.05	-0.65
Online assessment	3.39	0.86	-0.41	-0.05
Monitoring of learning	3.33	0.95	-0.39	-0.26
Total	3.60	0.56	-0.44	0.36

Discussion

As a result of the COVID-19 pandemic, university professors were forced to teach their classes in online learning environments. Until now, no instrument was available to assess professors' expectations of online education during COVID-19 (Van Der Spoel et al., 2020). In this context, the objective of this work was to design and validate a questionnaire regarding the expectations of professors of higher education toward virtual education. The relevance of this work is to anticipate the concerns that professor may have regarding online teaching. Knowing professors' expectations allows universities to implement strategies to strengthen institutional accompaniment processes. Despite we are regaining face-to-face education, it has been reported that the experience during the sanitary emergency is expected to result in an increase of online components in regular classes and probably the creation of new b and e-learning courses and programs (Hodges, et al., 2020). In this context, research to gain information provided from instrument such as the one presented in this study, is valuable to transition from remote emergency teaching to quality online teaching.

Teacher expectations are defined as assumptions made by educational professionals about the present and future academic performance and general behavior of students during their learning process (Rubie-Davies et al., 2006). The factor structure of the scale was examined through exploratory factor analysis and confirmatory factor analysis in a sample of Chilean university professors. A well-fitting solution was found consisting of nine factors that depend on a general second-order factor.

In regards with original theoretical dimensions resulting from literature analysis, only the institutional engagement (F1) and academic planning (F5) dimensions were maintained with the proposed original structure. Regarding the rest of the dimensions, modifications and new configurations were performed by redistributing items and eliminating those that did not meet acceptable statistical criteria.

The dimension of teaching self-efficacy for online education (F2) was reduced, redistributing the items related to beliefs about the ability to reconcile online teaching with home activities and personal life on a new dimension of teleworking teaching in the context of crisis (F6). This implies that the teacher's perception of self-efficacy does not consider the condition of teleworking. In other words, if he or she is not capable of making home life activities compatible with online teaching is not considered related to his or her ability, given that teleworking from home would be an exceptional situation beyond his or her control. According to the theory of reasoned action, some behaviors are not considered to be under the absolute control of the person himself but require cooperative behaviors or also depend on external factors for their realization (Ajzen, 1991; Ajzen & Fishbein, 1980). In this case, the new approaches of university teaching resulting from external measures due to COVID-19 would be generating external factors for the success of teaching practice that are not assumed to threaten professors' beliefs about effectiveness.

In the case of the dimension interaction with students, the items included in this dimension refer to the interaction inside the classroom, which is of great relevance in the design of online courses (Swan, 2002). However, it does not make a difference between synchronous and asynchronous interaction, in the sense that it includes all types of interaction that can exist in a virtual learning classroom. In the analysis, items 27 and 28 were defined as a new dimension, related to the teachers' monitoring of the learning. This result suggests that professors do not considering monitoring as a tool to interact with their students, despite it has been reported that supervision and follow up is a mean for pedagogical interaction relevant to the teaching-learning process. This result suggests it is considered by teachers as a simple exchange, not being a part of routine interaction. (Ma et al., 2015; Wong et al., 2018). It seems that the learning monitoring dimension (F9) is associated with prospective work that requires rigor and extra time. Monitoring through learning analytics could facilitate this task, allowing to make pedagogical decisions that favor students' learning processes, which have been shown to decrease dropout rates and improve grades (Larrabe Sønderlund et al., 2019).

The quality dimension of teaching–learning was reorganized, resulting in three new dimensions: a) resources and learning activities (F4), b) online assessment (F8), and c) comparison with face-to-face (F7). In the case of learning resources and activities, this new dimension considers the importance of diversifying learning resources and activities, which has been proven to positively impact student learning. It would be interesting to consider an item that focuses on the organization of learning resources and activities in the virtual classroom, since it is considered a relevant factor when assessing the quality of a course (Bailey & Card, 2009). The dimension of online assessment is a fundamental issue that has gained relevance in times of COVID-19 (García-Peñalvo, et al., 2020). This is because many professors have questioned the assessment procedures in learning platforms; in particular, regarding issues related to the accuracy of the assessment procedures and anti-plagiarism systems, that has been have been discussed extensively (Bilen & Matros, 2021; Kearns, 2012).

Finally, regarding the dimension of comparison with face-to-face, given the emergency generated by COVID-19, it has been reported that virtual classroom design for some consisted in the adaptation of face-to-face classes materials and strategies, instead of redesigning materials and activities according to what has been reported as effective online teaching. This could be due to the lack of technological and pedagogical training, as well as resources (Green et al., 2020; Hodges, et al., 2020).

Descriptive analyses, suggest that professors have positive expectations with respect to teaching self-efficacy to carry out pedagogical, evaluative, and administrative processes on the platform; indicating that they generally feel prepared to carry out pedagogical and administrative activities in the virtual classroom. Likewise, no statistically significant differences were observed by gender, the quantity of training, discipline area, or self-perceived ability; indicating that professors' expectations are not determined by personal factors, such as demographic or professional information.

Conclusion

The results presented in this work allow us to conclude that the proposed version of the CEDVES has adequate psychometric properties, providing a useful instrument for higher education, which can provide valuable information to contribute to the implementation of quality online teaching. The analysis identifies the dimensions of professors' expectations that are relevant for virtual education, evidencing beliefs that are positively understood and internalized, as well as others that do not comply with the description of the teaching and learning process in virtual environments. Such is the case of the advantages to perform continuous monitoring of the interaction of students with the learning management systems and use this feature to supervise student progress as a key element to promote learning outcomes, recognizing the opportunity of sustainable interaction with the students through the platforms. This study provides an instrument to gain information to provide specific guidelines to encourage beliefs and practices for administrators that could foster better design of training programs for effective virtual education.

Recommendations

Knowledge of teachers' expectations will allow educational administrators to identify expectations that may risk academic development and retention of students in their undergraduate programs. Anticipating negative expectations about elements of online education allows moving from remedial to preventive actions, favoring maximum use of the advantages of online education. Similarly, policies that allow professors to develop beliefs that benefit their educational work could be designed and applied, generating positive results in their courses. Finally, several studies call for further research on this topic in higher education, since the reports have been scarce (Li & Rubie-Davies, 2018). Having a valid and reliable instrument will allow to study these beliefs and contribute to the transition from emergency remote teaching to effective online teaching.

Limitations

Among the limitations of this study is that the sample was selected from a single university, which restricts the possible generalization of the findings. In this sense, future research could evaluate the psychometric properties of this scale in universities with different characteristics and contexts. Another aspect to consider is that the study was performed during emergency remote teaching. It could be relevant to assess and compare expectations in normal settings of virtual education.

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Authorship Contribution Statement

Lobos: Contributed to the design of the study, interpretation of the results, literature review, and writing of the manuscript. Cobo-Rendón and Bustos: Contributed to the design of the study as well as data extraction, data analysis and

full text review. Bruna: Contributed to the interpretation of the results and writing of the manuscript. Arias: Contributed to the design of the study and interpretation of the results.

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Appendix

Presentation of the CEDVES

Item	Dimension	Spanish (applied version)	English
1	Institutional Engagement	Percibo que mi Universidad está comprometida con la educación en línea	I perceive that my university is committed with online education.
2		Creo que recibiré apoyo en el ámbito pedagógico durante la implementación de docencia online	I believe that I will receive pedagogical support during the implementation of online teaching.
3		Creo que recibiré apoyo en el ámbito tecnológico durante la implementación de docencia online	I believe that I will receive technological support during the implementation of online teaching.
4a		Creo que mi enseñanza en línea va a ser autodidacta	I believe that my online teaching will be self-taught.
5		Considero que el apoyo de mi Universidad será suficiente para satisfacer mis necesidades para realizar educación en línea	I believe that the support from my university will be sufficient to meet my needs to implement online education.
6		Considero que el apoyo de mi Universidad será oportuno para satisfacer mis necesidades para realizar educación en línea	I believe that the support from my university will be delivered timely to meet my needs to implement online education.
7		Creo que la Universidad cuenta con equipos profesionales con conocimiento y experticia para asesorar la realización de educación en línea	I believe that the University has professional teams with the knowledge and expertise to assist me in the implementation of online education.
8	Quality of teaching and learning processes	Las plataformas de gestión del aprendizaje disponibles (LMS) me ayudarán a lograr los resultados de aprendizaje esperados en mis estudiantes	The available learning management platforms (LMS) will help me achieve the expected learning outcomes for my students.
9		Creo que los recursos en línea de las asignaturas que puedo usar (ppt, infografías, videos, simuladores u otro) ayudarán a que mis estudiantes aprendan	I believe that the online course resources I can use (ppt, infographics, videos, simulators or other) will promote my students' learning
10		Creo que las actividades en línea que puedo usar (foros, evaluación por pares, videoconferencias y otras) ayudarán a mis estudiantes a aprender mejor	I believe that the online activities I can use (forums, peer assessment, videoconferences, and others) will help my students learn better.
11		Creo que la variedad de recursos y actividades en línea son importantes para un mejor proceso de enseñanza aprendizaje	I believe that the variety of online resources and activities are important for improving the teaching and learning process.
12		Creo que las evaluaciones en línea ayudarán a un mejor aprendizaje de mis estudiantes	I believe that online assessments will help my students to learn better.
13		Creo que el aula virtual posee actividades de evaluación que permiten apreciar los aprendizajes de mis estudiantes	I believe that the virtual classroom has assessment activities that allow me to estimate my students' learning.
14b		Creo que el aprendizaje de mis estudiantes será (Peor / Igual / Mejor) que la clase tradicional / presencial	I believe that my students' learning will be (Worse / Equal / Better) than the traditional / face-to-face classroom.
15b		Creo que el rendimiento académico de mis estudiantes será: (peor / igual / mejor) que en la clase tradicional / presencial	I believe that my students' academic performance will be: (Worse / Equal / Better) than in the traditional / face-to-face class.
16b		Creo que mis oportunidades de enseñar a mis estudiantes, a través del aula virtual, será: (menores / igual / mayores) que en la clase tradicional / presencial	I believe that my opportunities to teach my students through the virtual classroom will be: (less / equal / greater) than in the traditional / face-to-face class.

Appendix Table Continued

Item	Dimension	Spanish (applied version)	English
17	Quality of educational planning	Creo que mi curso se desarrollará de acuerdo con lo planificado	I believe that my course will be developed according to plan
18		Considero que la información sobre cómo se desarrollarán las asignaturas en línea serán entregadas en forma clara	I believe that the information about how online courses will be developed will be delivered in a clear way.
19		Creo que la información sobre cómo se desarrollarán las asignaturas en línea serán entregada a tiempo	I believe that the information on how online courses will be developed will be delivered on time.
20		Considero que es posible cumplir con los horarios de clases en línea	I believe that it is possible to comply with the online class schedules.
21		Creo que es posible cumplir con los horarios de atención en línea	I believe it is possible to comply with the declared online office hours.
22		Considero que el aula virtual provee entornos seguros para la ejecución de procesos evaluativos de aprendizajes	I consider that the virtual classroom provides safe environments for the execution of assessment learning processes.
23		Creo posible cumplir con las evaluaciones planificadas para mi asignatura	I believe it is possible to comply with the planned assessment of my course.
24	Quality of the relationship with the students	Creo que la plataforma me dará más oportunidades de relacionarme con mis estudiantes que de forma presencial	I believe that the platform will give me more opportunities to interact with my students than face-to-face.
25		Creo que el usar plataformas en línea favorecerá mi comunicación con los estudiantes	I believe that using online platforms will favor communication with my students.
26		Creo que las herramientas en línea me permitirán apoyar más a mis estudiantes en su aprendizaje	I believe that the online tools will allow me to provide more support to my students.
27		Creo que podré hacer seguimiento del progreso de los estudiantes con mayor facilidad en el aula virtual	I believe that I will be able to monitor student progress more easily in the virtual classroom.
28		Creo que el aula virtual me permitirá darme cuenta de cómo van aprendiendo mis estudiantes	I believe that the virtual classroom will allow me to see how my students are learning.
29b		Creo que la relación con mis estudiantes en línea será: (Peor/igual/mejor) que en la tradicional / presencial	I believe that the relationship with my students online will be: (Worse/equal/better) than in the traditional / face-to-face one.
30	Perceived self-efficacy for virtual education	Creo que seré capaz de seleccionar y crear recursos del aula virtual	I believe that I will be able to select and create virtual classroom resources.
31		Creo que seré capaz de seleccionar y crear actividades en el aula virtual	I believe I will be able to select and create activities in the virtual classroom.
32		Creo que seré capaz de ejecutar procesos evaluativos en el aula virtual	I believe I will be able to execute evaluative processes in the virtual classroom.
33		Creo que seré capaz de revisar el progreso de mis estudiantes en el aula virtual	I believe I will be able to monitor my students' progress in the virtual classroom.
34		Creo que seré capaz de motivar a mis estudiantes en el uso del aula virtual	I believe I will be able to motivate my students to use the virtual classroom.
35		Creo que seré capaz de ejecutar procesos administrativos de la carrera de manera online (ingresar notas, obtener claves, extraer informes, etc.)	I believe that I will be able to perform administrative processes of the course online (publish grades, obtain passwords, extract reports, etc.).
36		Creo que seré capaz de enseñar on-line de manera efectiva en espacios compartidos con mi grupo familiar	I believe that I will be able to teach online effectively in shared spaces with my family group.
37		Creo que podré compatibilizar la dedicación para implementar aula virtual con mi vida personal	I believe that I will be able to reconcile the dedication to implement virtual classroom with my personal life.
38		Creo que el aprendizaje de mis estudiantes este semestre va a ser: (muy malo / malo / regular / bueno / muy bueno)	I believe that my students' learning this semester will be: (very bad / bad / fair / good / very good)