Publicaciones. Facultad de Educación y Humanidades del Campus de Melilla
Depósito legal: GR-94-2001 · eISSN: 2530-9269 · pISSN: 1577-4147
Editor: Facultad de Ciencias de la Educación y del Deporte de Melilla (Universidad de Granada)

Evidence of validity and reliability of DigCompEdu CheckIn among professors at a Peruvian private university

Evidencias de validez y confiabilidad del DigCompEdu CheckIn en docentes de una universidad privada peruana

DigCompEdu CheckIn 在一所秘鲁私立大学的教师中的有效性和可靠性证据

Доказательства валидности и надежности DigCompEdu CheckIn среди преподавателей частного перуанского университета

Eliana Gallardo-Echenique
Peruvian University of Applied Sciences
eliana.gallardo@upc.edu.pe
https://orcid.org/0000-0002-8524-8595

Ambrosio Tomás-Rojas
Peruvian University of Applied Sciences
ambrosio.tomas@upc.edu.pe
https://orcid.org/0000-0002-9722-2501

Jorge Bossio
Peruvian University of Applied Sciences
jorge.bossio@upc.edu.pe
https://orcid.org/0000-0002-4426-8063

Úrsula Freundt-Thurne
Peruvian University of Applied Sciences
ursula.freundt@upc.edu.pe
https://orcid.org/0000-0002-5983-3651

Fechas · Dates

Received: 2022-06-29
Accepted: 2022-10-14
Published: 2023-01-01

Cómo citar este trabajo · How to Cite this Paper

Gallardo-Echenique, E., Tomás-Rojas, A., Bossio, J., & Freundt-Thurne, U. (2023). Evidence of validity and reliability of DigCompEdu CheckIn among professors at a Peruvian private university. *Publicaciones, 53*(2), 69–88. https://doi.org/10.30827/publicaciones.v53i2.26817

Resumen

Introducción: Desde hace algunos años, se vienen desarrollando diversos marcos y herramientas de autoevaluación para describir las facetas de la competencia digital de los docentes, siendo uno de estos el DigCompEdu CheckIn. Este ha sido validado al inglés en Marruecos, al alemán en Alemania, y al español en España. El objetivo de este estudio consiste en validar el instrumento que fue elaborado en otro contexto, para que responda a la necesidad de medir la competencia digital de los docentes de una universidad privada en Lima, Perú, a partir de su autopercepción.

Método: Se realizó un estudio instrumental para determinar las evidencias de validez y confiabilidad de la herramienta DigCompEdu CheckIn. La muestra estuvo constituida por 1218 docentes de diferentes áreas: Arte, Ciencias, Ciencias Sociales, Ciencias Jurídicas, Ingenierías y Arquitectura, Ciencias de la Salud, y Humanidades.

Resultados: Los resultados señalan la reagrupación de las competencias digitales en una estructura de tres factores (F1, F2, F3) y 22 competencias, a diferencia de la estructura original compuesta de seis factores. Esta reducción de la estructura de las competencias no descarta la interacción entre las competencias generales, sino que la mantiene. Las tres competencias globales (Competencias de los estudiantes (F1); Competencias profesionales de los educadores (F2); Competencias pedagógicas de los educadores (F3) interactúan y se interrelacionan.

Conclusiones: Los hallazgos evidencian que el DigCompEdu CheckIn es una herramienta válida y confiable entre los docentes. Es necesario realizar nuevos estudios que verifiquen la propuesta de tres factores del instrumento para el contexto peruano, así como su confiabilidad en nuevas poblaciones y contextos culturales.

Palabras clave: competencia digital, educación superior, COVID-19, validez, confiabilidad.

Abstract

Introduction: For some years now, various frameworks and self-assessment tools have been developed to describe the facets of teachers' digital competence, one of these being the DigCompEdu CheckIn. This has been validated in English in Morocco, in German in Germany, and in Spanish in Spain. The objective of this study is to validate the instrument that was developed in another context, so that it responds to the need to measure the digital competence of teachers at a private university in Lima, Peru, based on their self-perception.

Method: An instrumental study was carried out to determine the evidence of validity and reliability of the DigCompEdu CheckIn tool. The sample consisted of 1,218 teachers from different areas: Art, Sciences, Social Sciences, Legal Sciences, Engineering and Architecture, Health Sciences, and Humanities.

Results: The results indicate the regrouping of digital skills in a structure of three factors (F1, F2, F3) and 22 skills, unlike the original structure composed of six factors. This reduction in the structure of competencies does not rule out the interaction between general competencies, but rather maintains it. The three global competencies (Student Competencies (F1); Educators Professional Competencies (F2); Educators Pedagogical Competencies (F3) interact and interrelate.

Conclusions: The findings show that the DigCompEdu CheckIn is a valid and reliable tool among teachers. New studies are needed to verify the three-factor proposal of the instrument for the Peruvian context, as well as its reliability in new populations and cultural contexts.

Keywords: digital competence, higher education, COVID-19, validity, reliability.

Аннотация

Введение: В течение нескольких лет было разработано несколько шаблонов и инструментов самооценки для описания аспектов цифровой компетентности учителей, одним из которых является DigCompEdu CheckIn. Она была утверждена на английском языке в Марокко, на немецком языке в Германии и на испанском языке в Испании. Целью данного исследования является проверка инструмента, который был разработан в другом контексте, чтобы ответить на необходимость измерения цифровой компетентности преподавателей частного университета в Лиме, Перу, на основе их самовосприятия.

Метод: Было проведено инструментальное исследование для определения доказательств валидности и надежности инструмента DigCompEdu CheckIn. Выборка состояла из 1218 учителей из различных областей: искусства, естественных наук, социальных наук, юридических наук, инженерии и архитектуры, здравоохранения и гуманитарных наук.

Результаты: Результаты показывают перегруппировку цифровых компетенций в структуру из трех факторов (F1, F2, F3) и 22 компетенций, в отличие от первоначальной структуры из шести факторов. Такое сокращение структуры компетенций не исключает взаимодействия между общими компетенциями, а сохраняет его. Три глобальные компетенции (компетенции обучающихся (F1); профессиональные компетенции педагогов (F2); педагогические компетенции педагогов (F3)) взаимодействуют и взаимосвязаны.

Выводы: Полученные результаты свидетельствуют о том, что DigCompEdu CheckIn является валидным и надежным инструментом для учителей. Необходимы дальнейшие исследования для проверки трехфакторного подхода инструмента для перуанского контекста, а также его надежности в новых популяциях и культурных контекстах.

Ключевые слова: цифровая компетентность, высшее образование, COVID-19, валидность, надежность.

摘要

引言：多年来，用来描述教师数字能力各个方面的不同自我评估框架和工具已经得到了开发，其中之一就是 DigCompEdu CheckIn。该工具已在摩洛哥的英语版本、德国的德语版本和西班牙的西班牙语版本中得到验证。本研究的目的是验证其另一种背景下的开发，以便它回应秘鲁利马一所私立大学教师根据自我认知来衡量的数字能力的需求。

研究方法：我们进行了一项工具型研究，以确定 DigCompEdu CheckIn 工具的有效性和可靠性的证据。样本包括来自不同领域的 1218 名教师：艺术、科学、社会科学、法律科学、工程与建筑学、健康科学和人文科学。

研究结果：结果表明数字技能在三个因素（F1、F2、F3）和 22 项技能的结构中重新组合，与由六个因素组成的原始结构不同。这种能力结构的减少并不排除一般能力之间的相互作用，而是保持它。三种全球能力（学生能力F1；教育者专业能力F2和教育者教学能力F3）相互作用和相互关联。

研究结论：调查结果表明，DigCompEdu CheckIn 在教师中是一种有效且可靠的工具。此外，我们需要进行新的研究来验证这一在秘鲁背景下由三个因素组成的工具，以及它在新的人群和文化背景下的可靠性。

关键词：数字能力、高等教育、COVID-19、有效性、可靠性。

Introduction

In December 2019, the world was struck by the COVID-19 pandemic, which was first reported in Wuhan, China (PAHO, 2020) and identified as a severe acute respiratory disease that, if worsened, could lead to death (Twinamasiko et al., 2021). According to the World Health Organization, from March 11, 2020, this disease was categorized as a pandemic (PAHO, 2020), thus affecting the development of higher education in various aspects (Mok et al., 2021), with the educational gaps being more visible and deepened in terms of access to digital technologies, internet connection, and social exclusion (Reimers, 2022).

The spread of the disease worldwide forced governments to establish conditions such as passing regulations on social distancing of citizens, suspension of all kinds of activities in educational centers, and limiting and interrupting a good number of economic and social activities (Hatabu et al., 2021; PAHO, 2020). Educational establishments, in many parts of the world, suspended face-to-face classes in March 2020, negatively affecting future educational systems (IIPE Unesco Latin America, 2020). The vulnerable student population and students with learning difficulties at home were the most impacted (IIPE Unesco Latin America, 2020; Pardo & Cobo, 2020).

Although before COVID-19, many countries had social, economic, and political challenges (IIEP Unesco Latin America, 2020) in the educational field, the pandemic demanded immediate responses such as the implementation of alternatives to quickly transition from face-to-face to remote teaching and the deployment of remote education strategies (Mok et al., 2021; Reimers, 2022). This has involved not only an exhaustive review of human relations, but also the mandatory redesign of a significant number of tasks, academic work, and educational experiences that transitioned from being face-to-face to being carried out through digital platforms (Alania-Contreras et al., 2022; Pardo & Cobo, 2020). In Peru, educational facilities at the pre-school, primary, secondary, and higher education levels suspended face-to-face activities. However, universities , strengthened remote education policies and activities for the non-face-to-face teaching of their subjects (Resolution of the Board of Directors, 2020) and established actions to have pedagogical resources and digital tools (Rojas-Salas et al., 2021).

The virtuality caused by the pandemic forced the design of roadmaps to be based on particular contexts with more innovative approaches, considering the needs and possibilities of each system, and taking into account the integration of digital technology (Reimers, 2022; Rodríguez et al., 2021). After more than two years since the beginning of the pandemic, many participants, traditionally used to holding face-to-face classes (Álvarez et al., 2020), have been forced to recognize the importance of virtual classes, incorporating them into their teaching work in response to the new demands of society (Pardo & Cobo, 2020; Rodríguez et al., 2021). The integration of digital technologies into the learning management system confirms that it is currently possible to refer to a "new normal" in the educational field (Álvarez et al., 2020; Mok et al., 2021).

Additionally, the Council and the European Parliament designed, in 2006, a reference framework on the main competences related to lifelong learning that habitants need to achieve to ensure active participation with social inclusion and employability in this society. These competences are: (a) communication in the mother tongue; (b) communication in foreign languages; (c) mathematical competence and basic competences in science and technology; (d) digital competence; (e) learning to learn; (f) social and civic competences; (g) sense of initiative and entrepreneurship; and (h) cultural awareness

and expression (European Commission, 2007). In this context, with the importance that digital technologies have acquired, digital competence has become essential (Gallardo-Echenique et al., 2018; Pozos & Tejada, 2018; Prendes et al., 2018) for active and systematic participation in this new post-pandemic society (Pardo & Cobo, 2020).

Digital competence is a key aspect related to a great number of activities carried out by professors. Therefore, the timely and adequate integration of technology has shown a significant role (Cobo, 2019; Padilla-Hernández et al., 2020). Digital competence is defined as:

The safe and critical use of information and communications technologies (ICTs) in society for work, leisure, and communication. It is based on basic ICT competences: the use of computers to obtain, evaluate, store, produce, present, and exchange information and to communicate and participate in collaborative networks through the Internet. (European Commission, 2007, p. 7)

However, digital teaching competences are considered as a set of attitudes, knowledge, competences, and abilities that favor the strengthening of their teaching–learning strategies; personal and professional development; and interactions with students, co-workers, relatives, among other actors (Redecker & Punie, 2020).

As a result of COVID-19, new technological resources that emerged online overwhelmed teachers and other educational staff, who were unprepared to ensure the continuity of students' learning (Pardo & Cobo, 2020). They faced the challenge of teaching remotely without adequate guidance, training, or access to the necessary resources (IIEP Unesco Latin America, 2020). However, this health emergency has become a new opportunity to build a more natural, fluid, close, and effective relationship with the available digital resources and tools, thus facilitating the teaching work and its educational practice (Mok et al., 2021; Padilla-Hernández et al., 2018; Selwyn, 2017).

In Peru, the interest in teaching digital competences, which increased significantly during the period of forced isolation, still remains given the regulatory changes introduced during this period of health emergency. In May 2020, through Legislative Decree No. 1496 (Government of Peru, 2020), the Peruvian Government included in the university law, the possibility of providing educational services in three modalities (face-to-face, semi-face-to-face, and remote or non-face-to-face), thereby expanding opportunities for a diversified and quality offering of education. In August 2020, by Resolution of the Board of Directors No. 105, the National Superintendence of Higher University Education (SUNEDU, 2020) established the quality conditions for the provision of educational services in these three modalities, indicating competent and qualified teaching staff in universities as a requirement, as well as clear policies for updating their digital competences.

Digital Competence for Educators (DigCompEdu)

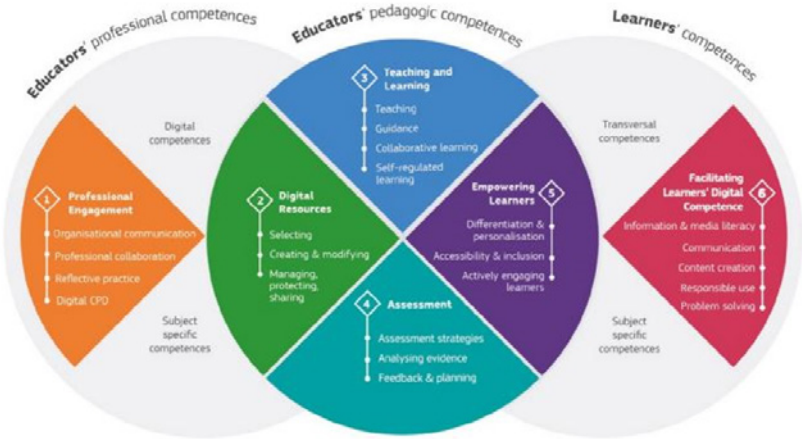
For several years, many self-assessment frameworks and tools have been developed internationally to name the different phases of professors' digital competence (Redecker & Punie, 2020, 2017). One of these is the so-called European Framework for the Digital Competence of Educators (DigCompEdu), whose purpose is to guide policies for the establishment of tools and training programs for professors' competence (European Commission, 2021b; Redecker & Punie, 2020). This framework is part of the European Commission's project for the training, preparation, and instruction on digital environments (European Commission, 2021b). The DigCompEdu framework,

whose goal is to gather and describe the digital competences of teachers, is aimed at educators at various levels (pre-school, higher and adult education), also considering general and professional training, and education for special needs students (Redecker & Punie, 2020).

The DigCompEdu framework comprises the progress of six areas of teaching digital competence (Figure 1): (1) Professional engagement, (2) digital content, (3) teaching and learning, (4) assessment and feedback, (5) empowerment of students, and (6) development of digital competence of students (Redecker & Punie, 2020). The core of the DigCompEdu framework includes areas 2–5 that explain "the digital pedagogical competence of educators, that is, the digital competences that professors need to adopt efficient, inclusive, and innovative teaching and learning strategies" (Redecker & Punie, 2020, p. 16). This is complemented by area 1, which is aimed at the professional environment and with area 6 which determines the specific pedagogical competences necessary to develop students' digital competence (Redecker & Punie, 2020).

Figure 1

DigCompEdu Framework Synopsis



Note. Taken from the *European Framework for the Digital Competence of Educators: DigCompEdu* (p. 19), by C. Redecker, Y. Punie, 2020, Joint Research Center of the European Commission.

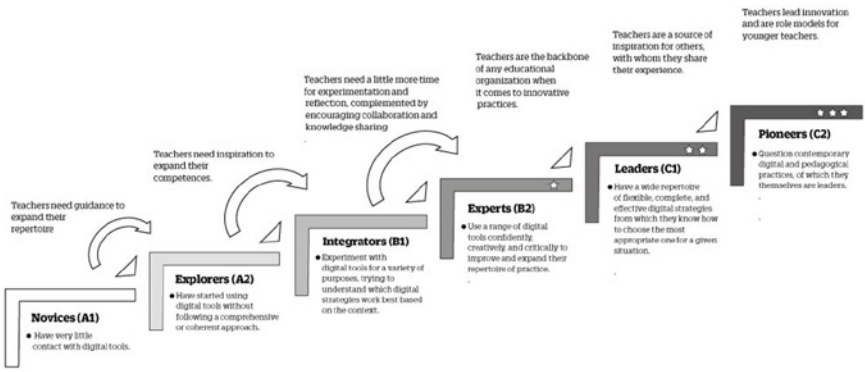
Competence development consists of "six proficiency levels used by the Common European Framework of Reference for Languages (CEFR), ranging from A1 to C2" (Redecker & Punie, 2020, p. 28) (Figure 2). This framework developed a self-perception instrument of digital teaching competence provisionally called DigCompEdu CheckIn developed by Redecker and Punie (2017b), which has been adapted to many languages and teaching profiles (European Commission, 2021b, 2021a). Its design is the result of several international proposals and experiences in multiple academic and scientific events, as well as consultation with professors, researchers, experts, and professionals from the European community (European Commission, 2021b; Ghomi & Redecker, 2019; Redecker & Punie, 2020), who were invited to comment on the items and test the survey. The DigCompEdu proposes 22 competences organized in areas and compe-

tence levels (A1, A2, B1, B2, C1, C2) and aims to promote digital teaching competence and innovation in education (Redecker & Punie, 2020, 2017). Currently, the instrument continues to be validated among educators from different States of the European Union and the world (European Commission, 2021a) to demonstrate that the cultural context requires special attention and assessment.

In March 2018, the initial version of DigCompEdu CheckIn was published in Morocco in English with the validation of 160 teachers of the English course (Benali et al., 2018). In April 2018, it was translated into German and validated by 22 professors from Germany (Ghomi & Redecker, 2019). In May 2018, 20 experts (researchers and professors) were consulted to discuss the relevance and representativeness of the items. In October 2018, a new version of the instrument was made in English and German (Ghomi & Redecker, 2019). Between September and November 2018, the instrument was validated again, by means of an online survey of the European Union, by 335 German professors, (Ghomi & Redecker, 2019). In 2021, it was validated by 2,180 Spanish higher education professors (Cabero-Almenara et al., 2021).

Figure 2

Proficiency Levels



Note. Taken from the *European Framework for the Digital Competence of Educators: DigCompEdu* (pp. 29–30), by C. Redecker, Y. Punie, 2020, Joint Research Center of the European Commission.

Many researchers (Arafat et al., 2016; Yaghoobzadeh et al., 2019) warn that the use of measurement instruments developed in other countries must consider specific cultural variables to generate valid and reliable findings. Validity is the coherence between theory and empirical evidence so that the interpretations made with the instrument make sense (Campo-Arias & Oviedo, 2008; Ramada-Rodilla et al., 2013). It should be noted that validity is not a property of the measurement instrument as such (Messick, 1995b), but will depend on the goal of the measurement, items, population, and application context; hence, an instrument may be valid for a certain group, but not for others (Messick, 1995a; Soriano Rodríguez, 2014). This is the reason for any validation process to be ongoing and requires constant empirical verification (Messick, 1995a, 1995b). Moreover, reliability is the ability of the instrument to show similar results in repeated measurements; however, it is not enough to guarantee the validity of an instrument for a specific population (Campo-Arias & Oviedo, 2008; Soriano Rodríguez, 2014).

Since 1994, the International Test Commission has been developing guidelines for the adaptation of questionnaires and tests (Muñiz et al., 2013) and to methodologically guide the process of adaptation and improvement of its quality (Hernández et al., 2020). The first version was published in 2005, and the second one in 2017, containing 18 directives grouped into six categories—precondition (3 directives), test development (5 directives), confirmation (4 directives), administration (2 directives), punctuation and interpretation (2 directives), and documentation (2 directives) (Hernández et al., 2020; ITC, 2017).

The DigCompEdu CheckIn has already been validated in English, German, and Spanish in Morocco, Germany, and Spain, respectively. Although it has already been administered in Latin American countries that make up MetaRed, this is the first study to date, seeking to validate an instrument developed in another context, that responds to the relevance of measuring teaching digital competence in a private university in Latin America, Lima, Peru, based on their self-perception. MetaRed Peru is the organization of Peruvian public and private universities, created with the support of Universia to debate, reflect, and work collaboratively on the relevance of digital technologies (Ojeda del Arco, 2021). To understand the state of Peruvian teaching digital competences, MetaRed decided to use DigCompEdu in 2019 to ensure that, based on the reflection carried out by each university, it proposes virtualization policies, teacher training plans, and an educational model (Ojeda del Arco, 2021).

Methods

An instrumental study was carried out and its goal was to specify the evidence of validity and reliability of the DigCompEdu CheckIn tool, adapted in a different sample from the original (Millan et al., 2013). This study is part of MetaRed Peru and its purpose is for universities to be able to use the tool developed by the Joint Research Center of the European Commission (MetaRed Peru, 2021). The 22 items of the original version that have Likert-type response alternatives were taken into consideration.

The data corresponding to the teachers of a Peruvian private university were collected. The non-probabilistic convenience and homogeneous sample consisted of 1,218 higher education professors from different areas of that institution such as Art, Sciences, Social Sciences, Legal Sciences, Engineering, and Architecture, Health Sciences, and Humanities. In April 2021, the instrument was distributed by email to more than 4,000 professors, who participated voluntarily and anonymously, and no academic and/or employment harm was caused to them. All participants received timely information on the nature of the research and the undertaking to safeguard their confidentiality and anonymity (Grady et al., 2017).

Regarding data treatment, these were organized, coded, and analyzed using statistical calculation programs IBM SPSS Statistics 25, IBM SPSS Amos 23, Jamovi 2.0, and JASP 0.16. The sample was randomly divided into two equal parts, to evaluate the internal structure of the instrument. Exploratory factorial analysis was carried out using the first part, while a confirmatory factorial analysis was conducted with the second part. Descriptive analyzes of the items were performed: "mean, standard deviation, asymmetry, and kurtosis" (Ventura-León et al., 2018, p. 25); Additionally, their homogeneity was evaluated by calculating the corrected item-test correlation.

Subsequently, the exploratory factor analysis was performed. Regarding the confirmatory factor analysis (CFA), the goodness-of-fit indexes were calculated using Chi

Square, Chi Square/Degrees of Freedom, Root Mean Residual, Tucker–Lewis Index, Comparative Fit Index, Incremental Fit Index, and the Mean Square Error of Approximation with their confidence intervals. Finally, reliability was determined by internal consistency using McDonald's Omega coefficient. It should be noted that Cronbach's Alpha was not used due to its limitations as the magnitude of the coefficient is affected by the number of items and response alternatives and sampling error. On the contrary, the calculation of the Omega coefficient depends on the factor loadings obtained in the confirmatory analysis, which makes this method produce more stable reliability results (Ventura-León et al., 2018).

Results

Preliminary analysis of the items

Table 1 presents the descriptive statistics of the items: "mean, standard deviation, asymmetry, and kurtosis" (Ventura-León et al., 2018, p. 25). Corrected item-test correlations are also presented. It is observed that item 9 presents the highest mean (M = 3.06; SD = .83) and item 21 presents the lowest mean (M = 2.30; SD = 1.13). Regarding asymmetry and kurtosis, all items presented values lower than +/– 1.5 (Ferrando & Anguiano-Carrasco, 2010; Pérez & Medrano, 2010), which shows that the data present an approximation to the normal distribution. This finding was decisive in opting for the maximum likelihood factorization method (Ximenez & García, 2005). In addition, the corrected item-test correlation values indicated that all items should be retained because they obtained a correlation coefficient greater than .20 (Klin, 2016).

Exploratory factor analysis (EFA)

Before carrying out the exploratory factor analysis (EFA), it was verified whether the data met the requirements to be able to carry it out; the measure of sample adequacy obtained with the Kaiser–Meyer–Olkin coefficient was .96 (excellent) and the Bartlett's sphericity test obtained a coefficient $X^2 = 6360.47$, $p < .001$ (optimal). With these results, the EFA was carried out using the maximum likelihood extraction method. (Costello & Osborne, 2005). The determination of the number of factors was carried out through parallel analysis (Timmerman & Lorenzo-Seva, 2011) which suggested a three-factor solution to group the 22 items of the DigCompEdu CheckIn, as shown in Table 2. These factors explained 47.70% (acceptable) of the variance of the construct. It is observed that the factor loadings were higher than .30 (Kline, 1993). Items 8, 15, and 17 were in more than one factor. Due to this, it was decided to keep them and group them with the items belonging to the original dimensions.

It can be noted that the three-factor structure is related to the competences evaluated by the DigCompEdu CheckIn. Therefore, the factors found will be called student competences (Factor 1); professional competences of educators (Factor 2), and pedagogical competences of educators (Factor 3) (Redecker & Punie, 2017). It is observed that Factor 1 grouped the items of dimensions 5 and 6 of the original instrument (empowerment of students and development of digital competence of students). However, Factor 2 grouped dimensions 1 and 2 of the original instrument (professional commitment and digital content); finally, Factor 3 grouped dimensions 3 and 4 of the original instrument (teaching-learning and evaluation-feedback).

Table 1

Preliminary analysis of the DigCompEdu CheckIn items

Items	M	SD	g^1	g^2	r_{itc}
1. Organizational communication	2.62	.81	–.18	–.15	.50
2. Professional collaboration	2.41	.93	–.22	–.01	.52
3. Reflective practice	2.48	.96	.01	–.71	.58
4. Continuous professional development through digital means	3.02	.93	–.76	.12	.45
5. Selection	2.63	.88	–.13	–.64	.50
6. Creation and modification	2.72	.81	–.70	1.27	.49
7. Protection, management, and exchange	2.51	1.21	–.51	–.56	.39
8. Teaching	2.71	1.02	–.49	-.41	.65
9. Guidance and support in learning	3.06	.83	–.85	.81	.57
10. Collaborative learning	3.02	.93	–.86	.64	.58
11. Self-regulated learning	2.67	.94	–.80	.56	.64
12. Evaluation strategies	2.82	.84	–.53	.36	.59
13. Learning analytics	2.57	1.00	–.35	–.51	.59
14. Feedback, planning, and decision making	2.72	.84	–.36	–.05	.62
15. Accessibility and integration	2.97	1.06	–.91	.19	.61
16. Customization	2.42	1.23	–.42	-.93	.62
17. Active engagement of students with their learning	2.73	.95	–.57	.24	.58
18. Information and media literacy	2.43	1.03	–.37	–.41	.62
19. Communication	2.56	.85	–.20	.33	.62
20. Content creation	2.64	1.09	–.94	.33	.59
21. Responsible use	2.30	1.13	–.15	–.54	.71
22. Problem solving	2.59	.91	–.53	.52	.70

Note. M = Mean; SD = Standard deviation; g^1 = Asymmetry; g^2 = Kurtosis; r_{itc} = Corrected item-test correlation.

Table 2

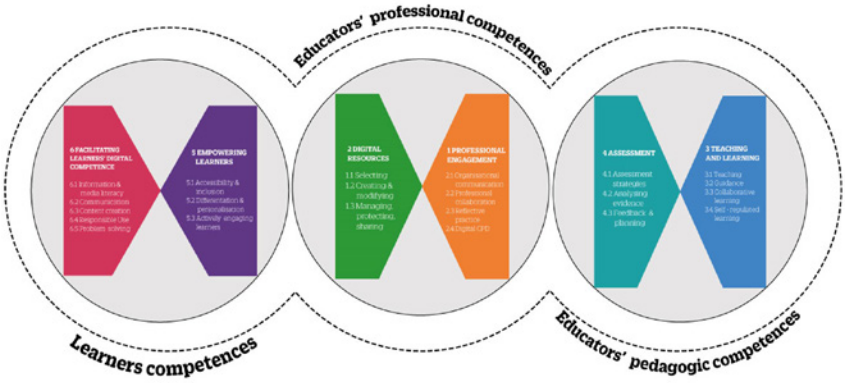
Exploratory factor analysis of the DigCompEdu CheckIn

Items	Factor 1	Factor 2	Factor 3	Communality
21. Responsible use	.94			.31
22. Problem solving	.71			.41
18. Information and media literacy	.66			.52
20. Content creation	.56			.60
16. Customization	.48			.50
19. Communication	.46			.50
15. Accessibility and integration	.34		.40	.54
17. Active engagement of students with their learning	.33		.36	.51
6. Creation and modification		.72		.52
3. Reflective practice		.71		.49
5. Selection		.70		.51
1. Organizational communication		.56		.61
8. Teaching		.55	.36	.36
2. Professional collaboration		.50		.63
4. Continuous professional development through digital means		.44		.71
7. Protection, management, and exchange		.34		.75
12. Evaluation strategies			.71	.43
9. Guidance and support in learning			.65	.55
14. Feedback, planning, and decision making			.50	.49
10. Collaborative learning			.49	.57
13. Learning analytics			.49	.54
11. Self-regulated learning			.46	.46
Eigenvalues	9.20	.74	.32	
Variance %	17.10%	15.00%	15.60%	

As shown in Figure 3, unlike the original model (Figure 1), the order and placement of competences— student competences (Factor 1); professional competences of educators (Factor 2) and pedagogical competences of educators (Factor 3) change location.

Figure 3

DigCompEdu framework proposal validated in the Peruvian context



Confirmatory factor analysis (CFA)

The purpose of this analysis was to confirm the results of the EFA. Table 3 shows the three factors that obtained excellent goodness-of-fit values.

Table 3

DigCompEdu CheckIn Statistical Goodness-of-Fit Indexes

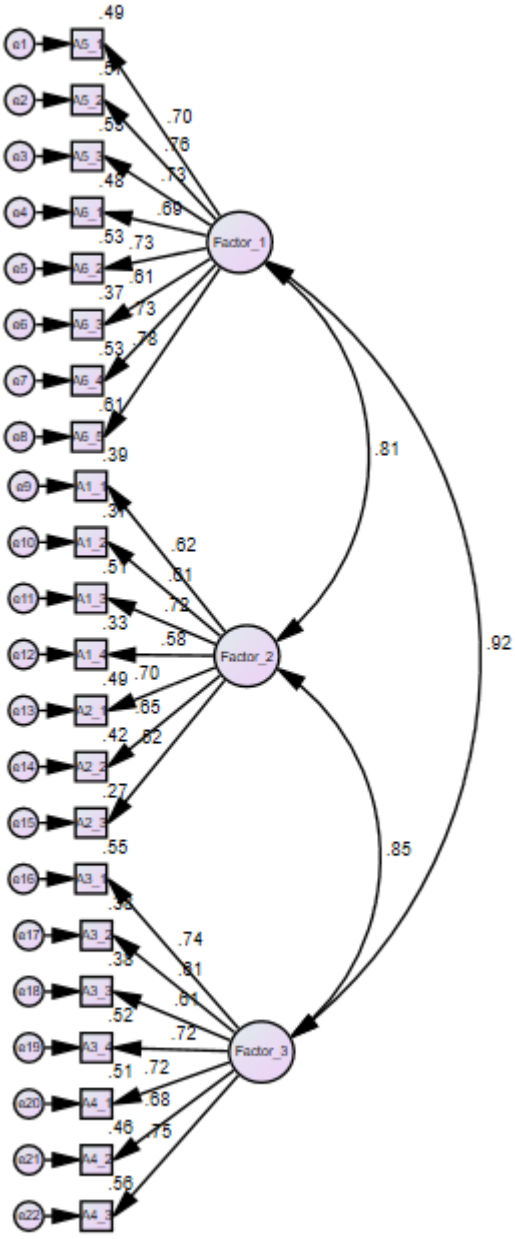
Model	X^2 (gl)	X^2/gl	RMR	TLI	CFI	IFI	RMSEA [IC90%]
Three factors	633.54 (206)	3.07	.04	.92	.93	.93	.06 [.05–.06]

Note. χ^2 = Chi square; gl= Degrees of freedom; RMR= Mean residual root; TLI= Tucker-Lewis Index; CFI= Comparative Fit Index; IFI= Incremental Adjustment Index; RMSEA= Root Mean Square Error of Approximation; CI= Confidence intervals.

Figure 4 shows the factorial structure of the DigCompEdu CheckIn. It can be seen that the factor loadings are in the range between .52 and .78, which can be considered strong.

Figure 4

Factor structure of the DigCompEdu CheckIn



Analysis of the reliability

Finally, the internal consistency reliability of the DigCompEdu CheckIn was verified by means of McDonald's Omega coefficient, as well as their respective confidence intervals, the results of which are shown in Table 4. It is observed that the reliability of this solution is considered good in all the factors, as coefficients ω > .80 were found.

Table 4

Internal consistency reliability of the DigCompEdu CheckIn

Factors	ω	CI95%
Factor 1	.89	[.87 –.90]
Factor 2	.81	[.79 –.83]
Factor 3	.86	[.84–.88]

Note. ω = McDonald's Omega Coefficient; 95% CI = Confidence interval.

Conclusions

When self-perception instruments developed in other contexts, cultures (and languages), and populations are used, it is necessary to carry out a methodologically adequate process of cross-cultural adaptation (Arafat et al., 2016; Yaghoobzadeh et al., 2019). Consequently, the emphasis is on culturally adapting the instruments (Arafat et al., 2016) so that they are psychometrically sound and capable of generating valid and generalizable findings (Yaghoobzadeh et al., 2019). In line with previous results (Borsa et al., 2012; Yaghoobzadeh et al., 2019), instruments without due validity and reliability can present problems, thus generating unreliable data when used in other studies.

Therefore, the goal was to validate an instrument, developed in another context that would respond to the requirement of measuring digital teaching competence in a private university in Lima, Peru, based on self-perception. This study incorporates the recommendations of previous authors (Benali et al., 2018; Ghomi & Redecker, 2019) who raise the need for adaptations to other contexts and cultures. The findings introduced show that the DigCompEdu CheckIn is valid and reliable among the population under study. Moreover, these results confirm the importance for studies on digital competences to have evaluation instruments that are validated and applied cross-culturally and within cultures, as in the case of DigCompEdu.

The proposal obtained shows the regrouping of digital competences in a structure of three factors and 22 items, unlike what is shown in the original six-factor structure. A possible explanation for the new regrouping of factors could be the validity evidence prior to the original instrument. The validations of the instrument carried out in Morocco, Germany, and Spain lack psychometric properties (Benali et al., 2018; Cabero-Almenara et al., 2021; Ghomi & Redecker, 2019). However, in all of them it is declaratively stated that the opinions of experts were available, although no explicit evidence of the content validity process was shown. There is no concordance analysis of the experts' opinions, which is decisive in ruling out possible answers given randomly. This reduction in the structure of competences does not rule out the in-

teraction between general competences, but rather maintains them even though the position of the factors of the original structure (Figure 1) has been modified (Figure 3).

The structure of three factors (F1, F2, and F3) is connected. Although the position of the factors changes location from that shown in Figure 1 (F1: Professional competences of educators; F2: Pedagogical competences of educators; F3: Competences of the students), as stated in Figure 3 (F1: Student competences; F2: Professional competences of educators; F3: Pedagogical competences of educators), all interrelate and interact (Redecker & Punie, 2017). This finding is partially consistent with that reported by Cabero-Almenara et al. (2021), because the integrity of the items of the original instrument is preserved; but they are grouped into three factors that correspond to the theoretical structure of the DigCompEdu (Redecker & Punie, 2020), although in a different position. In line with previous studies (Arafat et al., 2016; Borsa et al., 2012; Yaghoobzadeh et al., 2019), there are factors of a cultural nature, language (the presence of localisms or regionalisms), and context that also significantly influence the factorial structure found in this study.

Considering that the original instrument was created before the pandemic, when access to remote education was even more limited, the change in the internal position of the factors could be due to the perception of teachers regarding the abilities of students to address the use of digital competences. This perception, within the new structure, places students in the first place (F1) of the new structure (Figure 3), thus highlighting the importance of the student and the professor in the entire digital teaching–learning dynamic.

In their own practice, if professors do not perceive students to be trained or empowered, learning is far from being achieved. Learning dynamic would not exist without student empowerment. The pedagogical competences of educators were reorganized in Factor 2. A possible explanation could be that professors were forced to take on important challenges linked to instructional design and learning experiences in digital environments. Collaboration and professional commitment among faculty members are essential.

Finally, Factor 2 of the original scheme (Figure 1), which includes areas such as evaluation and feedback (4), teaching and learning (3), are the third Factor of the new structure (Figure 3). As an instrument that measures the self-perception of professors, the relocation could be due to the fact that areas 4 and 3 have traditionally been considered as competences associated with teaching (Falco, 2017), but not as competences directly linked to digital environments.

In line with Cabero-Almenara et al. (2021), this new structure was tested by CFA, showing excellent fit indexes. Using McDonald's Omega coefficient, the new instrument showed internal consistency reliability with values greater than .70, as reported by Cabero-Almenara et al. (2021). The finding that the construct validity obtained in this study and the model of Cabero-Almenara et al. (2021) present different factorial structures, but just as valid and reliable, suggests the need for new studies to verify the instruments' structure and reliability in new populations. This is because the perceptions of participants in the academic world depend on the organizational culture, among others.

Additionally, this result raises the need to work on digital competences with the aim of empowering students' use of digital tools in such a way that they facilitate learning in an integral way. For this, it is essential to follow good practices in the process of adapting instruments developed in a certain context when applying them in others. The

foregoing should be carried out with the aim of avoiding errors and guaranteeing the comparison of test scores. If this process is not conducted rigorously, mistakes could be made while making decisions regarding future virtualization and teacher training policies. As highlighted by different authors, urgent pedagogical training and technological support actions are required to allow digital empowerment in university teaching activities (Benali et al., 2018; Durán et al., 2016; Martinez Rodriguez & González Martínez, 2015; Prendes et al., 2018).

This research has three limitations. First, it is related to the fact that the data was collected from a single institution with a homogeneous non-probabilistic convenience sample preventing the results from being generalized. Second, it is associated with the fact that data were not collected by the authors of this study but were taken from a secondary source (MetaRed Peru). Finally, it is a self-perception and self-applicable instrument, and thus the answers of participants would be expected to have a certain level of social desirability.

Acknowledgments

The authors thank the Universia Foundation and the following authorities of MetaRed: Tomás Jiménez García (Coordinator of MetaRed Global), Dr. Edward Roekaert Embrechts (President of MetaRed Peru), and Ugo Ojeda de Arco (Coordinator of the Working Group on Technologies Educational). In addition, they thank the university professors who participated voluntarily in this project.

Funding

This study was partially funded by the Peruvian University of Applied Sciences (UPC).

References

Alania-Contreras, R. D., Chanca-Flores, A., Condori-Apaza, M., Fabian-Arias, E., & Rafaele-de-la-Cruz, M. (2022). Adaptation, validation, reliability, and assessment of an attitude scale towards online education for university students in the COVID-19 crisis. *Publications*, *52*(3), 229–260. https://doi.org/10.30827/publicaciones.v52i3.22273

Álvarez, M., Gardyn, N., Iardelevsky, A., & Rebello, G. (2020). Educational segregation in times of pandemic: Balance of the initial actions during social isolation by COVID-19 in Argentina. *International Journal of Education for Social Justice*, *9*(3), 25–43. https://doi.org/10.15366/riejs2020.9.3.002

Arafat, S., Chowdhury, H., Qusar, M., & Hafez, M. (2016). Cross cultural adaptation and psychometric validation of research instruments: A methodological review. *Journal of Behavioral Health*, *5*(3), 129. https://doi.org/10.5455/jbh.20160615121755

Benali, M., Kaddouri, M., & Azzimani, T. (2018). Digital competence of Moroccan teachers of English. *International Journal of Education and Development Using Information and Communication Technology*, *14*(2), 99–120. http://ijedict.dec.uwi.edu/viewissue.php?id=51

Borsa, J. C., Damásio, B. F., & Bandeira, D. R. (2012). Cross-cultural adaptation and validation of psychological instruments: Some considerations. *Paidéia (Ribeirão Preto)*, *22*(53), 423–432. http://dx.doi.org/10.1590/S0103-863X2012000300014

Cabero-Almenara, J., Guillén-Gámez, F. D., Ruiz-Palmero, J., & Palacios-Rodríguez, A. (2021). Digital competence of higher education professor according to DigCompEdu. Statistical research methods with ANOVA between fields of knowledge in different age ranges. *Education and Information Technologies*, 4691–4708. https://doi.org/10.1007/s10639-021-10476-5

Campo-Arias, A., & Oviedo, H. C. (2008). Psychometric properties of a scale: The internal consistency. *Journal of Public Health*, *10* (5), 831–839. https://doi.org/10.1590/s0124-00642008000500015

Cobo, C. (2019). *I accept the conditions: Uses and abuses of digital technologies*. Fundación Santillana.

European Commission. (2007). *Key competences for lifelong learning. A European frame of reference*. Publication Office of Official European Communities. https://www.educacionyfp.gob.es/dctm/ministerio/educacion/mecu/movilidad-europa/competenciasclave.pdf?documentId=0901e72b80685fb1

Costello, A. B., & Osborne, J. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment Research & Evaluation*, *10*(7), 1–9. https://doi.org/10.7275/jyj1-4868

Durán, M., Gutiérrez, I., & Prendes, M. (2016). Certification of the ICT competence of the university teaching staff. *Mexican Journal of Educational Research, 21*(69), 527–556. https://doi.org/10.17398/1695288X.15.1.97

European Commission. (2021a). *DigCompEdu. The European Framework for the Digital Competence of Educators.* https://ec.europa.eu/jrc/en/digcompedu/self-reflection

European Commission. (2021b). *Digital Competence Framework for Educators (DigCompEdu)*. https://ec.europa.eu/jrc/en/digcompedu

Falco, M. (2017). Reconsidering Educational Practices: ICTs in the teaching-learning process. *Pedagogical Trends*, *29*, 59–76. https://doi.org/10.15366/tp2017.29.002

Ferrando, P. J., & Anguiano-Carrasco, C. (2010). Factor analysis as a research technique in psychology. *Psychologist Papers*, *31*(1), 18–33. https://psycnet.apa.org/record/2010-04075-002

Gallardo-Echenique, E., Poma-Acevedo, A., & Esteve Mon, F. M. (2018). Digital competence: Analysis of an experience in the university context. *Journal of Education Sciences. ACADEMICUS*, *I*(12), 6–15. http://www.ice.uabjo.mx/media/15/2019/03/1A2019.pdf

Ghomi, M., & Redecker, C. (2019). Digital competence of educators (DigCompedu): Development and evaluation of a self-assessment instrument for teachers' digital competence. *CSEDU 2019 - Proceedings of the 11th International Conference on Computer Supported Education*, *1*, 541–548. https://doi.org/10.5220/0007679005410548

Gobierno del Perú. (2020, May 9). Legislative Decree No. 1496. *El Peruano Official Gazette*, 32–34. https://busquedas.elperuano.pe/normaslegales/decreto-legislativo-que-establece-disposiciones-en-materia-d-decreto-legislativo-n-1496-1866211-3/

Grady, C., Cummings, S. R., Rowbotham, M. C., Mcconnell, M. V, Ashley, E. A., Phil, D., & Kang, G. (2017). Informed consent. *New England Journal of Medicine*, *376*(9), 856–867. https://doi.org/10.1056/NEJMra1603773

Hatabu, A., Mao, X., Zhou, Y., Kawashita, N., Wen, Z., Ueda, M., Takagi, T., & Tian, Y. S. (2021). Knowledge, attitudes, and practices toward COVID-19 among university students in Japan and associated factors: An online cross-sectional survey. *PLoS ONE*, *15*(12), 1–19. https://doi.org/10.1371/journal.pone.0244350

Hernández, A., Hidalgo, M. D., Hambleton, R. K., & Gómez-Benito, J. (2020). International test commission guidelines for test adaptation: A criterion checklist. *Psicothema*, *32*(3), 390–398. https://doi.org/10.7334/psicothema2019.306

IIPE Unesco América Latina. (2020). *Report of policies: Education during and after COVID-19*. https://www.un.org/sites/un2.un.org/files/policy_brief_-_education_during_covid-19_and_beyond_spanish.pdf

International Test Commission. [ITC]. (2017). *ITC guidelines for translating and adapting tests* (2nd ed.). International Test Commission (ITC). https://www.intestcom.org/files/guideline_test_adaptation_2ed.pdf

Kline, P. (1993). *An easy guide to factor analysis*. Routledge. https://doi.org/10.4324/9781315788135

Kline, R. (2016). *Principles and practices of structural equation modelling* (4th ed.). The Guilford Press.

Martinez Rodriguez, F., & González Martínez, J. (2015). Use and appropriation of information and communication technologies by teachers in engineering faculties. *Engineering Networks*, *6*(1), 6–24. https://doi.org/10.14483/udistrital.jour.redes.2015.1.a01

McDonald, R. P. (1999). *Test theory: A unified treatment*. Psychology Press. https://doi.org/10.4324/9781410601087

Messick, S. (1995a). Validity of psychological assessment: Validation of inferences from persons' responses and performances as scientific inquiry into score meaning. *American Psychologist*, *50*(9), 741–749. https://doi.org/10.1037/0003-066X.50.9.741

Messick, S. (1995b). Standards of validity and the validity of standards in performance assessment. *Educational Measurement: Issues and Practice*, *14*(4), 5–8. https://doi.org/10.1111/j.1745-3992.1995.tb00881.x

MetaRed Perú. (2021). *Webinar: Teaching digital competences in Higher Education*. https://www.metared.org/pe/novedades/webinar--competencias-digitales--docentes-en-la-educacion-superi.html

Millán, A., Calvanese, N., & D'Aubeterre, M. E. (2013). Psychometric properties of the Working Conditions Questionnaire (qCT) in a Venezuelan multi-occupational sample. *CES Psychology*, *6*(2), 28-52–52. https://doi.org/10.21615/2543

Mok, K. H., Xiong, W., Ke, G., & Cheung, J. O. W. (2021). Impact of COVID-19 pandemic on international higher education and student mobility: Student perspectives from mainland China and Hong Kong. *International Journal of Educational Research*, *105*(101718), 1–11. https://doi.org/10.1016/j.ijer.2020.101718

Muñiz, J., Elosua, P., & Hambleton, R. K. (2013). Guidelines for the translation and adaptation of the tests: Second edition. *Psychothema*, *25*(2), 151–157. https://doi.org/10.7334/psicothema2013.24

Ojeda del Arco, U. (2021). *ICODI PERU 2021. Report on Digital Competences of Professors in Peruvian Higher Education*. University & MetaRed Peru. https://www.metared.org/pe/novedades/-MetaRedPeru-icodi-2021.html

Pan American Health Organization [PAHO]. (2020). *Coronavirus*. https://www.paho.org/es/temas/coronavirus

Padilla-Hernández, A. L., Gámiz-Sánchez, V. M., & Romero-López, M. A. (2020). Evolution of the teaching digital competence of university professors: Critical incidents from life stories. *Educate*, *56*(1), 109–127. https://doi.org/10.5565/REV/EDUCAR.1088

Padilla-Hernández, A. L., Gámiz Sánchez, V. M., & Romero López, M. A. (2018). Selection of categories for the study on the evolution of the digital competence of the teaching staff in higher education. *Interuniversity Journal of Educational Technology Research*, *4*, 55–67. https://doi.org/10.6018/riite/2018/327881

Pardo, H., & Cobo, C. (2020). Expand the university beyond the emergency remote teaching. Outliers School. http://outliersschool.net/project/universidadpostpandemia/

Pérez, E., & Medrano, L. (2010). Exploratory factor analysis: Conceptual and methodological bases. *Argentine Journal of Behavioral Sciences (RACC)*, *2*(1), 58–66. https://doi.org/10.32348/1852.4206.v2.n1.15924

Pozos, K. V., & Tejada, J. (2018). Digital competences in higher education professors: Mastery levels and training needs. *Digital Journal of Research in University Teaching*, *12*(2), 59–87. https://doi.org/10.19083/ridu.2018.712

Prendes, M. P., Gutiérrez, I., & Martínez, F. (2018). Digital competence: A need for university professors in the 21st century. *Journal of Remote Education (RED)*, *56*, 1–22. https://doi.org/10.6018/red/56/7

Ramada-Rodilla, J. M., Serra-Pujadas, C., & Delclós-Clanchet, G. L. (2013). Cultural adaptation and validation of health questionnaires: Review and methodological recommendations. *Public Health of Mexico*, *55*(1), 57–66. https://doi.org/10.1590/S0036-36342013000100009

Redecker, C., & Punie, Y. (2020). *European framework for the digital competence of educators: DigCompEdu.* Joint Research Center of the European Commission. https://doi.org/10.2760/159770

Redecker, & Punie, Y. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. Publications Office of the European Union. https://doi.org/10.2760/159770

Reimers, F. M. (2022). Learning from a pandemic. The Impact of COVID-19 on Education around the world. In *Primary and secondary education during Covid-19: Disruptions to educational opportunity during a pandemic* (pp. 1–37). Springer. https://doi.org/10.1007/978-3-030-81500-4_1

Rodríguez, A., Caurcel, M. J., Gallardo-Montes, C. D., & Crisol, E. (2021). Psychometric properties of the questionnaire "Demands and potentials of ICT and apps for assisting people with autism" (DPTIC-AUT-Q). *Education Sciences*, *11*(10), 1–30. https://doi.org/10.3390/educsci11100586

Rojas-Salas, G., Huanca-Apaza, M. Á., Castro-Paniura, C., & Gallardo-Echenique, E. (2021). Virtual education on health during the COVID-19 pandemic. *2021 IEEE 1st International Conference on Advanced Learning Technologies on Education & Research (ICALTER)*, 1–4. https://doi.org/10.1109/ICALTER54105.2021.9675084

Selwyn, N. (2017). Teachers and technology: Rethinking the digitization of teaching. *Journal of the Free Institution of Education*, *104*, 27–36. https://doi.org/10.31235/osf.io/jauea

Soriano Rodríguez, A. M. (2014). Design and validation of measurement instruments. *Diá-Logos*, *14*(12), 19–40. https://doi.org/10.5377/dialogos.v0i14.2202

Resolution of the Board of Directors. (2020). https://www.gob.pe/institucion/sunedu/normas-legales/462882-039-2020-sunedu-cd

National Superintendency of University Higher Education. [SUNEDU]. (2020, August 24). Resolution of the Board of Directors No. 105-2020-SUNEDU/CD. *Oficial Gazette El Peruano*, 33–40. https://busquedas.elperuano.pe/normaslegales/aprueban-disposiciones-para-la-prestacion-del-servicio-educa-resolucion-n-105-2020-sunedu-cd-1879494-1/

Timmerman, M. E., & Lorenzo-Seva, U. (2011). Dimensionality assessment of ordered polytomous items with parallel analysis. *Psychological Methods*, *16*(2), 209–220. https://doi.org/10.1037/a0023353

Twinamasiko, N., Nuwagaba, J., Maria Gwokyalya, A., Nakityo, I., Wasswa, E., & Sserunjogi, E. (2021). Drivers affecting the acceptance and use of electronic learning among Ugandan university students in the COVID-19 era: A cross-sectional survey among three universities. *SAGE Open*, *11*(3), 21582440211029920. https://doi.org/10.1177/21582440211029922

Ventura-León, J., Caycho-Rodríguez, T., Vargas-Tenazoa, D., & Flores-Pino, G. (2018). Adaptation and validation of the Frustration Tolerance Scale (FTS) in Peruvian children. *Journal of Clinical Psychology with Children and Adolescents (RPCNA)*, *5*(2), 23–29. https://doi.org/10.21134/rpcna.2018.05.2.3

Ximénez, M. C., & García, A. G. (2005). Comparison of maximum likelihood and unweighted minimum squares estimation methods in confirmatory factor analysis using Monte Carlo simulation. *Psicothema*, *13*(3), 528–535. https://www.psicothema.com/pdf/3140.pdf

Yaghoobzadeh, A., Pahlevan Sharif, S., Ong, F. S., Soundy, A., Sharif Nia, H., Moradi Bagloee, M., Sarabi, M., Goudarzian, A. H., & Morshedi, H. (2019). Cross-cultural adaptation and psychometric evaluation of the Herth Hope Index within a sample of Iranian older peoples. *International Journal of Aging and Human Development*, *89*(4), 356–371. https://doi.org/10.1177/0091415018815239