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An instrument for evaluating the innovation of an educational platform: Reliability piloting*

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ABSTRACT

Innovation is fundamental for the development, stability, and competitiveness of organizations through the application of changes that generate added value. Within educational institutions, this value is translated into improvements in the processes for the development of learning. This paper presents the valuation of an educational platform and describes the reliability assessment of a tool for assessing educational innovations: a Likert scale questionnaire, qualitatively validated. The instrument is structured in two parts: elements of innovation (change/novelty and added value) and types of innovation. The instrument's reliability piloting was carried out applying it to an innovative object, a digital educational platform, in a pre-school teacher training school in Mexico. The results of the piloting applied to 21 students are presented and discussed in this paper. The psychometric results showed that the overall reliability of the instrument is solid.

CCS CONCEPTS

• Applied computing • Education • Learning management systems

KEYWORDS

Educational innovation, Measuring instrument, Educational platform, Reliability.

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1. Introduction

Within an organization, innovation introduces new processes, products or services; in today's society, innovation is a central axis for the stability of organizations. From a capitalist perspective and as a classic author of innovation, Schumpeter defines innovation as the introduction of new combinations of economically viable products or processes [1]. From a social point of view, Rogers [2] states that innovation is an idea, practice or object that is perceived as a novelty by an individual and another unit of adoption. On the educational side, innovation refers to any adaptation (organizational, administrative, pedagogical or formative) that enhances or improves learning [3].

This study has the objective of presenting the reliability piloting of an instrument to identify the degree of innovation and the type of innovation to which an innovative object applied in education is oriented. The instrument is designed to assess any initiative, strategy, resource, etc., implemented in an educational context. For the piloting presented in this study, "Escuela en Red," a digital platform deployed in a Normal Preschool School in Mexico, was evaluated. The instrument is structured in two parts: elements of innovation (change/novelty and added value) and types of innovation (incremental, systematic, disruptive and open).

The structure of the paper presents a theoretical-conceptual revision of educational innovation, of instruments for the valuation of educational innovations and digital platforms applied in education. Subsequently, the research method is described, both for the results of the assessment, as well as for the psychometric analysis of the instrument. Finally, the results and the discussion

of the data are presented, closing with a conclusion of the work carried out.

2. Conceptual framework

2.1 Educational innovation

In educational innovation, implementing changes which focus on improving training processes is vital. Such changes should consider modifications in the training environment through planning, seeking to be an effective, efficient and sustainable process that allows it to be transferable beyond the context in which it arises [4, 5]. It is important not to confuse innovation with change, since a change does not lead to innovation alone, for example, including technologies in educational processes is not in itself an innovation [6, 7]. Thus, to consider innovation as such, it is necessary to look beyond the implementation of changes.

Educational innovation is about new elements that add value [8]. The added value is related to the acquisition of learning and teaching processes, increasing quality, fulfillment of new demands or representing a contribution to the institution and the students [9]. Below are the concept definitions for the development of the instrument:

- **Change/novelty:** They are original, planned and implemented ideas that cause an incremental or disruptive modification. The changes range from the adoption of external elements to the internal generation of solutions to problems or fulfillment of needs.

- **Added value:** The value generated by the changes implemented within the organization, which must represent improvements, benefits or increase of quality to a process.

In addition to the elements of innovation, conceptualizations have been identified according to the degree of the scope of the innovations. The types of innovation contemplated conceptually for the design of the instrument are four:

1. **Incremental or continuous:** These are minor changes that seek to improve a product, service or technology. It is about improving aspects of already existing processes [10, 11, 12].

2. **Systematic:** It is related to the Theory of Innovative Problem Solving (TRIZ), which consists of the following steps: (1) analysis of the situation, (2) definition of the problems, (3) solution of the problems, (4) evaluation of the solution. Successful actions are taken in other contexts; in higher education, this innovation is essential to improve learning, student satisfaction and management efficiency [13, 14, 15, 16].

3. **Disruptive:** It refers to significant changes in processes, and it usually includes complex models with dominant technologies and sophisticated products, which are transformed into more straightforward services by incremental changes. This is typically related to new technologies [17, 18, 19].

4. **Open:** It refers to the participation of external and internal knowledge to accelerate internal innovation and expand the market for the external use of innovation. Openness and bonding skills are developed; investments in the production of scientific knowledge and technology design, interaction strategies and definition of intellectual property rights are required [20, 21, 22].

2.2 Measuring instruments for innovation in education

Educational institutions are increasingly in need of innovation in their training activities. For this, they use the resources available to them; and in the search to achieve this objective, different parties are consulted to obtain relevant opinions [23]. These opinions are usually the perceptions of students or beneficiaries of innovation projects that are implemented to improve specific aspects of them [24, 25, 26].

The instruments of measurement of educational innovations have already been previously reported in the literature, and several investigations look for effective ways to evaluate them. An example is the validation of an instrument by exploratory factor analysis, confirmatory factor analysis, and reliability [27]. Another example measures technologies incorporated into education in rural schools with a Likert scale [28], and in another one, an instrument of educational innovation applied in a MOOC was valued through the Delphi method, considering the didactics, technique and organization dimensions [29]. Therefore, innovation measurement instruments regularly focus on specific aspects of projects.

As mentioned, other studies of instruments aimed at the measurement of educational innovations were reviewed, in Table 1 some are described, identifying the authors, innovative object and characteristics.

Table 1. Instruments of educational innovation

Research	Innovative object	Type of instrument	Reliability analysis
[10]	The practice of the open innovation process (company)	Five-dimension Likert questionnaire	Cronbach's alpha coefficient
[13]	QR codes applied in teaching (MOOC)	Four-dimension Likert questionnaire (32 items)	Cronbach's alpha coefficient
[14]	Innovation processes of teachers	Likert Questionnaire (12 items) with three categories.	Exploratory analysis
[28]	Incorporating ICT into education in rural schools	Likert scale questionnaire (12 items) and dichotomous questionnaire.	Piloting with 10 teachers (editorial revision)
[30]	Innovation experiences mediated by ICT.	Four-dimension Likert questionnaire (95 items)	Cronbach's alpha coefficient
[31]	Educational innovation projects (<i>i scale</i>).	Integral scale (four levels of scope)	Miscellaneous (Consulting, expert appraisal, etc.)

Thus, various instruments have been developed to assess educational innovation initiatives. These instruments, except López and Heredia's instrument [31], are designed to measure specific innovation objects. Therefore, the present study seeks to pilot the reliability of an instrument that values innovative objects in education from the perspective of the users and that, also, can be applicable in a general way to any innovative object within the educational sector.

2.3 Educational platforms

Human activities have migrated to the digital world; consequently, all sectors of society incorporate digital tools into their processes for their daily tasks. The economy has become a digital economy; digital technologies are now the basis for decision-making, growth of innovative products, expansion of links, improvement of management efficiency, the path to openness [32]. In this context, education has not been left behind, and digital platforms are a reality in education that seeks to improve pedagogical processes consistent with the current world.

The implementation of a digital platform in education requires planning and defining what is expected. Álvarez Angulo et al. [33], report that in the implementation of an educational platform they sought to (a) motivate and protect students, and (b) offer resources for their training; the elements considered for the planning of their implementation included: (1) theoretical framework, (2) groups for experimentation, (3) development of teaching materials and tools, (4) design experimentation, (5) organization of materials in the system.

The success of a digital platform applied in pedagogical processes is due to the participation of teachers, their attitudes and knowledge regarding this tool. The teacher's appropriation of the platform is necessary as well to develop social usability, defined by interactive and pedagogical resources; however, there is a warning that the use of ICT in education is not responsible for overcoming the educational crisis [34]. It is concluded then, that the active participation of the teacher is still essential for the achievement of learning; that is to say, the teacher, through the implementation of innovative strategies, techniques, and methodologies based on the educational needs of their students, will be the one who makes possible the added value of the digital platform for the educational process.

3. Method

The proposal of the instrument for evaluating an educational innovation is a three-dimensional self-administered questionnaire. It has 28 items that integrate the innovation construct and types of innovation in education. Its design seeks the possibility of evaluating any object of educational innovation. This assessment is obtained through the individual perspectives of the users who respond to the questionnaire. The study applies a quantitative research method, with a non-experimental, exploratory design. Reliability is calculated according to Cronbach's alpha [35].

3.1 Participants and platform

The instrument was applied to a convenience sample of 22 students from a pre-school teacher training school. They answered the questionnaire based on their experience of using a digital platform as an innovative object. The sample corresponds to students with similar profiles. No specific participants were selected. According to the demographic data, 100% are women, and the age of the participants is between 19 and 30 years old.

The platform valued in this pilot study, "Escuela en Red," was initially used for the application of institutional exams; but from the last semesters, a turn was made to focus on the learning processes of students. Teacher-student interaction spaces and the teacher and student portfolio in which they upload their evidence of learning according to the units of each course were implemented. The platform has also been enabled to carry out virtual consultancies and be a complement to face-to-face counseling, so a digital file of each student is kept. It also offers information regarding the curriculum courses, the semi-annual, monthly and daily plans can be accessed, and students can also check the contents that will be studied per unit, per day, the learning activities that will be carried out and consult the basic bibliography of the course..

3.2 Instrument

The instrument of this research was designed based on three dimensions and 28 items. The first dimension focuses on 8 items related to the change/novelty sub-construct; the second consists of 8 items associated with added value; the third has 12 items related to the four types of educational innovation: incremental, systematic, disruptive and open. The items of the dimensions have been designed according to the concepts and instruments analyzed in the introduction of this paper.

The questionnaire uses a Likert scale of 4 levels, 4: Strongly agree, 3: Agree, 2: Mildly agree, 1: Disagree; it also had a 5th option: I cannot answer / I do not want to answer, which was scored according to the mode. The scale of measurement is of intervals, considering that the options do not measure the distance between the answers, because instead, they are levels of preference.

Qualitative content validity was performed, for which aspects of sufficiency, clarity, coherence, and relevance were considered [36]. Then, to evaluate the writing and comprehension of the items, it was applied face to face with several undergraduate students, who gave feedback regarding the writing of the items. Subsequently, it was reviewed by two experts in educational innovation.

The questionnaire was structured as follows. Items from 1 to 8 correspond to the Change/Novelty dimension; items 9 to 16 focus on the added value dimension. Items from 17 to 28, value the dimension of the innovation type, organized as follows: incremental innovation items 17 to 19; systematic innovation from 20 to 22; disruptive innovation from 23 to 25, and open innovation from 26 to 28. Table 2 presents the items.

Table 2. Instrument's items

#	Items
	<i>Change / Novelty</i>
1	I have had difficulties in learning because of the organization of the space in which I learn.
2	I consider that the innovation object helps to cover the needs of the person who learns.
3	The innovative object gives me the possibility to learn in more than one space.
4	This educational experience has only been carried out in my country.
5	I have perceived that the innovative object differs from other learning experiences in which I have participated.
6	I consider that the innovative object makes my learning space different from other similar spaces.
7	Thanks to this educational experience I have managed to learn by researching on my own.
8	I consider that this type of educational experience already applies in almost all contexts.
	<i>Added value</i>
9	The innovative object allows me to have a clear idea of how to exploit the knowledge I acquire.
10	I consider that it is viable and useful to apply the innovative object in other educational contexts.
11	I believe that the innovative object is valuable to improve the quality of my learning.
12	I identify that the innovative object allows me to learn more things than in a traditional space.
13	The model of educational innovation helps me to adopt a critical stance on the subjects I learn.
14	I feel more motivated to participate in activities to improve my learning.
15	I believe that the innovative object in question has fallen short to cover my demands for learning quality.
16	I have perceived that the innovative proposal takes into account the monitoring of my learning.
	<i>Incremental innovation</i>
17	I consider that the innovative object maintains traditional elements, but suitably adapted to improve my learning.
18	I value innovation, but I consider it not suitable for my learning pace.
19	I believe that the innovative object is so revolutionary that it would impress anywhere else.
	<i>Systematic innovation</i>
20	Thanks to the innovative object I have explored processes to improve the learning that I did not recognize before.
21	The innovative object is valuable for my learning because in other contexts it has been very successful.
22	Thanks to the innovative object I have learned through tools that are commonly used outside the educational field.
	<i>Disruptive innovation</i>
23	The innovative object would not be possible without the use of technology.
24	I believe that the innovative object makes learning accessible for many people.
25	The experience with the innovative object makes me more productive in improving my learning.
	<i>Open innovation</i>
26	The innovative object establishes mechanisms so that I can participate in its improvement or development.
27	I know that the innovative object is the result of the joint work of various agents.
28	I have access to the information to learn about the process of elaboration of the innovative object.

3.3 Procedure

Once the final version was obtained, the instrument was edited to be answered with the Google Forms tool. A specific link was

generated to evaluate the innovative object in question (Escuela en Red platform); this form was responded to within the computer laboratory of the participating institution. Data were obtained and analyzed statistically to identify the degree of innovation perceived by users, as well as the level of reliability of the instrument.

The Cronbach's alpha coefficient was calculated to estimate the internal consistency or reliability of the instrument. This psychometric analysis consists of calculating the variance of the results by item, as well as the variance of the sum of the responses per participant [31]. The range of the value of the coefficient is between 0.00 and 1.00; the results are more reliable the closer the value gets to 1.00; Lozano-Rodríguez et al. [37] divide the ranges into three to determine the degree of reliability as follows: [0.00, 0.33) low reliability, [0.33, 0.66) moderate reliability, [0.66, 1.00] high reliability. This coefficient is calculated with the following formula, where the alpha is equal to the number of items between the same number minus one, and this is multiplied by one unit minus the sum values of the individual variances (per item) between the sum of the total variances (per participant):

$$\alpha = \frac{k}{k-1} \left[1 - \frac{\sum v_i^2}{v_1} \right]$$

Then, the analysis processes apply this formula, and the validity of the instrument corresponds to the feedback received by students, regarding the writing of the items, as well as the experts in educational innovation who supervised its elaboration. This process considered ethical aspects, such as the confidentiality of student data, as well as their responses. Also, this research does not seek to judge or evaluate the educational platform, but to test the reliability of an instrument based on the perceptions of the participants' experience.

4. Results

In this space, the results of the piloting of the instrument carried out with the student teachers are presented. First, the statistical data is presented, and then, the psychometric information of the instrument.

4.1 Statistical information of the application in the sample

Statistical information was obtained from the implementation of the instrument to identify the conceptions of innovation regarding the educational platform implemented. Table 3 shows the summary information of this application, the data summarized for each item is presented, the aspects considered are: mean, mode, median, and variance.

Table 3. Statistical description

Items	Mean	Mode	Median	Variance
1	2.8	3.0	3.0	0.5
2	3.0	3.0	3.0	0.2
3	3.1	3.0	3.0	0.5

4	2.0	2.0	2.0	0.2
5	3.1	3.0	3.0	0.4
6	2.8	3.0	3.0	0.3
7	2.9	3.0	3.0	0.5
8	2.6	3.0	3.0	0.4
9	2.7	3.0	3.0	0.4
10	3.4	4.0	3.0	0.4
11	3.1	3.0	3.0	0.5
12	2.7	3.0	3.0	0.7
13	2.7	3.0	3.0	0.3
14	2.5	3.0	3.0	0.6
15	2.8	3.0	3.0	0.5
16	3.1	3.0	3.0	0.5
17	3.1	4.0	3.0	0.8
18	2.2	2.0	2.0	0.9
19	2.1	2.0	2.0	0.7
20	2.5	2.0	2.0	0.3
21	2.7	3.0	3.0	0.4
22	2.9	3.0	3.0	0.5
23	3.9	4.0	4.0	0.1
24	2.7	3.0	3.0	0.8
25	2.7	3.0	3.0	0.4
26	2.7	3.0	3.0	0.6
27	3.1	3.0	3.0	0.6
28	1.9	2.0	2.0	0.8

From the previous table, it is possible to get an idea of what the perceptions of the students who participated in the questionnaire have been. In the case of the change/novelty dimension, that is, from items 1 to 8, the range of the means is between 3.1 and 2.0, which indicates that the students agree and mildly agree about the change or the novelty that the platform represents in their education.

In the case of the second dimension, added value -items from 9 to 16- the results of the means go from 2.7 to 3.4. There are mild agreement and agreement. These results exceed, on average, 0.3 perceptions of novelty, so that it is perceived less as a novelty, but more as an added value to improve their learning.

Regarding the types of innovation, items 17 to 28, the participants were more oriented to consider the platform as a disruptive innovation (items 23 to 25), since the means are 3.9, 2.7 and 2.7; then systematic innovation follows (items 20 to 22) with results of 2.5, 2.7 and 2.9, third continuous innovation (items 17, 18 and 19) with 3.1, 2.2 and 2.1, and lastly open innovation (items 26, 27 and 28) with 2.7, 3.1 and 1.9. However, a discriminant function concerning the four types of innovation is not identified.

4.2 Psychometric information about the instrument's characteristics

According to the method proposed, this study seeks to identify the internal consistency (reliability) of the educational innovation assessment instrument to identify errors in the measurement. To

do this the Cronbach's alpha was calculated; Table 4 shows the results by dimension, as well as the global Cronbach's alpha.

Table 4. Psychometric reliability results

Dimensions	Cronbach's Alfa	Global Cronbach's Alfa
Change/novelty	0.62	0.83
Added value	0.76	
Type of innovation	0.59	

As shown in table 4, the global Cronbach's alpha is 0.83. The Cronbach's alpha for each of the dimensions was also calculated. The dimension with the highest result is the added value with 0.76, followed by the change/novelty dimension with 0.62, and finally, the dimension with the lowest alpha was type of innovation with 0.59.

5. discussion

From the analysis of the results of the application of the instrument, as well as its psychometric information, in this section, the discussion regarding the conceptual framework addressed in the first section is presented. The design of the instrument was based on the identification of the elements and types of innovation to assess innovative objects applied in educational contexts.

The instrument helped to define the degree of innovation perceived by the participants of the object. The results of the questionnaire (Table 3), show that the change/novelty dimension has an average of 2.78 on the Likert scale and the added value dimension had an average of 2.8. It has been mentioned that changes are reflected in changes in planned teaching and learning and that it is possible to transfer them beyond their context [4, 5] and that it is something more than just a change [6], that is, it generates an added value [9]. Therefore, it could be inferred that students do not consider the object with a high degree of innovation, but rather in a medium degree.

The study showed that the innovative object, in this case, the educational platform, maintains an orientation towards disruptive innovation. Table 3 shows the means of the summarized responses; on average it gives a result of 3.1. It is necessary to remember that disruptive innovation involves great changes in processes, which usually include models with sophisticated technologies and products, generally of new technologies [25, 31, 37]. It is worth noting that the participants made their assessment thinking about their context, this could be an explanation of why in the previous dimension the educational platform is considered as having a medium degree of innovation, and in this case, it is deemed to be disruptive. Then, it should be noted that the platform is the first technological resource integrated into their institution as a learning resource.

The presented instrument is useful for the valuation of innovative objects in education from the perspective of its users, and its internal consistency has a result considered reliable. Table 4 shows that the global Cronbach's alpha is 0.83; this result indicates that the reliability is high since it is in the range of [0.66, 1.00]

[19]. Unlike the instruments shown in other references [14, 28, 30], this instrument can be used for any innovative object in education.

Regarding the educational platform evaluated, it is necessary to review aspects of the established teacher's appropriation to take advantage of its functionalities efficiently. In Table 3, the averages of the items of the added value give an average of 2.8, that is, they approach the 'agree' response. It is considered that the teacher's appropriation of the platform is fundamental for the achievement of learning [4], to note the added value offered by the implementation of this change in learning outcomes and perceptions [8]. Thus, it is necessary to check whether aspects such as teacher appropriation affect the perception of value for learning in this case.

Conclusion

In this work, the design of an instrument to assess innovative objects in education has been presented; there was a pilot applied in the evaluation of an educational platform implemented in a teacher training school. This instrument is structured in three dimensions: change/novelty, added value and type of innovation. This article provides valuable knowledge for those interested in the user's perceptions regarding educational innovation implemented in different kind of educational organizations. The results show that global measurement maintains high reliability. For future applications, the results obtained in the first and third dimensions of the instrument should be reviewed, and those items that cause conflict regarding the reliability of the dimension should be identified. It is also convenient to calculate the validity, for example, of the dimensions presented in this design.

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