JSSER
www.jsser.org
Journal of Social Studies Education Research
Sosyal Bilgiler Eğitimi Araştırmaları Dergisi
2024:15 (2), 204-230

A platform for learning entrepreneurship and complex thinking: Questionnaire validation for evaluation

Edgar López-Caudana[1], Carlos George-Reyes[2] & Sandra Martínez-Pérez[3]

Abstract

Digital learning platforms as scaffolds for learning in formal and informal educational scenarios have had few assessments to determine their acceptance and success in fostering high order thinking skills. The primary objective of this study was to develop, validate, and assess the reliability of an instrument designed to measure the acceptance of a platform dedicated to nurturing complex thinking skills in social, scientific, and technological entrepreneurship. The methodology developed to systematize this process involved four stages: 1) instrument development based on the UTAUT2 model, 2) computation of the Kappa coefficient to select experts for instrument validation, 3) application of the Simplified Digital Delphi Method for validation, and 4) analysis of instrument reliability using Cronbach's alpha and McDonald's Omega coefficients. The results were 1) a questionnaire consisting of 9 dimensions and 22 items, all validated by experts and exhibiting an acceptable level of quality, exceeding the 0.8 coefficient threshold indicative of good item quality; and 2) the development of a methodology named EAAP that systematizes and objectifies the task of creating and refining an instrument and readying it for implementation. This work emphasizes the need to assess the acceptance of digital learning platforms to identify areas for improvement and promote the development of instruments using reliable methodologies.

Keywords: *Complex thinking, educational innovation, higher education, user experience*

Introduction

The digital era, represented by the widespread use of the Internet and people's interaction in the knowledge society, has permeated nearly all aspects of human activities, like online shopping, digital governance, access to information in various formats, and, of course, it has transformed the ways of teaching and learning. In this regard, digital learning platforms have become online spaces where pedagogies and digital content, teaching strategies, activity delivery formats, and information resources, among others, converge (Marta-Lazo et al., 2022).

[1] *Research Prof. Institute for the Future of Education, Tecnologico de Monterrey, Mexico,* edlopez@tec.mx
[2] *Postdoctoral researcher, Institute for the Future of Education, Tecnologico de Monterrey, Mexico,* cgeorge@tec.mx
[3] *Research Prof. Department of Didactics and Educational Organization, Universidad de Sevilla, Spain,* smartinezperez@us.es

Digital learning platforms constitute an online learning ecosystem, mirroring the physical classroom where teachers can publish content, assign tasks, communicate with students, generate discussions, and more, aiming to achieve high-quality learning outcomes (Al-Abdullatif & Alsubaie, 2022). Their use is associated with self-regulated learning (Adeyeye et al., 2022), encouraging individuals to seek knowledge autonomously, intentionally, and from any electronic device at any time (Gameil & Al-Abdullatif, 2023). This has spurred research into the impact of learning mediated by such platforms (Bidarra & Rusman, 2017; Mayer, 2018) and comparisons between face-to-face and online learning processes of their acceptance and perceived improvements in learning (Hurlbut, 2018; Nennig et al., 2020).

Digital platforms are linked to cognitive theory, as participants perceive and recognize information from content and resources, storing this information for retrieval when needed (Alshammary & Alhalafawy, 2023). Furthermore, these platforms assume an innovative technological role in the teaching and learning process, serving not merely as repositories of information and resources but as educational spaces centered on the learner, where the teacher's role is enhanced through technology (Hanoon, 2023). Some of these technologies are disruptive, such as artificial intelligence (Lim et al., 2013), enabling human-machine interactions using chatbots (Yan, 2023) or virtual and augmented reality, creating complex learning platforms in immersive environments (Stromberga et al., 2021).

In higher education, these platforms support face-to-face, virtual, or blended instruction, facilitating the connection between teachers and students, the acquisition of new knowledge, collaborative reflection, and fostering participation (Cerdeño-Romero, 2019). They can even be enablers in adopting active learning strategies such as flipped classrooms, gamification, and problem-based learning (Dziuban et al., 2018).

Numerous studies have focused on analyzing the use of learning platforms, highlighting their effectiveness in improving students' performance and learning achievements (Ouadoud et al., 2017; Alzboun et al., 2020) and their associated benefits, such as enhancing the level of learning achievement due to their flexibility to access the learning experiences within them (Moreno et al., 2017). Furthermore, they have examined the advantages of fostering competencies associated with self-directed learning and effective time management (Alzboun et al., 2020).

Learning Platforms Based on Complex Thinking

Complex thinking facilitates the development of essential problem-solving skills in complex learning environments (Ramírez-Montoya et al., 2022) because individuals who develop it are better equipped to understand uncertain situations by considering the multiple variables and relationships involved (Pacheco et al., 2023). It proves highly valuable for efficient participation in digitalized environments emblematic of the knowledge society (Vázquez-Parra et al., 2022).

Unfolding complex thinking reveals sub-competencies such as 1) critical thinking (analyzing, synthesizing, and evaluating information), 2) systemic thinking (analyzing and understanding complex phenomena), 3) innovative thinking (stimulating creative capacity), and 4) scientific thinking (problem-solving based on objective evidence) (Patiño et al., 2023). Learning platforms are essential in developing complex thinking by providing resources, pedagogical approaches, and interactive environments that foster deep understanding, critical analysis, and problem-solving in complex contexts.

The development of learning platforms within the framework of complex thinking is still in its early stages; however, they have yielded satisfactory results in various disciplines. For example, they have facilitated knowledge acquisition and skills development to promote the design and creation of citizen science projects (Sanabria et al., 2022). They have also favored scaling competencies to empower students to create social entrepreneurship projects (Cruz-Sandoval et al., 2022). Some platforms explore the effectiveness of using microlearning as a learning strategy to boost creativity among participants (Romero-Rodríguez et al., 2022).

Similarly, platforms have been developed to help students create projects based on complex thinking by constructing open educational resources (Suárez-Brito et al., 2022). Other platforms have been designed with virtual reality applications to encourage participants to improve their understanding of computational thinking (George-Reyes et al., 2023) and to foster skills related to the sharing economy (Sanabria et al., 2022).

In this research, an instrument designed to assess the complex thinking learning platform was the *Education 4.0 Platform to Strengthen Scientific, Technological, and Social Entrepreneurship through Scaling Complex Thinking Competencies.* This platform aims to develop, experiment with, and implement an online education experience characterized by features and services using artificial intelligence, multimedia, interactive user interfaces, and gamification driven by 4.0

Technologies. It promotes scientific, technological, and social entrepreneurship by fostering complex thinking competencies among higher education students and lifelong learners.

Participants engage in active learning dynamics in real-world complex environments, promoting the creation of technology-based solutions for priority issues. The system uses the Platform as a Service (PAAS) model. It provides four types of functions/services: 1) methodologies and assessment tools, 2) teaching-learning programs (formal, non-formal, or informal), 3) emulation of complex real-world scenarios, 4) resources for Open Innovation, education, and open science. Figure 1 shows the basic layout of the platform.

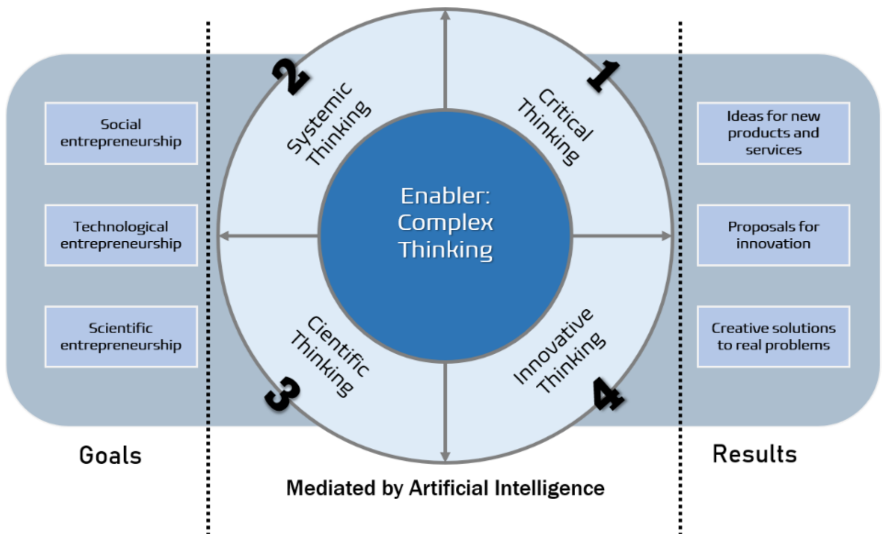

Figure 1. OpenEDR4C Platform Layout.

The Expert Competency Coefficient

Expert judgment has been considered an efficient method for assessing the relevance and feasibility of research proposals (Fernandez-Cerero et al., 2023). A data collection method used in various disciplines (Cabero & Llorente, 2013; Gutiérrez-Castillo et al., 2017) has aimed to obtain opinions and evaluations from individuals considered experts in a specific field. These experts have sufficient knowledge (Kc) and the necessary argumentation skills (Ka) to express opinions regarding the relevance of a statement, for example (Robles & Rojas, 2015), and in the case of questionnaire design, the coherence, clarity, and relevance of an item (Cabero & Barroso, 2013).

Applying this method in research processes, particularly in instrument validation for data collection, is considered useful (Galicia et al., 2017). Several authors agree that the main characteristic of expert judgment is that participants assess the dimensions and items that comprise a questionnaire to measure their relevance and representativeness (Attiaoui et al., 2017; Erazo & Narvaez, 2022). Three fundamental aspects have defined this method: 1) the specificity of the term "expert," 2) the definition of the expert's required level of knowledge, and 3) the number of experts required to participate in validating an instrument (Pereza et al., 2019).

Research has mentioned that there is no single specificity to define who is an expert in a subject (Cabero et al., 2020b). However, it is suggested that a person with experience in the discipline associated with the Instrument under evaluation is appropriate, in addition to expertise related to the research's subject matter, for example, a questionnaire. As for the degree of knowledge, research has recommended that the participants possess a broad and deep understanding to achieve mastery of the subject matter beyond the level of their peers (Nadina et al., 2018).

Cabero et al. (2020b) suggested that the number of individuals required for the method to be valid depends on the experts in the discipline available when applying the method. However, some researchers mention a requirement of 9 to 24 experts, while others suggest between 15 and 35 (Witkin & Altschuld, 1995). This research confirmed that selecting the number of experts can be complex because there is not always the possibility of having individuals with deep knowledge of the research topic, experience in designing and evaluating data collection instruments, or the time to participate in the study. This indicates that the method should preferably be applied in a single round, conducted quickly, with the highest number of experts possible (Cabero & Barroso, 2013).

The composition of the expert panel is crucial in terms of the number of participants, the criteria for selecting them, and the quality of the process. Thus, the Expert Competency Coefficient (K) has been used recurrently as a reference to validate the effectiveness of the method's application (Cabero et al., 2020c; Cabero et al., 2021). The following equation determines the coefficient:

$$K=1/2\ (Kc+Ka)$$

Kc represents the Knowledge Coefficient, i.e., a person's experience with a discipline, problem, or topic. It represents a self-assessment on a scale from 0 to 10, where 0 indicates no knowledge, and 10 represents deep knowledge. Ka is the Argumentation Coefficient, obtained from a measurement of six possible sources of argumentation using a predefined scale (Dobrov & Smirnov, 1972;

Blasco et al., 2010), which evaluates an expert's competency in the subject matter at three levels: a) high, b) medium, and c) low.

After applying the K coefficient, the ratings analyzed classify experts into three levels per the following criteria: 1) If K is greater than 0.8 and greater than or equal to 1 (high influence); 2) If K is greater than or equal to 0.7 but less than or equal to 0.8 (medium influence); and 3) If K is greater than or equal to 0.5 but less than or equal to 0.7 (low influence). (Molero et al., 2022). It is suggested that a score below 0.80 is not valid to participate in evaluating an instrument (Mengual, 2011). Using the K coefficient is generally considered a preliminary step for conducting a study based on the Delphi method (López-Gómez, 2018; Cruz & Martínez, 2020).

The Simplified Digital Delphi Method

The Delphi method validates scientific instruments such as questionnaires and rubrics to collect information on a subject from a group of individuals. It involves obtaining experts' consensus on a research objective (Hult & Khan, 2020). Delphi collects opinions through repeated surveys of a group of individuals with expertise in a scientific or academic field (López, 2018). This method efficiently validates instruments related to the use of technologies in teaching and learning processes (Ayub, Mohamad, Wei & Luaran, 2020).

The method rests on two principles: 1) collective intelligence, which operationalizes the rational opinions of various experts, and 2) anonymous participation, which means that experts express their opinions without knowing the identity of their peers (Cabero & Infante, 2014). The Delphi method is advantageous when dealing with complex, uncertain, or hard-to-predict issues, as it allows tapping into the collective knowledge of experts instead of relying solely on a single source of information (Ayub et al., 2020). Although the Delphi method can be time-consuming due to multiple rounds of opinion and feedback, it can produce valuable and well-founded results (Bakieva, Jornet, González & Leyva, 2018).

Various researchers have successfully used this method. They considered the following phases: 1) Selection of experts with deep knowledge of the topic in question, 2) presentation of the Instrument to the experts, 3) rounds of opinion in which experts provide assessments of the instrument items considering their clarity and relevance, 4) iteration, where rounds of opinion repeat multiple times to converge opinions towards consensus, and 5) results analysis, where trends, patterns, and points of agreement or disagreement among experts are analyzed statistically (Hu, Wu, Lin & Wang, 2017; Sondakh, Osman & Zainudin, 2020; Yusoff, Ashaari, Wook & Ali, 2021).

As technologies have become increasingly accessible to researchers, implementing the method's phases has involved digital applications, which has given rise to emerging strategies where the use of paper questionnaires or email communication with experts is replaced by tools such as automated digital forms and video conferencing (Ko & Lu, 2020).

The application of the method using digital applications has successfully collected expert opinions and obtained results more promptly (Cruz & Rua, 2018), thus accelerating the validation process (Coma et al., 2021). This method of application, called the Simplified Digital Delphi Method (SDDM), incorporates the characteristics of the Simplified Delphi Method (George-Reyes & Valerio, 2022).

Method

This work used the EAAP method to systematically conduct the Instrument's validation and reliability analysis. Its purpose is to guide the design and fine-tuning of an instrument for data collection in scientific research. The method consists of four stages: 1) design of the Instrument, 2) application of the K Coefficient, 3) application of the Simplified Digital Delphi Method, and 4) pilot testing of the Instrument. Figure 2 illustrates the actions derived from each of these stages.

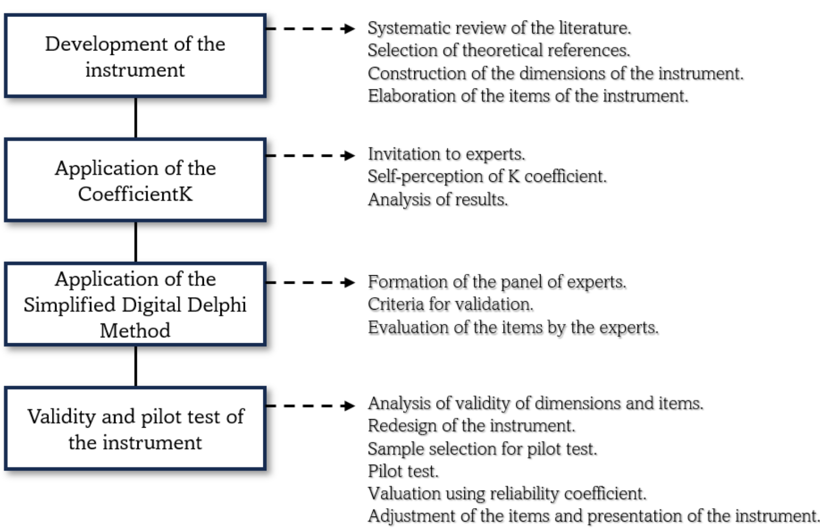

Figure 2. Stages of the EAAP Method

Stage 1: Instrument Design

The instrument emerged from the need to assess the participants' perception of the OpenEdR4C learning platform called the Education 4.0 Platform to Strengthen Scientific, Technological, and Social Entrepreneurship through Scaling Complex Thinking Competencies (Tecnologico de Monterrey, 2023). The questions that guided the design of the instrument were as follows:

What dimensions should be used to construct an instrument to measure the acceptance of the OpenEdR4C educational platform?
What items can evaluate the users' intentions to use the platform and their behavior in the subsequent usage?

To answer these questions, the authors conducted a systematic literature review, finding that one of the most widely used technology acceptance models is the UTAUT (Unified Theory of Acceptance and Use of Technology) (Venkatesh et al., 2003), along with its extension called UTAUT2 (Gansser & Reich, 2021). This research model commonly analyzes the intention to use and the users' behavior with emerging technologies (Aranyossy, 2022) and evaluates educational platforms (Ameri et al., 2020; Raman & Thannimalai, 2021).

UTAUT2 examines performance and effort expectations, social influence, facilitating conditions, hedonic motivation, price value, habit (behavioral intention), and actual behavior (Araujo et al., 2021). Based on the model's characteristics, the researchers developed a questionnaire named OpenEdR4C: Measurement of Acceptance of Learning Platforms based on Complex Thinking. For the questionnaire responses, a Likert scale with four responses offered the responses: 1) Strongly Disagree, 2) Disagree, 3) Agree, and 4) Strongly Agree. Table 1 shows the design of the first questionnaire and the references from which its dimensions and items emerged.

Table 1

The first version of the OpenEdR4C instrument: Measurement of Acceptance of Learning Platforms based on Complex Thinking.

Num.	Dimension	Reference	Item
Q1	Performance Expectation	Khechine & Lakhal (2018).	I consider using the educational platform beneficial for my learning about entrepreneurship.
Q2	Thoughts and Feelings	Museum Provided or	Using the educational platform allows me to complete my tasks more quickly.
Q3	Instructional Plans	Developed by the Teacher	Using the educational platform enhances my understanding of topics related to entrepreneurship.
Q4	Effort Expectation	Ameri et al. (2020).	Navigating through the modules of the educational platform is easy.
Q5			My interaction with the educational platform is intuitive.
Q6			Becoming proficient in using the educational platform is easy for me.
Q7			I found it very easy to use the educational platform.
Q8	Intention to Use	Aranyossy, M. (2022).	In the future, I intend to review content updates of the educational platform.
Q9			I will continue to use the educational platform to understand how to solve complex issues related to entrepreneurship.
Q10			I would like my university to use this type of educational platform to enhance entrepreneurship learning.
Q11	Social Influence	Khechine & Lakhal (2018).	My peers believe that we should continue using the educational platform.
Q12			My professors believe that using the educational platform can improve my learning.
Q13			I believe that the benefits of using the educational platform for entrepreneurship should be shared on social media.
Q14	Facilitating Conditions	Azizi, et al. (2020).	I have the necessary digital devices to use the educational platform.
Q15			I have sufficient digital literacy to use the educational platform with agility.
Q16			The technologies I commonly use are similar to the complex educational platform.
Q17	Hedonic Motivation	García de Blanes et al. (2022)	It is motivating to use the contents of the educational platform.
Q18			The way I can visualize the contents of the educational platform is enjoyable.
Q19			Time flies when I use the educational platform to learn about entrepreneurship.
Q20	Platform Value	Musa et al. (2022).	The time and effort invested in using the educational platform are proportional to the entrepreneurship learning I can gain.
Q21			The educational platform allows me to share my knowledge with others quickly and easily.
Q22			The educational platform enables me to enhance my learning to solve complex issues related to entrepreneurship.
Q23	Habit	Gansser & Reich (2021).	If more entrepreneurial topics and content were added to the educational platform, I would use it consistently.
Q24			The entrepreneurial topics shared on the educational platform stimulated my interest in participating.
Q25			It is necessary to use the educational platform to learn about entrepreneurial topics not taught in school.
Q26	Behavior	Gunawan et al. (2019).	I regularly use the educational platform to study entrepreneurship.
Q27			To solve some complex entrepreneurial problems, I would recommend using the contents of the educational platform.
Q28			I would recommend my friends and colleagues to use the educational platform to solve complex problems about entrepreneurship.

Stage 2: Application of the K Coefficient.

Following the expert coefficient method, the researchers invited experts in social, scientific, and technological entrepreneurship. Seventy-nine emails went to researchers and professors from public and private higher education institutions in Mexico and Latin America. These individuals were found through bibliographic management platforms such as Scopus, Web of Science, ResearchGate, and Google Scholar. Participants had to meet the following criteria: 1) a master's or doctoral degree and 2) documented expertise in the subject matter, as evidenced by publications in indexed journals.

Positive responses arrived from 31 individuals. They received a collaboration request outlining the purpose of the research and their role in the study. The researchers administered an online questionnaire with two questions to calculate the Knowledge Coefficient (Kc) and Argumentation Coefficient (Ka). The first question assessed participants' perception of knowledge, while the second inquired about the necessary sources of information for their involvement in instrument validation. Table 2 displays the scoring criteria for assessing Kc and Ka.

Table 2

Indicators to Assess the K Coefficient.

Kc	**Responses**		
1. Please mark the box corresponding to your knowledge level of social, scientific, and technological entrepreneurship.	Scale: 1-10 1 = Limited knowledge. 10 = Extensive knowledge.		
Ka	**Degree of Influence**		
2. Self-assess the degree of influence that each of the sources presented here has had on your knowledge and experience of entrepreneurship.	High	Medium	Low
Theoretical analyses on entrepreneurship topics.	0.30	0.20	0.10
Experience in publishing scientific articles on entrepreneurship.	0.50	0.40	0.20
Reviewed national studies on entrepreneurship.	0.05	0.02	0.05
Reviewed international studies on entrepreneurship.	0.05	0.05	0.05
Personal experience working with entrepreneurship topics.	0.05	0.05	0.05
Enthusiasm to learn about entrepreneurship topics.	0.05	0.05	0.05
Theoretical analyses on entrepreneurship topics.	0.30	0.20	0.10

The mean Kc score obtained from the 31 experts was 7.48, with a standard deviation of 1.19, indicating that, in general, they perceived themselves to have an acceptable level of knowledge and experience in social, scientific, and technological entrepreneurship. Regarding Ka, the results indicated that only 15 experts should be selected because their ratings exceeded 0.80, the minimum threshold to be considered for the next study stage (Cabero et al., 2020c).

Stage 3. Application of the Simplified Digital Delphi Method.

Table 3 displays the selected experts' profiles and their K coefficients.

Table 3

Profiles of Participants in the Delphi Method.

Student	Gender	Education	Google Scholar		Expert Coefficients		
			Citations	Index	Ka	K	Kc
X1	Male	Ph.D. Educational Technology	1829	23	0.90	1.00	0.95
X2	Female	Ph.D. Pedagogical Sciences	1635	20	0.80	1.00	0.90
X3	Male	Ph.D. Innovation in Educational Technology	562	14	0.80	0.90	0.85
X4	Female	Ph.D. Computer Science	561	11	0.90	1.00	0.95
X5	Female	Ph.D. Educational Innovation	494	11	1.00	1.00	1.00
X6	Male	Ph.D. Educational Sciences	296	12	0.80	1.00	0.90
X7	Female	Ph.D. Knowledge Society Training	131	10	0.90	0.9	0.90
X8	Male	Ph.D. Computer Science	101	9	0.80	1.00	0.90
X9	Female	Ph.D. Pedagogy	97	7	0.90	0.70	0.80
X10	Female	Ph.D. Psychology	92	8	0.70	1.00	0.85
X11	Male	Ph.D. Information and Communication Technologies	75	4	0.90	0.70	0.80
X12	Male	Ph.D. Educational Innovation	71	6	0.70	0.90	0.80
X13	Male	Ph.D. Artificial Intelligence	59	4	0.70	0.90	0.80
X14	Female	Ph.D. Social Anthropology	49	5	0.80	0.80	0.80
X15	Female	Ph.D. Philosophy of Education	12	1	0.70	0.90	0.80

An online digital form using a Likert-type scale with four response options started the validation process. The intermediate response option was removed to ensure greater clarity in assessing the level of agreement and disagreement (Abal et al., 2017). Three criteria chosen for the analysis were coherence (CH), clarity (CL), and relevance (RL) (Exposito et al., 2023; Bernal et al., 2020). Table 4 displays the assessment for each criterion along with its interpretation.

Table 4

Criteria Used for Instrument Evaluation.

Category	Minimum rating = 1 Maximum rating = 4	**Interpretation**
Clarity The item is understandable to users, and the grammar is correct.	Unclear.	The item is not understandable by users of the Instrument. It should be deleted.
	Low level of clarity.	The item can be improved in at least half of its components regarding wording and grammar.
	Acceptable level of clarity.	The item is quite clear; its wording could be improved.
	High level of clarity.	The item can be understood very clearly by users and follows grammatical rules.
Coherence The item assesses a central aspect of the Instrument's theoretical construct and/or dimensions.	Incoherent.	The item does not contribute to assessing the purpose or dimensions of the Instrument in any aspect. It can be deleted.
	Low level of coherence.	The item partially contributes to assessing the Instrument's purpose or dimensions. It should be rewritten.
	Medium level of coherence.	The item contributes to the assessment of the purpose or dimensions of the Instrument. Its wording could be improved.
	High level of coherence.	The item contributes highly to the assessment of the purpose or dimensions of the Instrument.
Relevance The item is essential for the Instrument and should be included.	Irrelevant.	The item is not relevant for the users of the Instrument. It should be deleted.
	Low level of relevance.	The item may have some relevance, but another item in the Instrument may measure the same thing.
	Acceptable level of relevance.	The item is relevant, and its wording could be improved; it is not advisable to delete it.
	High level of relevance.	The item is very relevant; eliminating it could diminish the quality of the Instrument.

The validation form had the following sections: a) letter of informed consent, b) instructions on how to perform the validation, c) expert information, and d) validation of coherence, clarity, and relevance. After obtaining the results, the researchers defined the statistical analyses to justify the validation and reliability. Table 5 shows the coefficients used and their associated hypotheses.

Table 5

Coefficients Used for Instrument Validation and Pilot Testing.

Coefficients for Instrument Validation				
Coefficient	**Information Provided**	**Analysis**	**Hypothesis**	**Reference**
Aiken's V (V) per item	Relevance of items based on ratings from N judges.	Pretest	H0: There is no significant relevance (V<0.7) H1: There is significant relevance (V>0.7)	Aw (2019)
Aiken's V (V) per dimension	Relevance of items based on ratings from N judges.	Pretest and post-test	H0: There is no significant relevance (V<0.7) H1: There is significant relevance (V>0.7)	Aw (2019)
Confidence Interval Value (ICI)	Variability between the measured and actual values of the evaluators.	Pretest and post-test	H0: There is no significant ICI (ICI<0.5) H1: There is significant ICI (ICI>0.5)	Wilcox & Serang, (2017)
Intraclass Correlation Coefficient (ICC)	Concordance between two or more measurements obtained from different evaluators.	Pretest y post-test	H0: There is no significant agreement (ICC<0.75) H1: There is a significant agreement (ICC>0.75)	Koo & Li (2016)
Fleiss' Kappa Statistic (K)	Degree of agreement among evaluators.	Post-test	H0: There is no significant agreement (K<0.7) H1: There is significant relevance (K>0.7)	Fleiss (1981), Falotico & Quatto (2015).

Coefficients for Conducting Instrument Pilot Testing			
Coefficient	**Information Provided**	**Hypothesis**	**Interpretation**
Cronbach's Alpha	The extent to which items in an instrument are correlated	H0: There is no significant reliability (V<0.8) H1: There is a significant reliability (V>0.8)	Taber (2018)
MacDonald's Omega	Homogeneity and consistency of items concerning the total variance of observed scores.	H0: There is no significant reliability (V<0.7) H1: There is a significant reliability (V>0.7)	Lisawadi et al. (2019)

Results

This section presents stage 4 of the EAAP model, which consists of 6 items: 1) validity analysis of dimensions and items, 2) instrument redesign, 3) sample selection for pilot testing, 4) pilot testing, 5) assessment using reliability coefficients and 6) item adjustment and instrument presentation. The results are in the order described in Table 4.

Item validity assessment: Aiken's V coefficient

The results were organized for each of the dimensions of the Instrument. Table 6 shows the results for the first three dimensions (performance expectation, effort expectation, and intention to use). While some items have data distributed over a wide range of values, this did not significantly affect the coefficient that quantifies the relevance of these items, as most of them exceed the acceptable limit for determining their validity. Items with values below 0.7 were removed (Q2 clarity=0.667, coherence=0.699; Q6 clarity=0.689, coherence=0.600, relevance=0.667).

Table 6

Results of Validation I

Dimension	Item	Validation	Mean	Standard Deviation	Aiken's V Coefficient
Performance Expectation	Q1	Clarity	3.667	0.488	0.889
		Coherence	3.867	0.352	0.956
		Relevance	3.933	0.258	0.978
	Q2	Clarity	3.000	0.655	0.667
		Coherence	3.133	0.516	0.699
		Relevance	3.400	0.737	0.800
	Q3	Clarity	3.733	0.458	0.911
		Coherence	3.733	0.458	0.911
		Relevance	3.800	0.414	0.933
Effort Expectation	Q4	Clarity	3.867	0.352	0.957
		Coherence	3.400	0.507	0.800
		Relevance	3.733	0.458	0.911
	Q5	Clarity	3.600	0.507	0.867
		Coherence	3.600	0.500	0.867
		Relevance	3.867	0.352	0.956
	Q6	Clarity	3.067	0.704	0.689
		Coherence	2.800	0.862	0.600
		Relevance	3.000	0.845	0.667
	Q7	Clarity	3.733	0.458	0.911
		Coherence	3.800	0.414	0.933
		Relevance	3.933	0.258	0.978
Intention to use	Q8	Clarity	3.667	0.488	0.889
		Coherence	3.733	0.458	0.911
		Relevance	3.800	0.414	0.933
	Q9	Clarity	3.733	0.458	0.911
		Coherence	3.800	0.414	0.933
		Relevance	3.867	0.352	0.956
	Q10	Clarity	3.800	0.414	0.933
		Coherence	3.867	0.352	0.956
		Relevance	3.867	0.350	0.937

Table 7 shows the results of the items grouped in the dimensions of social influence, facilitating conditions, and hedonic motivation. One can observe that most items are above a coefficient of 0.8; however, there are two items below 0.7; therefore, they did not have significant statistical relevance and were removed from the instrument. Furthermore, the standard deviation associated with these items was close to 1, indicating a very high dispersion of expert opinions (Q13 clarity=0.611, coherence=0.679; Q16 clarity=0.644, coherence=0.756).

Table 7

Results of Validation II

Dimension	Item	Validation	Mean	Standard Deviation	Aiken's V Coefficient
Social Influence	Q11	Clarity	3.667	0.488	0.889
		Coherence	3.733	0.458	0.911
		Relevance	3.733	0.458	0.911
	Q12	Clarity	3.867	0.352	0.956
		Coherence	3.867	0.352	0.956
		Relevance	3.800	0.414	0.933
	Q13	Clarity	3.133	0.640	0.611
		Coherence	3.200	0.941	0.679
		Relevance	3.467	0.640	0.822
Facilitating Condition	Q14	Clarity	3.467	0.516	0.822
		Coherence	3.867	0.352	0.956
		Relevance	3.667	0.488	0.889
	Q15	Clarity	3.733	0.458	0.911
		Coherence	3.933	0.258	0.978
		Relevance	3.867	0.352	0.956
	Q16	Clarity	2.933	1.033	0.644
		Coherence	3.267	0.961	0.756
		Relevance	3.467	0.834	0.819
Hedonic Motivation	Q17	Clarity	3.667	0.488	0.889
		Coherence	3.733	0.458	0.911
		Relevance	3.933	0.258	0.978
	Q18	Clarity	3.933	0.258	0.978
		Coherence	3.867	0.352	0.956
		Relevance	3.867	0.352	0.956
	Q19	Clarity	3.600	0.632	0.867
		Coherence	3.733	0.458	0.911
		Relevance	3.400	0.632	0.800

When evaluating the items that make up the dimensions of platform value, habit, and behavior, the researchers found that the dispersion of judges' ratings was high for two items because the standard deviation was close to one, which negatively affected Aiken's V coefficient (Q21 clarity=0.533, coherence=0.519, relevance=0.693; Q26 clarity=0.611, coherence=0.656, relevance=0.633). In most cases, the coefficient exceeded the 0.70 threshold. Notably, most items surpassed the 0.80 coefficient, with some reaching values above 0.90 (Q20, Q22, Q24).

Table 8

Results of Validation III

Dimension	Item	Validation	Mean	Standard Deviation	Aiken's V Coefficient
Platform Value	Q20	Clarity	3.800	0.414	0.933
		Coherence	3.733	0.458	0.911
		Relevance	3.867	0.352	0.956
	Q21	Clarity	2.600	0.828	0.533
		Coherence	2.600	0.632	0.519
		Relevance	3.400	0.507	0.693
	Q22	Clarity	3.800	0.414	0.933
		Coherence	3.800	0.414	0.933
		Relevance	3.867	0.352	0.956
Habit	Q23	Clarity	3.467	0.640	0.822
		Coherence	3.800	0.414	0.933
		Relevance	3.867	0.352	0.956
	Q24	Clarity	3.733	0.458	0.911
		Coherence	3.867	0.352	0.956
		Relevance	3.867	0.352	0.956
	Q25	Clarity	3.600	0.507	0.867
		Coherence	3.467	0.640	0.822
		Relevance	3.467	0.516	0.822
Behavior	Q26	Clarity	3.133	0.834	0.611
		Coherence	3.267	0.884	0.656
		Relevance	3.200	0.676	0.633
	Q27	Clarity	3.600	0.507	0.867
		Coherence	3.733	0.458	0.911
		Relevance	3.667	0.488	0.889
	Q28	Clarity	3.600	0.507	0.867
		Coherence	3.800	0.414	0.933
		Relevance	3.733	0.458	0.911

After assessing each item, the researchers decided to eliminate those with Aiken's V coefficient lower than 0.7 (Q2, Q6, Q13, Q16, Q21, and Q26), resulting in a reorganized instrument with nine dimensions and 22 items.

Validity Assessment by Dimension: Aiken's V coefficient

An analysis of Aiken's V coefficient before and after item validation determined if removing items improved the Instrument's quality. The results showed that most of them exceeded a score of 0.80 in the initial test, with the lowest coefficient for the Facilitating Condition dimension (clarity=0.7926) and Platform Value dimension (coherence=0.7993). However, after removing items with lower ratings, Aiken's V coefficient improved for the corresponding dimensions. Table

9 demonstrates that clarity, coherence, and relevance in the post-test exceed 0.8667 (habit) in their lowest scores and 0.9667 (facilitating condition) in their highest score, allowing acceptance of H1: *There is significant relevance (V>0.7)*, and reject H0: *There is no significant relevance (V<0.7)* (Aw, 2019).

Table 9

General Values of Aiken's V Coefficient by Dimension

Dimension	Clarity		Coherence		Relevance	
	Pre	Post	Pre	Post	Pre	Post
Performance Expectation	0.8201	0.9001	0.8074	0.933	0.9037	0.9556
Effort Expectation	0.8556	0.9110	0.8003	0.8671	0.8778	0.9481
Intention to use	0.9130	0.9130	0.9333	0.9333	0.9481	0.9481
Social Influence	0.8519	0.9220	0.8667	0.9330	0.8890	0.9220
Facilitating Condition	0.7926	0.8667	0.8963	0.9667	0.8800	0.9200
Hedonic Motivation	0.9111	0.9110	0.9259	0.9259	0.9121	0.9121
Platform Value	0.8001	0.9300	0.7993	0.9222	0.9037	0.9549
Habit	0.8667	0.8667	0.9030	0.9030	0.9001	0.9001
Behavior	0.8148	0.8672	0.8660	0.9120	0.8443	0.9000

Confidence Interval Value (ICI) and Intraclass Correlation Coefficient (ICC)

An analysis of the Confidence Interval Value (ICI) helped understand the variability between the obtained measurement and the real measurement by the evaluators. An Intraclass Correlation Coefficient (ICC) study assessed the agreement between two or more measurements obtained from different evaluators. Table 10 shows that, in the pretest, the ICI exceeded the established minimum threshold of 0.5 (Wilcox & Serang, 2017) for clarity, coherence, and relevance, while the ICC surpassed the coefficient of 0.75, except for the clarity of the item, which had a value of 0.7497, very close to an acceptable factor (Koo & Li, 2016). Data analysis after eliminating the items from the instrument that did not meet Aiken's V coefficient threshold revealed a slight improvement in all coefficients, confirming the acceptance of H1: *There is a significant ICI (ICI>0.5)* and H1: *There is a significant agreement (ICC>0.75)* while rejecting H0: *There is no significant ICI (ICI<0.5)* and H0: *There is no significant agreement (ICC<0.75).*

Table 10

Overall values of the Aiken's V coefficient, ICI, and ICC.

Items	Aiken's V		ICI		ICC	
	Pre	Post	Pre	Post	Pre	Post
Clarity	0.8473	0.8988	0.3310	0.2891	0.6314	0.7211
Coherence	0.8658	0.9230	0.3120	0.2619	0.7106	0.7422
Relevance	0.8975	0.9305	0.2860	0.2446	0.6430	0.7817

Fleiss Kappa Statistic

Lastly, an analysis of Fleiss Kappa statistics measured the agreement among three or more evaluators (Landis & Koch, 1977; Fleiss, 1981). The coefficient ranges from 0 to 1, where 0 represents no agreement, and 1 indicates perfect agreement. A coefficient greater than 0.75 is considered acceptable (Falotico & Quatto, 2015). Table 11 confirms that the clarity measurement could be considered acceptable, while the computed coherence and relevance values were outstanding, allowing us to reject H0: *There is no significant agreement* $(K<0.7)$ and accept H1: *There is significant relevance* $(K>0.7)$ in the assessment of the instrument.

Table 11

Fleiss Kappa Coefficient and Statistical Significance.

Items	K	P
Clarity	0.8217	0.006
Coherence	0.8631	0.031
Relevance	0.8766	0.025

Instrument Pilot Testing

After validating the instrument, the researchers conducted a reliability study with the participation of 109 students from a polytechnic university in central Mexico. It is essential to clarify that the intention was not to conduct an exhaustive statistical analysis but rather a proof-of-concept to confirm the instrument's quality using Cronbach's alpha coefficient, a widely accepted indicator of instrument quality in scientific research (Taber, 2018). The computed coefficient of 0.8309 suggested evidence that the items fell within a very acceptable confidence interval (Plummer & Tanis, 2015). The complementary McDonald's Omega coefficient also resulted in an acceptable value of 0.8401 (Lisawadi et al., 2019).

Discussion

Developing a comprehensive method to assess the validity of an instrument is a valuable contribution for researchers who need to validate a questionnaire systematically and methodically. This work guides designing and creating instruments through the four stages described in Figure 2. In particular, using the K coefficient to determine which experts are best qualified to participate in the Delphi methodology application is essential. Table 5 confirms that the instrument validation presented in this article was not discretionary but was part of a process intended to ensure the quality of expert selection.

The results of the instrument validation confirmed that a useful, reliable, and objective questionnaire was developed that consistently assesses the acceptance of digital educational platforms. The statistical findings indicated very acceptable validity for all analyzed dimensions. Tables 6, 7, and 8 show that it was necessary to eliminate items Q2, Q6, Q13, Q16, Q21, and Q26 because they did not exceed Aiken's V coefficient of 0.7.

This not only allowed these items to be identified as unclear, incoherent, and irrelevant but also determined that they diminished the overall validity of the instrument. Table 9 confirms this assertion by showing that Aiken's V coefficient increased by removing the defective items. Therefore, it can be inferred that creating well-written items describing the purpose of the measurement is crucial to having a consistent instrument. Also, mapping those of lower quality is vital to improve quality coefficients.

A questionnaire validated by appropriately selected experts allowed for obtaining measurements of acceptable clarity and remarkably high coherence and relevance, as shown in Table 11, which allows for asserting the instrument's significant relevance. Thus, the questionnaire offered in this work can be used and adapted to measure the level of acceptance of a training platform based on complex thinking and enable the identification of its strengths and areas for improvement (Ramírez-Montoya et al. 2022; Vázquez-Parra et al. 2022).

Conclusions

The success of an educational training platform is determined not only by its graphical and content quality but also by variables such as intention to use, motivation, and expectation of effort, among others. Therefore, it is necessary to have validated instruments for these variables' clear, coherent, and relevant measurements. Moreover, it is even more critical that the validation of these instruments results from a systematic selection process of experts with the necessary credentials to justify their participation and ensure high quality.

The perspective of this research involves using the developed and validated instrument to measure the acceptance of digital educational platforms in different learning contexts and situations to achieve a consensus that demonstrates its statistical reliability. Future works building on this article will also need to use the EAAP method (Instrument Development, Application of the K Coefficient, Application of the Simplified Digital Delphi Method, and Pilot Testing of the Instrument) to establish a viable option for guiding the development and implementation of high-quality questionnaires. Finally, regarding limitations, it is necessary to conduct reliability analyses under different conditions and contexts to consolidate the instrument's quality.

In conclusion, the implementation of educational platforms should be accompanied by their evaluation through systematically validated instruments with high-quality expert selection and the choice of statistical tests that underpin their validity.

Acknowledgment

The authors acknowledge the financial and technical support of the Writing Lab Novus (N22-305), Institute for the Future of Education, Tecnologico de Monterrey, Mexico, in the production of this work. The authors acknowledge the financial support received from Tecnologico de Monterrey through the "Challenge-Based Research Funding Program 2022," Project ID # I004-IFE001-C2-T3–T.

References

Abal, F., Aune, S., Lozzia, G., & Attorresi, H. (2017). Funcionamiento de la categoría central en ítems de Confianza para la Matemática. *Revista Evaluar*, 17(2), 18-31. https://doi.org/10.35670/1667-4545.v17.n2.18717

Adeyeye, B., Ojih, S. E., Bello, D., Adesina, E., Yartey, D., Ben-Enukora, C., & Adeyeye, Q. (2022). Online Learning Platforms and Covenant University Students' Academic Performance in Practical Related Courses during COVID-19 Pandemic. Sustainability, 14(2), 878. MDPI AG. http://dx.doi.org/10.3390/su14020878

Al-Abdullatif, A. M., & Alsubaie, M. A. (2022). Using Digital Learning Platforms for Teaching Arabic Literacy: A Post-Pandemic Mobile Learning Scenario in Saudi Arabia. Sustainability, 14(19), 11868. MDPI AG. http://dx.doi.org/10.3390/su141911868

Alshammary, F. M., & Alhalafawy, W. S. (2023). Digital Platforms and the Improvement of Learning Outcomes: Evidence Extracted from Meta-Analysis. *Sustainability*, *15*(2), 1305. MDPI AG. http://dx.doi.org/10.3390/su15021305

Alzboun, M., Khawaldah, H., & Alzboun, N. (2020). Perceptions of the University of Jordan's students toward the effectiveness of using electronic learning platforms in developing their self-learning skills in national culture course. An-Najah University Journal for Research - B (Humanities), 34(12), 2267–2302. https://doi.org/10.35552/0247-034-012-006

Ameri, A., Khajouei, R., Ameri, A. & Jahani, Y. (2020). Acceptance of a mobile-based educational application (LabSafety) by pharmacy students: An application of the UTAUT2 model. Education and Information Technologies, 25, 419–435. https://doi.org/10.1007/s10639-019-09965-5

Aranyossy, M. (2022). Technology Adoption in the Digital Entertainment Industry during the COVID-19 Pandemic: An Extended UTAUT2 Model for Online Theater Streaming. Informatics, 9, 71. https://doi.org/10.3390/informatics9030071

Araújo, N.; Fraiz, J.A.; Pelegrín, J. (2021). Applying the UTAUT2 Model to a Non-Technological Service: The Case of Spa Tourism. Sustainability, 13, 803. https://doi.org/10.3390/su13020803

Attiaoui, D., Martin, A., & Yaghlane, B. (2017). Belief measure of expertise for experts detection in question answering communities: case study stack overflow. *Procedia Computer Science*, 112(C), 622-631. http://dx.doi.org/10.1016/j.procs.2017.08.099

Ayub, E., Mohamad, S., Wei, G. y Luaran, J. (2020). A learning design strategy framework for content transformation using the fuzzy Delphi method. *International Journal of Information and Education Technology*, *10*(12), 882-888. http://doi.org/10.18178/ijiet.2020.10.12.1474

Azizi, S. M., Roozbahani, N., & Khatony, A. (2020). Factors affecting the acceptance of blended learning in medical education: Application of UTAUT2 model. BMC Medical Education, 20(1) doi:10.1186/s12909-020-02302-2

Bakieva, M., Jornet, J., Gonzalez, J. & Leyva, Y. (2018). Colegialidad docente: validación lógica del instrumento para autoevaluación docente en España y México. *Estudios sobre Educación*, 34, 99-127. https://doi.org/10.15581/004.34.99-127

Bernal, M., Salamanca, D., Perez, N. & Quemba, M. (2020). Validez de contenido por juicio de expertos de un instrumento para medir percepciones físico-emocionales en la práctica de disección anatómica, *Educación Médica*, 21(6), 349-356. https://doi.org/10.1016/j.edumed.2018.08.008

Bidarra, J., & Rusman, E. (2017). Towards a pedagogical model for science education: bridging educational contexts through a blended learning approach. *Open Learning: The Journal of Open Distance and e-Learning*, *32*(1), 6-20. https://doi.org/10.1080/02680513.2016.1265442

Blasco, J. E. et al. (2010). Validación mediante el método Delphi de un cuestionario para conocer las experiencias e interés hacia las actividades acuáticas con especial atención al windsurf. Ágora para la educación física y le deporte, 12 (1), 75-94.

Cabero, J., & Barroso, J. (2013). La utilización del juicio experto para la evaluación de TIC: el Coficiente de competencia experta. Bordón. Revista de Pedagogía, (65(2), 25-38.

Cabero, J., & Infante, A. (2014). Empleo del método Delphi y su empleo en la investigación en comunicación y educación. *Edutec. Revista Electrónica de Tecnología Educativa*, 48.

Cabero, J., & Llorente, M. C. (2013), La aplicación del juicio de experto como técnica de evaluación de las tecnologías de la información (TIC). *Eduweb. Revista de Tecnología de Información y Comunicación en Educación*, *7*(2), 11-22.

Cabero, J., Barroso, J., Palacio, A., & Llorente, C. (2021). Evaluación de t-MOOC universitario sobre competencias digitales docentes mediante juicio de expertos según el Marco DigCompEdu. *Revista de Educación a Distancia (RED)*, 21(67). https://doi.org/10.6018/red.476891

Cabero, J., Barroso, J., Palacios, A. & Llorente, C. (2020b). Marcos de Competencias Digitales para docentes universitarios: su evaluación a través del coeficiente competencia experta. Revista Electrónica Interuniversitaria de Formación del Profesorado, 23(2), 1-18.

Cabero, J., Romero, J., Palacios, A. (2020c). Evaluation of teacher digital competency frameworks through expert judgment: the use of the expert competency coefficient. Journal of New Approaches in Educational Research, 9(2), 275–293. https://doi.org/10.7821/naer.2020.7.578.

Cabero, J., Romero, R., Barroso, J., & Palacios, A. (2020a). Marcos de Competencias Digitales Docentes y su adecuación al profesorado universitario y no universitario. *Revista Caribeña de Investigación Educativa (RECIE)*, *4*(2), 137-158. https://doi.org/10.32541/recie.2020.v4i2.pp137-158

Cerdeño-Romero, E. (2019). Entornos virtuales de aprendizaje y su rol innovador en el proceso de enseñanza. *ReHuSo: Revista de Ciencias Humanísticas y Sociales*, *4(*1), 119-127. https://doi.org/10.33936/rehuso.v4i2.1845

Coma, S. P., Grau, L. R., Foguet, O. C., & Balcells, M. C. (2021). Creation and validation of the survey «AECM» (analysis of the strategy in mountain races) through the Delphi method. *Retos*, (39), 177-181. https://doi.org/10.47197/retos.v0i39.72111

Cruz, M. & Rua, J. (2018). Surgimiento y desarrollo del método Delphi: una perspectiva cienciometrica. *Biblios*, 71, 90-107. https://doi.org/10.5195/biblios.2018.470

Cruz, M., & Martínez, M. (2020). Origen y desarrollo de un índice de competencia experta: el coeficiente k". *Revista Latinoamericana de Metodología de la Investigación Social - ReLMIS*. 19(10). http://www.relmis.com.ar/ojs/index.php/relmis/article/view/248

Cruz-Sandoval, M., Vázquez, J.C., & Alonso, P. (2022). Student Perception of Competencies and Skills for Social Entrepreneurship in Complex Environments: An Approach with Mexican University Students. *Social Sciences*, 11(7), Art.314. https://doi.org/10.3390/socsci11070314

Dobrov, G. M., & Smirnov, L. P. (1972). Forecasting as a means for scientific and technological policy control, *Technological Forecasting and Social Change*, 4(1), 5-18. http://dx.doi.org/10.1016/0040-1625(72)90043-1

Dziuban, Ch., Grahan, Ch. R., Moskal, P., Norberg, A., y Sicilia, N. (2018). Blended learning: the new normal and emerging technologies. *International Journal of Educational Technology in Higher Education, 15*(3), 1-16. https://doi.org/10.1186/s41239-017-0087-5

Erazo, J. C. &. Narváez, C. I. (2022). Impacto de la responsabilidad social universitaria en las UEP de la Ciudad de Cuenca. Revista Conrado, 18(89), 378-387.

Expósito, J., Romero, J. J., & Olmedo, E. M. (2023). Diseño y validación de contenido de una rúbrica para medir el valor educativo de aplicaciones para dispositivos móviles. Revista de Educación a Distancia (RED), 23(72). https://doi.org/10.6018/red.542261

Fernández-Cerero, J., Fernández-Batanero, J. & Cabero, J. (2023). Digital teaching competencies and disability. Validation of a questionnaire design using the K coefficient to select experts. Helyon, 9 e164667. https://doi.org/10.1016/j.heliyon.2023.e16467

Galicia, L., Balderrama, J., & Edel, R. (2017). Validez de contenido por juicio de expertos: propuesta de una herramienta virtual. Apertura, 9(2), 42-53. http://dx.doi.org/10.18381/Ap.v9n2.993

Gameil, A., & Al-Abdullatif, A.M. (2023). Using Digital Learning Platforms to Enhance the Instructional Design Competencies and Learning Engagement of Preservice Teachers. *Education Sciences*, 13, 334. https://doi.org/10.3390/educsci13040334

Gansser, O., & Reich, C. (2021). A new acceptance model for artificial intelligence with extensions to UTAUT2: An empirical study in three segments of application, Technology in Society, 65(C). DOI: 10.1016/j.techsoc.2021.101535

García de Blanes Sebastián, M., Sarmiento Guede, J. R., & Antonovica, A. (2022). Application and extension of the UTAUT2 model for determining behavioral intention factors in use of the artificial intelligence virtual assistants. Frontiers in Psychology, 13 doi:10.3389/fpsyg.2022.993935

George-Reyes, C., & Valerio-Ureña, G. (2022). Validación de un instrumento para medir las competencias digitales docentes en entornos no presenciales emergentes. *Edutec. Revista Electrónica de Tecnología Educativa*, (80), 181-197. https://doi.org/10.21556/edutec.2022.80.2315

George-Reyes, C., Contreras, Y., Ruiz-Ramírez, J. & López-Caudana, E. (2023). Aprendizaje de los componentes del pensamiento computacional mediado por una aplicación virtual de la educación 4.0 en el entorno del pensamiento complejo. Educar, 59(2), 1-20. https://doi.org/10.5565/rev/educar.1645

George-Reyes, C., López-Caudana, E.O., Ramírez-Montoya, M.S., & Ruiz, J. (2023). Pensamiento computacional basado en realidad virtual y razonamiento complejo: caso de estudio secuencial. *RED. Revista de Educación a Distancia*, 23(73). http://dx.doi.org/10.6018/red.540841

Gunawan, A., Muchardie, B. G., & Liawinardi, K. (2019). Millennial behavioral intention to adopt E-books using the Utaut2 model. Paper presented at the Proceedings of 2019 International Conference on Information Management and Technology, ICIMTech 2019, 98-102. doi:10.1109/ICIMTech.2019.8843826

Gutiérrez-Castillo, J. J., Cabero-Almenara, J., & Estrada-Vidal, L. I. (2017). Diseño y validación de un instrumento de evaluación de la competencia digital del estudiante universitario. *Espacios*, *38*(10).

Hannoon, T. (2023). The impact of teaching using the Google Classroom platform on the achievement of the Iraqi EFL students at the University of Missan. Eastern Journal of Languages, Linguistics and Literature, 4, 18–35. https://doi.org/10.53906/ejlll.v4i1.130

Hu, C., Wu, C., Lin, Y., & Wang, A. (2017). How computer scientists and computing teachers think differently about the concepts to be included in a secondary school computing curriculum. Paper presented at the Proceedings of International Conference on Computational Thinking Education, 50-54.

Hult, D. & Khan, S. (2020). Social psychology and pandemics: Exploring consensus about research priorities and strategies using the Delphi method. *Asian Journal of Social Psychology*, 23(4), 363-371. http://doi.org/10.1111/ajsp.12442

Khechine, H., & Lakhal, S. (2018). Technology as a Double-Edged Sword: From Behavior Prediction with UTAUT to Students' Outcomes Considering Personal Characteristics. Journal of Information Technology Education: Research, 17, 063-102.

Ko, W. & Lu, M. (2020). Evaluation of the professional competency of kitchen staff to avoid food waste using the modified Delphi method. *Sustainability (Switzerland)*, 12(19), 1-11. http://doi.org/10.3390/su12198078

Lim, W. M., Gunasekara, A., Pallant, J. L., Pallant, J. I., & Pechenkina, E. (2023). Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators. *International Journal of Management Education*, *21*(2). https://doi.org/10.1016/j.ijme.2023.100790

Lisawadi, S., Ahmed, S., Reangsephet, O. & Shah, M. (2019). Simultaneous estimation of Cronbach's alpha coefficients. *Communications in Statistics-Theory and Methods*, *48*(13), 3236-3257. https://doi.org/10.1080/03610926.2018.1473882

López, E. (2018). The Delphi method in current educational research: A theoretical and methodological review. *Educacion XX1*, 21(1), 17-40. http://doi.org/10.5944/educXX1.15536

Marta-Lazo, C., Gabelas-Barroso, J. A., Nogales-Bocio, A., Badillo-Mendoza, M. E. (2022). Aprendizaje Multimedia y Transferencia de Conocimiento en una Plataforma Digital. Estudio de Caso de Entremedios. *RIED. Revista Iberoamericana de Educación a Distancia*, *25*(1), pp. 101-120. https://doi.org/10.5944/ried.25.1.30846

Mengual, S. (2011). La importancia percibida por el profesorado y el alumnado sobre la inclusión de la competencia digital en educación Superior. Alicante: Departamento de Didáctica General y Didácticas específicas de la Facultad de Alicante.

Molero, T., Lázaro, J. L. & Gisbert, M. (2022). Una solución tecnológica para personas con discapacidad intelectual en situaciones de emergencia. REICE. Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación, 20(2), 65-83. https://doi.org/10.15366/reice2022.20.2.004

Moreno, V.; Cavazotte, F.; Alves, I. (2017). Explaining university students' effective use of e-learning platforms. British Journal of Educational Technology, 48, 995–1009. https://doi.org/10.1111/bjet.12469

Musa, M., Ismail, M. N., Tahir, S., Fudzee, M. F. M., & Jofri, M. H. (2022). Student acceptance towards online learning management system based on UTAUT2 model. International Journal of Advanced Computer Science and Applications, 13(11), 139-147. doi:10.14569/IJACSA.2022.0131115

Nennig, H. T., Idárraga, K. L., Salzer, L. D., Bleske-Rechek, A., y Theisen, R. M. (2020). Comparison of student attitudes and performance in an online and a face-to-face inorganic chemistry course. *Chemistry Education Research and Practice.* https://doi.org/10.1039/C9RP00112C

Ouadoud, M., Chkouri, M. Y., Nejjari, A., & El Kadiri, K. E. (2017). Exploring a Recommendation System of Free E-learning Platforms: Functional Architecture of the System. *International Journal of Emerging Technologies in Learning (iJET)*, *12*(02), pp. 219–226. https://doi.org/10.3991/ijet.v12i02.6381

Pacheco, E.A., Vázquez J.C., Cruz, M., Salinas, D.E., & Carlos, M. (2023). Business Decision-Making and Complex Thinking: A Bibliometric Study. *Administrative Sciences*, 13(3), 80. https://doi.org/10.3390/admsci13030080

Patiño, A., Ramírez-Montoya, M.S., & Buenestado-Fernández, M. (2023). Active learning and Education 4.0 for complex thinking training: analysis of two case studies in open education. *Smart Learning Environments*, 10(8). https://doi.org/10.1186/s40561-023-00229-x

Peraza, M., Armenta, A. & Hernández, S. (2019). Juicio de expertos para la validación de un proyecto formativo. *Revista Electrónica Desafíos Educativos*, 5, 24-34.

Plummer, J. & Tanis, A. (2015). Preservice teachers developing coherent inquiry investigations in elementary astronomy. Science Education, 99(5), 932–957. https://doi.org/10.1002/sce.21180

Raman A., & Thannimalai R. (2021). *Factors Impacting the Behavioural Intention to Use E-learning at Higher Education amid the Covid-19 Pandemic: UTAUT2 Model*. Psychological Science and Education, 26(3), 82-93. https://doi. org/10.17759/pse.2021260305

Ramírez-Montoya, M. S., Castillo-Martínez, I.M., Sanabria-Zepeda, J.C., & Miranda, J. (2022). Complex Thinking in the Framework of Education 4.0 and Open Innovation—A Systematic Literature Review. *Journal of Open Innovation: Technology, Market, and Complexity, 8*(4). https://doi.org/10.3390/joitmc8010004

Robles, P., & Rojas, M. D. C. (2015). La validación por juicio de expertos: dos investigaciones cualitativas en Lingüística aplicada. *Revista Nebrija de Lingüística Aplicada*, 18. http://r.issu.edu.do/l.php?l=229SH9

Romero-Rodríguez, J. M., Ramirez-Montoya, M.S., Glasserman-Morales, L.D. & Ramos Navas-Parejo, M. (2022). Collaborative online international learning between Spain and Mexico: a microlearning experience to enhance creativity in complexity. Education + Training, https://doi.org/10.1108/ET-07-2022-0259

Sanabria, J. C., Molina, J. M., Alfaro, B., & Vycudilíková, M. (2022). Umbral para proyectos de ciencia ciudadana: el pensamiento complejo como impulsor de desarrollo holístico. *RIED-Revista Iberoamericana De Educación a Distancia, 25*(2), 113–131. https://doi.org/10.5944/ried.25.2.33052

Sanabria, J.C., Castillo-Martínez, I.M., González-Pérez, L.I. & Ramírez-Montoya, M.S. (2023). Complex thinking through a Transition Design-guided Ideathon: testing an AI platform on the topic of sharing economy. Frontier Education 8, 1186731. https://doi.org/110.3389/feduc.2023.1186731

Sondakh, D. E., Osman, K., & Zainudin, S. (2020). A proposal for holistic assessment of computational thinking for undergraduates: Content validity. European Journal of Educational Research, 9(1), 33-50. https://doi.org/10.12973/eu-jer.9.1.33

Stromberga, Z., Phelps, C., Smith, J., & Moro, C. (2021). Teaching with disruptive technology: The use of augmented, virtual, and mixed reality (HoloLens) for disease education https://doi.org/10.1007/978-3-030-61125-5_8

Suárez-Brito, P., López-Caudana, E.O., Baena-Rojas, J.J., & Ramírez-Montoya, M.S. (2022). Eliciting Complex Thinking through Open Educational Resource Projects. Journal of Social Studies Education Research 13(4), 56-77. https://jsser.org/index.php/jsser/article/view/4472

Taber, K. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, *48*(6), 1273-1296. https://doi.org/10.1007/s11165-016-9602-2

Tecnológico de Monterrey (2023). *OpenEdR4C. Plataforma educativa para la innovación y emprendimiento*. https://www.research4challenges.world/openedr4c

Vázquez-Parra, J.C.; Alonso-Galicia, P.E.; Cruz-Sandoval, M.; Suárez-Brito, P.; Carlos-Arroyo, M. (2023). Social Entrepreneurship, Complex Thinking, and Entrepreneurial Self-Efficacy: Correlational Study in a Sample of Mexican Students. Adm. Sci. 13, 104. https://doi.org/10.3390/admsci13040104

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Witkin, B. R. & Altschuld, J. W. (1995). Planning and conducting needs assessment: A practical guide. Thousand Oaks, Sage.

Yan, D. (2023). Impact of ChatGPT on learners in an L2 writing practicum: An exploratory investigation. *Education and Information Technologies*. https://doi.org/10.1007/s10639-023-11742-4

Yusoff, K. M., Ashaari, N. S., Wook, T. S. M. T., & Ali, N. M. (2021). Validation of the components and elements of computational thinking for teaching and learning programming using the fuzzy Delphi method. International Journal of Advanced Computer Science and Applications, 12(1), 80-88. https://doi.org/10.14569/IJACSA.2021.0120111