Validation of a Scale to Measure the Adoption of Open Educational Resources: Students' Perspective

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Abstract

It is increasingly evident that using technological resources has broadly impacted people's lives, including their education. One of the technologies implemented for several years is Open Educational Resources (OER), with elements of open practice to mitigate the impact of the digital divide. This article describes the validation process of an instrument to measure the adoption of OER as perceived by higher education students in Mexico (means, standard deviations and normality, construct validity and reliability). The study included 392 participants, of whom 117 (29.8%) were male, 273 (69.6%) were female and 2 (.5%) did not identify with either sex. Ages ranged from 18 to 62 years (M= 22.0 years, SD= 5.8). The instrument underwent descriptive statistics techniques, univariate normality analyses, and Confirmatory Factor Analysis using the maximum likelihood estimation method. The reliability of the measurement model was confirmed using Cronbach's Alpha and McDonald's Omega index. The resulting validated instrument investigates students' perceived usefulness, perceived ease of use, attitude, subjunctive standards, and behavioral control. For future studies, the application of the scale is suggested because of its manageable number of items and ease of administration, along with the examination of other validity tests that will help increase the robustness of the proposed measurement model, this measurement scale will be useful for teachers and researchers interested in understanding the impact of OER in education.

Keywords: *Educational technology, higher education, innovative education, measurement, OER, validation.*

Introduction

In education, technologies have transformed the ways of teaching and learning and have advanced the digitalization of learning, the interaction between teachers and students, and accessibility to information (Dalim et al. 2023; Kozlova & Pikhart, 2021; Moyo et al., 2022; Pérez Zúñiga et al., 2018; Pérez-Rojas, 2020. Despite the significant contributions of technology in education, an evident digital divide undeniably exists among the population.

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Open educational resources (OER) represent one of the most significant strategies for reducing the digital divide among the population. An essential aspect of knowing the impact that OER has had in reducing the digital divide in sectors such as education is the measurement for this different measurement scales have been designed (Alkhasawneh, 2020; Tlili et al., 2022) focused mainly on teachers, an aspect that has received less attention are the instruments that collect information from the students' perspectives (Pozón-López et al., 2021; Yi & Tan, 2022) the few existing studies focus on measuring perceived ease of use and satisfaction with the use of OER; however, the existing scales present theoretical and methodological limitations that must be resolved to ensure the quality of measurement and the making of value judgments with a solid scientific basis.

The adoption of OER by students represents one of the main areas to be addressed. Knowledge about the factors that affect the adoption of OER will favor the development of intervention programs to achieve their adequate use and thus contribute to the quality of education, the reduction of the digital divide, and the democratization of information (Ordalu et al., 2022) however, no study that addresses it was found in the existing literature. Therefore, this study seeks to fill this gap in the literature by presenting evidence of validation of a scale to measure the adoption of OER from students' perspectives.

Review of Literature

Open educational resources

A strategy to leverage technology in educational processes dates from the nineties to reduce the digital divide through a policy of open access to different educational resources. This open educational movement is defined by the conformation of educational activities oriented toward open authorization, selection, use of educational resources, and dissemination of open educational practices in academic environments (Ramírez-Montoya, 2013). Among the resources comprising the open educational movement are the Open Educational Resources (OER).

UNESCO's 2002 initiative proposed OER, using the term for the first time. These resources comprise materials designed to promote educational and research practices in the public domain or have an open license, allowing people to use, adapt, and redistribute them (Mishra, 2017; UNESCO, 2019). It implies a greater democratization of technology and, therefore, an effort to reduce the digital divide.

In addition, OER has contributed significant benefits to education. Different studies have evidenced such contributions, for example, cost reductions due to the standardization of their

application, more opportunities for access to educational materials and resources, less preparation time for classes, and more convenience enabling lifelong learning (Al Abri & Dabbagh, 2018; Alhrahsheh, 2023; Henderson & Ostashewski, 2018; Idrissi et al., 2018). Overall, OERs have been an essential factor in improving the quality of education (Ordalu et al., 2022)

Evidence in the literature shows that research on OER has increased in recent years. Research related to the topic has indicated trends such as studies that analyze aspects related to teachers' practices (Baas et al., 2023; Smirani & Boulahia, 2022; Tang & Bao, 2021, 2023), individual or personal aspects related to the use or acceptance of OER (Angelopoulou et al., 2022; Hilton, 2020; Muniyasamy & Jeyshankar, 2023; Zulaiha & Triana, 2023), and studies that account for different types of OER in various educational practices (Cheung et al., 2023; Dimitri et al., 2023; Morris et al., 2023; Stein et al., 2023). The present research shows that OERs have significantly benefitted the formation of educational communities of teachers and students and are practical resources for developing skills in their users.

Measurement of open educational resources

The development of OER research aligns with UNESCO's recommendations on elaborating OER public policies. UNESCO explicitly calls attention to the research community, encouraging research based on empirical data that allows observing the impact and effectiveness of OER on education (UNESCO, 2019). It is crucial for the generation of research with empirical data to validate measurement instruments for reliability to ensure that the instruments measure effectively. The field of OER measurement is still at an early stage, representing an opportunity for researchers. Existing studies on OER measurement can be categorized under five headings: (1) *quality and openness*: these instruments address aspects related to integration, user experience, OER content, reusability, barriers, personalization, accessibility, fairness, and, finally, instructional design aspects (Alkhasawneh, 2020; Canchola et al., 2021; Jaggars et al., 2018; Pozón-López et al., 2021; Ramírez-Montoya & Tenorio-Sepúlveda, 2021; Sandanayake et al., 2021; Tlili et al., 2022; Yi & Tan, 2022; Zawacki-Richter et al., 2022); (2) *use and usability*: these instruments address aspects related to the importance of using OER, usage practices, ease of use, interactivity, structure, incentives, benefits and cooperation (Alkhasawneh, 2020; Asghar et al., 2021; Brasley, 2018; Canchola et al., 2021; Osang, 2019; Pozón-López et al., 2021; Ramirez-Montoya & Tenorio-Sepulveda, 2021; Zawacki-Richter et al., 2022); (3) *attitudes and emotions*: the instruments address aspects such as satisfaction, perceived enjoyment, motivation, engagement, awareness,

subjective norms, and perceived behavioral control (Pozon-Lopez et al., 2021; Redcay et al., 2023; Tang & Bao, 2021; Tipton, 2020; Tlili et al., 2022; Yi & Tan, 2022); (4) *student and teacher performance*: they measure technology-task fit, digital and informational competencies, goal orientation, and professional development support (Osang, 2019; Sarango-Lapo et al., 2020; Tang & Bao, 2021; Zawacki-Richter et al., 2022); and (5) *institutional aspects*: this last category comprises instruments for issues related to OER management, cultural aspects, capacity building, and support policies (Asghar et al., 2021; Canchola et al., 2021; Ramírez-Montoya & Tenorio-Sepúlveda, 2021; Suárez-Brito et al., 2022).

The existing measurement instruments for the aspects categorized above do not necessarily consider the type of population measured. In the teaching process, the teacher plays a crucial role in selecting the best resources and strategies to guide students. In the case of OER, a significant part of the instruments have focused on the population of teachers, measuring aspects such as intentions of use in teaching practice (Brasley, 2018; Zhang et al., 2021); they also investigate factors related to teachers' competencies and capabilities to design or select OER (Ramírez-Montoya & Tenorio-Sepúlveda, 2021; Sarango-Lapo et al., 2020); finally, a significant number of instruments focus on psychological or individual aspects such as teachers' beliefs or attitudes towards OER implementation (Alkhasawneh, 2020; Tipton, 2020; Tlili et al., 2022; Zhang et al., 2021). Although teachers are dominant figures in the educational process, it is necessary to delve into the students' perspectives to know what barriers or factors limit or favor the adoption of OER in daily learning practice.

There are different theoretical perspectives in the literature to address the adoption of technologies, such as OER; one of the most relevant approaches is the Technology Acceptance Model (TAM) proposed by Davis (1989), which is still used today to analyze emerging technologies (Rocha-Estrada et al., 2022; Saif et al., 2023) and among the variables of the TAM Model, perceived usefulness and perceived ease of use present insights into what can be understood about technology adoptions. The former is defined as the potential user's subjective likelihood that using a given system (OER, for example) will improve his or her action. On the other hand, perceived ease of use refers to the degree to which the potential user expects the target system to be effortless.

Other crucial elements as stated by Kim et al (2009) are related to the attitude manifested to the uses of new technologies, in other words, the effect of attitude on the behavioral intention of individual users. Also, the subjunctive norms which derived from Theory of Reasoned Action

(TRA) and where it is verified that it is major determinant of behavioral intention to use (Abbas, 2016). According to Rouibah & Abbas (2010), this variable is defined as a person's perception of what people important to him/her think he/she should or should not perform in accordance with the behavior in question. Finally, the behavioral control needs to be understood as a predictor derived from the Theory of Planned Behavior (TPB), which was introduced to account for occasions when a person intends to perform a behavior, but the actual behavior is prevented for subjective or objective reasons (Nisson & Earl, 2020).

Measurement instruments focused on students' perspectives on OER, and their uses and applications remain limited. Existing instruments measure perceived quality, integration, satisfaction, perceived ease of use, and control of OER (Jaggars et al., 2018; Osang, 2019; Pozón-López et al., 2021; Yi & Tan, 2022), so it is necessary for the construction of an instrument that includes dimensions to measure the technological adoption of OER, given this gap in the literature in the field, this study presents the validation of an instrument to measure the adoption of OER from the perception of higher education students in Mexico, precisely, the study has the following objectives:

- To examine descriptive statistics of the scale, for which means, and standard deviations were considered.
- The scale's construct validity was analyzed by implementing a Confirmatory Factor Analysis.
- The scale's internal consistency was evaluated, and Cronbach's Alpha and McDonald's Omega coefficients were considered.

Method

Research Design

This study consists of a quantitative cross-sectional design where the data were collected at a specific time (Kerkinger, 2000) and of instrumental type. The main feature of this type of study is the focus on analyzing the properties of instruments that are translated into different languages, adaptations of existing instruments or the development of new tests to assess certain constructs (Ato et al., 2013).

Participants

Participants were selected on a non-probabilistic basis, with a total of 392 students of whom 117 (29.8%) were male, 273 (69.6%) were female and two (.5%) did not identify with either sex. Ages ranged from 18 to 62 years (M= 22.0 years, SD = 5.8). The study participants attended 16 Mexican secondary and higher education institutions in six different disciplines of study in professional, postgraduate, and continuing education (see Table 1).

Table 1

Discipline and degree of study of participants

Discipline of studies	n	%
Natural Sciences	*8*	*2*
Engineering and Technology	*44*	*11.2*
Health Sciences	*130*	*33.2*
Social Sciences	*42*	*10.7*
Humanities and Education	*81*	*20.7*
Business and Administration	*87*	*22.2*
Academic degree		
Undergraduate	*312*	*79.6*
Postgraduate	*17*	*4.3*
Continuing Education	*63*	*16.1*

Data Collection Tools

Adoption of open educational resources (AOER). The instrument proposed by Wang (2023), which measures perception and behavioral intention towards MOOCs, was taken from the literature, and 20 items were adapted to measure the adoption of OER from the students' perception. The adaptation of the instrument consisted of five dimensions: (a) *perceived usefulness* measures beliefs about the benefits of using OER to improve the learning process (four items, for example: "Open educational resources allow me to acquire new knowledge"); (b) *perceived ease of use* refers to beliefs about the management of OER four items, for example: "Open educational resources allow me to manage information according to my learning style"); (c) *attitude* measures the positive or negative evaluation that users have about the use of OER (four items, for example: "I think studying with open educational resources is enjoyable"); (d) *subjective norms* refers to the implicit rules about the use of OER (five items, for example: "I use open educational resources because my teacher has explained the benefits to me"); and (e) *behavioral control* measures three

items (for example: "In the future, I will use open educational resources as a way to study"). The scale has a Likert-type response format with values ranging from 1 (strongly disagree) to 5 (strongly agree).

Data Collection

Regarding the administration of the instrument, first, students were invited to participate in the study, the objectives of the study and the implications of their participation were explained to them. The students who agreed to participate voluntarily were provided with an informed consent form where they accepted their participation and where the handling of confidentiality and the ethical treatment of the information obtained were explained to them. The instrument was administered electronically through a Google form and had an approximate duration of 15 minutes to record responses.

Data Analysis

Descriptive analysis and normality. First, with the support of the Statistical Package for Social Sciences (SPSS 25), the researchers calculated the instrument's descriptive and univariate normality measures. These included values for skewness and kurtosis, normality values between 3 and -3, and standard deviations from the means.

Dimensionality. To examine the internal structure of the measurement model, a Confirmatory Factor Analysis (CFA) was performed. The CFA used the maximum likelihood (ML) estimation method. A bootstrap of 500 replicates with a 95% confidence interval ensured that multivariate normality problems did not affect the calculations. The $X2$ is sensitive to sample size, so we used the fit indices proposed by Blunch (2013) and Byrne (2013), $X2$, p (Chi-square and associated probability), TLI (Tucker-Lewis Index), SRMR (Standardized Statistical Mean Squared Residual), CFI (Comparative Fit Index), and RMSEA (Root Mean Square Error Approximation with its confidence interval). The $X2$ values with $p > .001$; TLI, CFI, AGFI $\geq .95$; RMSEA and SRMR $\leq .08$ (Byrne, 2013; Sharma et al., 2005) were considered indicators of data model fit.

Reliability. Cronbach's Alpha and McDonald's Omega indexes were applied to examine the reliability of the measurement model. Acceptable values of Cronbach's Alpha and McDonald's Omega were $> .70$ (Green & Yang, 2015; Hair et al., 2021).

Findings

The results are organized in three sections: first, the analysis of means, standard deviations, and normality of the scale's items is presented; second, the validation of the internal structure of the scale, which was carried out using a confirmatory factor analysis, is given; and finally, the analysis of the internal consistency of the scale is presented, in which Cronbach's Alpha and McDonald's Omega are reported.

Table 2 shows the OER adoption scale's means, standard deviations, minimum, maximum, skewness, and kurtosis (AOER). The mean scores indicated positive opinions of perceived usefulness and ease of use, attitude, subjective norms, and behavioral control over OER. The skewness and kurtosis values were within the values suggested in the literature, except for six items, which presented kurtosis values slightly above those indicated.

Table 2

Mean, standard deviation, minimum and maximum, skewness, and kurtosis of items in the open educational resources instrument.

Items	M	SD	Min	Max	Asymmetry	Kurtosis
Item 1	4.28	1.05	1	5	-1.95	3.54
Item 2	4.32	.97	1	5	-2.09	4.62
Item 3	4.26	.96	1	5	-1.95	4.29
Item 4	4.10	1.02	1	5	-1.46	2.07
Item 5	4.14	.94	1	5	-1.56	2.93
Item 6	4.11	1.07	1	5	-1.58	2.19
Item 7	4.14	.95	1	5	-1.63	3.19
Item 8	3.88	.99	1	5	-.92	.84
Item 9	4.14	.95	1	5	-1.57	2.98
Item 10	4.01	.96	1	5	-1.26	1.91
Item 11	4.21	.91	1	5	-1.85	4.32
Item 12	4.28	.90	1	5	-2.25	6.18
Item 13	3.71	.99	1	5	-.73	.48
Item 14	3.52	1.07	1	5	-.60	-.11
Item 15	3.80	1.08	1	5	-.82	.26
Item 16	4.10	.96	1	5	-1.45	2.49
Item 17	3.84	.97	1	5	-.92	.98
Item 18	4.02	.96	1	5	-1.34	2.15
Item 19	4.02	.97	1	5	-1.34	2.07
Item 20	4.01	.95	1	5	-1.43	2.15

Confirmatory Factor Analysis

The factor loadings of the items in the measurement model were significant, with values between .63 and .92 (see Figure 1). The AOER measurement items were grouped into five dimensions: perceived usefulness, perceived ease of use, attitude, subjective norms, and behavioral control; this is confirmed by the statistically significant correlation obtained in the correlations between the dimensions. The indices obtained confirm the fit of the data to the measurement model for measuring the adoption of open educational resources in students ($X^2 = 277.7\ gl = 139,\ p = <.000$; SRMR = .02; TLI = .97, CFI =. 98; RMSEA = .05, IC 90% [.04, .05]).
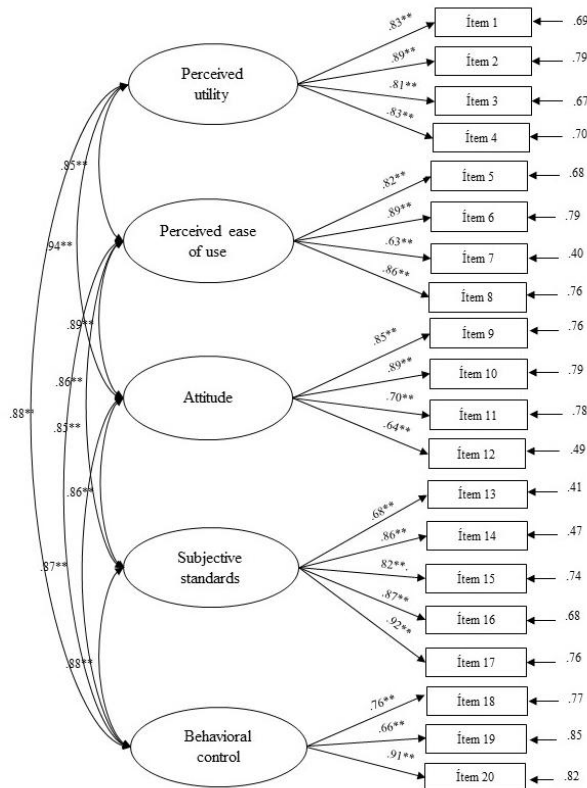

Figure 1. Adoption of open educational resources (AOER).

Reliability

The reliability indexes by Cronbach's Alpha method were between .87 and .93; with McDonald's Omega method, similar values were obtained (.87 to .94); globally, the scale presents values of .89 and .90; these values demonstrate the scores' reliability (see Table 3).

Table 3

Reliability of the Open Educational Resources adoption instrument

Dimension	Cronbach Alpha	McDonald Omega
Perceived utility	.91	.92
Perceived ease of use	.86	.87
Attitude	.92	.93
Subjective standard	.87	.88
Behavioral control	.93	.94
Global	.89	.90

Discussion, Conclusion and Implications

This study aimed to validate the instrument for measuring the adoption of open educational resources (AOER) from the perception of higher education students in Mexico by analyzing descriptive statistics, univariate normality, internal structure validity, and internal consistency.

The descriptive results of the scale show a positive perception of the adoption of OER in higher education students. These findings coincide with what is reported in the literature in which it is described that OER have been well accepted by education students due in part to the access to information and the advantages they have had in their training process (Delimont et al., 2016; Mullens & Hoffman, 2023). It is essential to continue to conduct studies that allow us to build a comprehensive framework on how OER has benefited and transformed student practices.

The results of the construct validity show the adequate fit of the proposed model, which was based on the dimensions proposed by the Technology Acceptance Model (TAM), which has been widely implemented to analyze how users appropriate technology (Abou-Kamar et al., 2023; Cabero-Almenara & Llorente, 2020; Camilleri & Falzon, 202; López et al., 2019), the proposed measurement model is composed of five dimensions: perceived usefulness, which measures the belief that the use of OER will improve academic practices, ease of use measures, on the other hand, the use of OER will be with low effort or with fewer complications, an attitude refers to the predisposition that students have to use OER in their school activities, subjective norms refer to the positive or negative evaluations that students have towards the inclusion of OER and finally, behavioral control refers to the belief that users have about their ability to successfully control and manage OER in the future. The results are aligned with studies that have measured OER adoption with dimensions of the TAM model (Tipton, 2020; Pozón-López et al., 2021; Zhang et al., 2021), which confirms the relevance of using that theoretical framework. Studies on developing or

validating OER instruments have focused on measurement from the teachers' perspective. However, agreement with our results confirms the robustness of the theoretical model of technology acceptance for measuring people's attitudes toward technology. For future studies, applying the scale in other contexts is needed to test the fit of the data to the proposed measurement model.

Concerning the reliability of the AOER scale, acceptable values were obtained with Cronbach's Alpha and McDonald's Omega methods, both in the dimensions that comprise it and the overall scale. The findings are like those in other studies that report evidence of reliability with scales like the AOER scale (Tipton, 2020; Pozón-Lopez et al., 2021; Zhang et al., 2021). These results confirm the model's internal consistency and ensure adequate construct measurement.

The present study has theoretical, methodological, and practical implications. From the theoretical point of view, it contributes to the delimitation of the construct and the soundness of the technology acceptance model. From the methodological point of view, this study contributes to the field of OER measurement by proposing a scale with adequate construct validity and reliability to measure OER adoption, considering the students' perspective, which helps fill the methodological gaps. This study has applications in the field of measurement related to the adoption of OER by students, it is a relevant instrument due to the need for further development of scientific research with the topic. From the practical point of view, it demonstrates the need to continue developing and validating measurement scales related to OER.

Limitations and recommendations for future studies

Although this study contributes to measuring the adoption of open educational resources from the students' perspective, it is essential to consider its limitations. First, the selection of participants was non-probabilistic, so it is recommended that another type of sampling be used. Second, the scale has a self-report format, which implies the presence of social desirability in the responses, so future research should consider other forms of measurement. Third, the scale was applied only to higher education, postgraduate, and continuing education students, so students from other educational levels, such as secondary and primary, represent opportunities. Finally, although we sought a representative sample by including students from various training disciplines, conducting an analysis for each dimension would be important.

For future studies, it is necessary to continue implementing the AOER scale in other contexts to know, as well as the data, the proposed measurement model. It is also essential to continue

analyzing other evidence of validity to increase the scale's robustness, and it is necessary to explore the effects of OER on the quality of education.

Finally, the AOER is a valuable tool to implement in OER studies because of its number of items. It is easy to administer and allows knowing aspects such as usefulness, ease of use, attitude, subjective norms, and behavioral control of the users; it even allows the possibility of relating these dimensions with other variables related to adopting OER.

Acknowledgments

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Appendix

Adoption of Open Educational Resources

1. Open educational resources are useful in my professional training.

2. Open educational resources allow me to acquire new knowledge

3. Open educational resources help me to complement the information seen in class

4. Open educational resources are useful because they are free of charge.

5. Open educational resources help me achieve my learning objectives at my own pace.

6. I can freely select different open educational resources according to my needs.

7. Open educational resources allow me to manage information according to my learning style.

8. Open educational resources are easy to access

9. I believe that open educational resources make it easy for me to access information.

10. I think studying with open educational resources is enjoyable

11. I think that studying with open educational resources is useful

12. Being able to access open educational resources is a benefit to me.

13. I use open educational resources because my school uses them.

14. I use open educational resources because my teacher has explained the benefits to me.

15. I use open educational resources because I do not have to pay for them.

16. I use open educational resources because I have a right to information

17. I use open educational resources because they provide me with reliable information

18. In the future, I will use open educational resources to study.

19. In the future, I will recommend open educational resources to my friends

20. In the future, I will share my own learning experience with open educational resources with my friends