Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v14i28.1814

Scientific articles

Instrumento para evaluar la percepción sobre la infraestructura física y virtual en las organizaciones: diseño y validación

Instrument to evaluate the perception about of physical and virtual infrastructure in organizations: design and validation

Instrumento para avaliar a percepção da infraestrutura física e virtual nas organizações: desenho e validação

Sergio Ivan Lopez Domínguez
Universidad Juárez del Estado de Durango, México
ivanlodo1990@hotmail.com
https://orcid.org/0000-0001-5764-3160

Jesús Guillermo Sotelo Asef
Universidad Juárez del Estado de Durango, México
chuy_sotelo@hotmail.com
https://orcid.org/0000-0002-0560-866X

Manuela Vargas Hernández
Universidad Juárez del Estado de Durango, México
mimi.vargas@ujed.mx
https://orcid.org/0009-0007-4502-9025

Resumen

La infraestructura física y virtual son aspectos importantes por evaluar en las organizaciones, ya que, en caso de no hacerlo, pueden surgir deficiencias en las operaciones, el equipo y el mobiliario no funcional, así como escaso control de datos y recursos electrónicos y poca adaptabilidad tecnológica, entre otros. Por eso, el objetivo de este trabajo es diseñar y validar un instrumento que recolecte información relacionada con la percepción sobre infraestructura en una organización. Para ello, se empleó un enfoque cuantitativo, transversal, correlacional, no exploratorio y descriptivo. La metodológica consistió en un panel de expertos que validó el contenido, así como en un análisis factorial que validó el constructo usando la prueba KMO (Kaiser Meyer Olkin) y la

esfericidad de Bartlett. Además, con el coeficiente alfa de Cronbach se obtuvo la confiabilidad del instrumento. Después de aplicar la prueba piloto a 58 individuos, el resultado fue el siguiente: KMO 0.738, esfericidad de Bartlett 0.000 y coeficiente alfa de Cronbach de 0.942 para el instrumento completo. Finalmente, los hallazgos permitieron determinar el incremento de cuatro a seis dimensiones propuestas por ISO con su respectivo coeficiente alfa de Cronbach, denominadas procesadores de información (0.882); ciberseguridad y telecomunicaciones (0.887); dispositivos electrónicos, servicio de internet y transporte (0.865); espacio físico y virtual (0.809); intercambio y almacenamiento de información (0.724); ergonomía y ventilación en el espacio de trabajo (0.861). En síntesis, la principal contribución es un instrumento pertinente y con rigor científico para el uso general en la comunidad académica y cualquier sector productivo.

Palabras clave: validez, instrumento de medida, percepción, organización.

Abstract

The physical and virtual infrastructure are important aspects to evaluate in organizations, since, if not, there could be deficiencies in operations, non-functional equipment and furniture, poor control of data and electronic resources, poor technological adaptability, to mention a few. Therefore, in an era of increasing remote work, technological dependence and demand for adequate conditions in the working area. The objective is to design and validate an instrument that collects information related to the perception of infrastructure in an organization, under a quantitative, cross-sectional, correlational, non-exploratory and descriptive approach. The methodology was: panel of experts validated the content; second, factor analysis validated the construct, using the KMO test (Kaiser Meyer Olkin) and Bartlett's sphericity; third, the reliability of the instrument was obtained with Cronbach's Alpha coefficient. The result, after applying the pilot test to 58 individuals was: KMO 0.738; Bartlett's sphericity 0.000; Cronbach's Alpha coefficient of 0.942 for the complete instrument. Finally, the findings and conclusions are the increase from four dimensions proposed by ISO to six, with their respective Cronbach's Alpha coefficient, called: information processors (0.882); cybersecurity and telecommunications (0.887); electronic devices, internet service and transportation (0.865); physical and virtual space (0.809); information exchange and storage (0.724); ergonomics and ventilation in the workspace (0.861). The main contribution is an instrument with scientific rigor, relevant for general use in the academic community and any productive sector.

Keywords: validity, measuring instrument, perception, organization.

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Resumo

As infra-estruturas físicas e virtuais são aspectos importantes a avaliar nas organizações, pois, caso não o façam, podem surgir deficiências nas operações, nos equipamentos e no mobiliário não funcional, bem como um mau controlo dos dados e dos recursos electrónicos e uma fraca adaptabilidade tecnológica, entre outros. Portanto, o objetivo deste trabalho é projetar e validar um instrumento que colete informações relacionadas à percepção de infraestrutura em uma organização. Para isso, utilizou-se uma abordagem quantitativa, transversal, correlacional, não exploratória e descritiva. A metodologia consistiu em um painel de especialistas que validou o conteúdo, bem como uma análise fatorial que validou o construto por meio do teste KMO (Kaiser Meyer Olkin) e esfericidade de Bartlett. Além disso, a confiabilidade do instrumento foi obtida por meio do coeficiente alfa de Cronbach. Após aplicação do teste piloto em 58 indivíduos, o resultado foi o seguinte: KMO 0,738, esfericidade de Bartlett 0,000 e coeficiente alfa de Cronbach de 0,942 para o instrumento completo. Por fim, os resultados permitiram determinar o aumento de quatro para seis dimensões propostas pela ISO com seus respectivos coeficientes alfa de Cronbach, denominados processadores de informação (0,882); cibersegurança e telecomunicações (0,887); aparelhos eletrônicos, serviço de internet e transporte (0,865); espaço físico e virtual (0,809); troca e armazenamento de informações (0,724); ergonomia e ventilação no ambiente de trabalho (0,861). Em resumo, a principal contribuição é um instrumento relevante e com rigor científico para uso geral na comunidade acadêmica e em qualquer setor produtivo.

Palavras-chave: validade, instrumento de medida, percepção, organização.

Reception date: September 2023 **Acceptance Date:** February 2024

Introduction

Contemporary society develops in an increasingly complex environment marked by a global interrelation. In this context, organizations and companies constantly seek to improve by focusing on key aspects such as both physical and virtual infrastructure. However, Gallo-León (2017) points out that evaluating infrastructure is presented as a complex challenge due to the need to consider criteria that transcend only the technical aspects, although he also highlights a growing interest in recent years in evaluating it, driven by concern for maintaining quality standards.

In this sense, work has been carried out in various fields to assess infrastructure for different purposes. For example, Salazar-Otálora *et al* . (2023) emphasize the importance of infrastructure in companies, since it contributes to better performance and performance, although they also indicate that evaluating its current state involves not only assessing physical-technical aspects, but

also estimating its general functionality, since this could contribute to create a more conducive work environment and improve employee performance.

In the educational field, research such as that of Quesada-Chaves (2019) and Pacheco-Martínez (2021) focuses on examining the efficiency of infrastructure in order to optimize student performance. Furthermore, in the health sector, studies such as those by Candía and Olivera (2021), Amon *et al*. (2022) and Kobeissi and Hickey (2023) deal with hospital and administrative infrastructure, although it should be noted that these works usually analyze structural aspects such as the state of buildings, electrical installations and other substructures, as well as accessibility and management. of waste, etc.

Depestre stands out. *et al*. (2021), which addresses the evaluation of road infrastructure from an architectural perspective. For their part, Shun -Lin *et al*. (2023) focus on assessing aspects related to optimal and effective infrastructure in the construction sector. Likewise, Frederiksen *et al*. (2021) analyze the feasibility of designing public infrastructure adapted to the needs of citizens, such as schools, daycares, and large public buildings. These inquiries present different approaches by not considering aspects directly related to individual perceptions of needs in a specific work environment.

On the other hand, it can be noted that there is a gap in the literature in terms of studies that provide tools to evaluate organizational infrastructure from the perspective of individuals. In this sense, the ISO 9001:2015 standard can be a useful guide, as it provides elements to guarantee operational effectiveness. One of its objectives is to ensure that organizations carry out their activities effectively, considering technical and management aspects (Mercader -Alarcón *et al*., 2023) and flexibility to adapt to both internal and external changes (Tebar -Betegon *et al* ., 2021). If the guidelines of this standard are followed, the performance of both employees and the organization is promoted, which would strengthen its image and increase its competitiveness (Ulloa -Bocanegra *et al*., 2020).

Therefore, in this research the dimensions proposed in chapter seven on support of the ISO 9001:2015 standard will be used, which are an integral part of the infrastructure. The overall objective of this study is to design and validate an instrument that is useful for a variety of companies and organizations, with a scope that spans the public, private and social sectors. The study aims to be a starting point to address a currently relevant topic, since work can be in-person, virtual or hybrid (Ammar *et al* ., 2021), so it is essential that the infrastructure is prepared to face current challenges.

Consequently, it is essential to develop a theoretical basis that supports this instrument, starting with the definitions of infrastructure in the literature, as well as the aspects inherent to it.

Infrastructure in organizations includes both material and non-material elements, which are designed according to individual needs and the objectives of organizations in order to facilitate work (Miranda *et al* ., 2017). On the one hand, the Mexican Official Standard [NOM-001] (2008) describes physical elements such as buildings, premises, facilities and various areas where tasks are carried out, from production to storage or provision of services. On the other hand, De Oliveira *et al* . (2018) identify individual and shared physical spaces, such as receptions, lounge and conference rooms, special facilities and parking lots, among others.

From the above it can be inferred that the infrastructure integrates physical and virtual aspects to facilitate the performance of tasks in the production and provision of services in order to achieve the organization's objectives. In the words of Rivas-Hernández *et al* . (2017), adequate infrastructure promotes people's well-being and is reflected in better service to users. That is, an optimal environment with functional tools that support task execution and service delivery can improve both the quality and personal development of the worker.

Regarding the tools and elements that make up the infrastructure, the International Organization for Standardization standard [ISO 9001] (2015) explains that it is the environment where processes are carried out with the aim of offering quality products and services. Some of them are buildings and their associated services, furniture and computer equipment, transportation equipment and information and communication technologies (ICT). These four elements, mentioned by the ISO, will form the dimensions of the *infrastructure variable* in this work.

Now, this infrastructure that includes buildings and offices must be adequate and provide comfort features. Therefore, according to Prieto (2012), offices must meet basic ventilation requirements, both mechanical and natural, as well as have space for activities other than those required by work, which can enhance work performance and performance. Although infrastructures built for other purposes are sometimes used as offices, care must be taken to ensure that they meet the specifications that people demand in terms of design and functionality.

Additionally, it is imperative to have functional furniture and equipment, as many organizations still use outdated computer equipment. In addition to this, the furniture must be ergonomic (Koma *et al* ., 2019), while computer equipment, printers, scanners and others must be constantly updated (Stair and Reynolds, 2010). In addition, it is crucial to improve the internet connection and the service distributed in the organization, given the growing dependence on activities that can currently be carried out remotely.

In line with this idea, Abualoush *et al*. (2018) highlight the importance of including elements such as information technology and a variety of tools and *hardware in the infrastructure* to ensure efficient performance, hence Yamoah *et al*. (2019) emphasize that infrastructure must

mainly take into account management and technological aspects. In other words, it is essential to understand and give relevance to these elements, since it is necessary to face the challenges in a technological environment that is constantly evolving.

According to Peña-Casanova and Anías-Calderon (2020), there is currently growing complexity, as well as greater diversity and size in infrastructures related to information technology, which has driven the emergence of comprehensive management that reflects the characteristics of a standardized and structured infrastructure.

Materials and methods

The methodological route followed for the present study was the following:

1. Design: The research was carried out using a correlational, cross-sectional quantitative approach with a descriptive, but not exploratory, scope.
2. Participants: The panel of experts was made up of 20 individuals, while the pilot test was applied to a sample of 58 people.
3. Instrument: The instrument was designed based on the guidelines of the ISO 9001:2015 standard.
4. Procedure: To validate the content of the instrument, it was subjected to evaluation by the panel of experts, who analyzed criteria of clarity, relevance and relevance of the items (Álvarez-Ríos *et al*., 2019). Based on the results obtained, adjustments were made to the items as necessary. To validate the construct of the instrument, factor analysis was applied using the KMO technique and Bartlett's sphericity test (De Clifford - Faugère *et al*., 2022). In addition, Cronbach's alpha coefficient was calculated to analyze the reliability of the instrument (Hernández-Sampieri *et al*., 2014; Supo, 2013). On the other hand, it is important to highlight that validating the content, construct and reliability is vital to guarantee the scientific rigor of a measurement instrument (Bautista-Díaz *et al* ., 2022). Finally, the components resulting from the analysis were proposed.
5. Data analysis: The results obtained were analyzed using IBM SPSS 25 *software*.

Procedure

The instrument was built following the ISO 9001:2015 standard, which proposes four dimensions for the *infrastructure variable*, as shown in table 1 of the supporting chapter. Initially, the number of items was 43.

Table 1. Variable operationalization

Variable	Dimension	Factor	Definition	items
Infrastructure	Buildings and associated services	Offices	Common work area where authorized project members and colleagues can share documents, publications, models, calendars, spreadsheets, photographs and any form of information to stay up to date on the status of projects or topics of common interest (Stair and Reynolds, 2010).	I1, I2, I3
		Internet	A set of interconnected networks that exchange information freely (Stair and Reynolds, 2010).	I4
		Grid	Computers and equipment that connect across a building, across a country, or around the world to enable electronic communications (Stair and Reynolds, 2010).	i5
		Cybersecurity	Availability is the property of being accessible and usable on demand by an authorized entity. Confidentiality is the property of information not being available or disclosed to unauthorized individuals, entities or processes , while integrity is the property of safeguarding the accuracy and completeness of assets (International Organization for Standardization [ISO 27000], 2018). .	I6, I7, I8
		Internet telephony or telephone switch (PBX)	Technologies that use Internet Protocol packet switched connections for voice service (Laudon and Laudon, 2012).	I9

Variable	Dimension	Factor	Definition	items
	Equipment, including hardware and software	Computer equipment (*hardware*)	Relatively small, inexpensive, and enormously versatile single-user computer, or single-user computer that provides ease of portability due to its small size (Stair and Reynolds, 2010)	I10, I11
		Office furniture	Desks, chairs, tables, bookcases, etc. are considered furniture and equipment. (Lara-Flores, 1999).	I12, 113
		Ventilation equipment (air conditioning)	For work center premises, such as offices, […], where artificial ventilation is available for the comfort of workers or for the requirements of the activity in the work center (NOM-001, 2008).	I14, I15
		Servers	A computer specifically optimized to provide software and other resources to other computers over a network (Laudon and Laudon, 2012).	I16
		Software	All associated documents and data configuration that are needed to make these programs operate correctly (Sommerville, 2011).	I17
	Transportation resources	Vehicles	Physical asset […] that is used to serve a business or organizational function (Hastings, 2010)	I18
		Devices for information transfer (USB,	Process that allows the sending and receiving of documents in a digital format without having to be printed (although printing is possible) (Stair and Reynolds, 2010).	I19

Variable	Dimension	Factor	Definition	items
		hard drive, etc.)		
	Technology of the information and communication	Information storage	Cloud storage or *cloud Storage* is the space to collect data, information, digital objects and others that are accessed over the Internet through a web service, using a browser (Vázquez-Moctezuma, 2015).	I20
		Information exchange	It is the ease of exchange of ideas and documents, as well as teamwork between people who are located at small or great distances. Examples: • Email: Outlook, Hotmail, Yahoo, Gmail, Live and institutional. • Instant messaging: WhatsApp, Hangouts, Messenger, Snapchat, Telegram, Line, Skype, Vibre. • Social networks: Facebook, Twitter, Instagram, Blog, Vine, Tumblr (Gerhard *et al* ., 2017).	I21, I22, I23
		Information control	When the organization uses documented information managed by software-based systems, it must control its changes, as well as address information security issues (International Organization for Standardization [ISO 10013], 2021).	I24, 125
		Information processing	They can be general purpose applications, which can be used for a wide variety of tasks, such as accounting, administration and word processing (Ortega-Arjona, 2000).	I26, I27

Variable	Dimension	Factor	Definition	items
		Digitization	Its objective is that information of different types (sounds, text, images, animations) is transmitted by the same media as it is represented in a single universal format (Ayala and Gonzales, 2015).	I28
		Video conference	Telecommunications system that combines video and telephone call capabilities with data or document transmission (Stair and Reynolds, 2010).	I29

Note: In equ als item; The number corresponds to the item.

Source: self made

The specific objective one of the study focused on the content validity of the instrument, for which a panel of experts was carried out according to the methodology described by De Clifford - Faugère *et al*. (2022). This panel was made up of 20 people with experience in areas of quality research and organizational management, who occupy management roles in quality areas. The 20 panelists are affiliated with the Juárez University of the State of Durango, and the meeting took place at a higher education institution.

Each item of the instrument was evaluated using the criteria of clarity, relevance and relevance (Martínez - Ques *et al*., 2022). To do this, a Likert-type scale was used, where the value one represented “strongly disagree”, two “disagree”, three “neither disagree nor agree”, four “agree” and five “very much”. agree” (Sánchez -Sánchez, 2021), a scale commonly used in the area of social sciences (Matas, 2018).

After carrying out the panel of experts, the analysis of the recommendations led to a reduction in the number of questions in the instrument (from 43 to 29). Subsequently, a pilot test was carried out, also using a Likert-type scale as previously mentioned.

The sample chosen in the study was deterministic, selected according to the need of the study (Sánchez -Correa *et al*., 2021), and included the participation of 70 people belonging to public, private and social organizations. The questionnaire was distributed through Google Forms , and although it was not answered by all individuals, for the purposes of the pilot test it was decided to work with 58 completed questionnaires.

To meet specific objective two, which was to validate the construct of the instrument, factor analysis was used using the KMO technique and Bartlett's test of sphericity. According to Almenares -Rodríguez *et al*. (2022), factor analysis verifies that the variables respond to the theory that supports the survey. On the other hand, Varimax rotation was used to allow a precise interpretation of the components, so that the weight of the coefficients between variables and factors could be weighted (Contreras -Bravo and González-Méndez, 2022). This method facilitates independence between components through the matrix of rotated components and the Varimax rotation method, which allows determining the factor loading of each of the items and grouping them for a better analysis by component (Barrera -Ovando *et al*., 2023).

In relation to the third specific objective, the reliability of the instrument was determined using Cronbach's alpha coefficient (Bonett and Wright, 2014), which is widely used in research in the area of social and organizational sciences and aims to measure consistency. internal of the instrument (Dueñas -Peña *et al*., 2022).

Results

Content validity

The panel of experts was in charge of evaluating structural aspects of the instrument, such as questions with leading, confusing or misleading elements (Elangovan and Sundaravel , 2021). The results of the evaluation of the 43 items included actions such as grouping items that had the same objective, restating items in their wording, reducing the length of the instrument, avoiding questions that addressed two topics in the same item and limiting the use of technicalities to improve comprehension. For this, the recommendations and suggestions of the experts were taken into account, which resulted in a final instrument composed of 29 items.

For example, in the study by Medina -Parra (2020) it was concluded that six items that did not meet the criteria evaluated by the experts should be eliminated, which resulted in a reduction in the number of items in the instrument. Similarly, in the work of Bernal -García *et al*. (2018), 16 items were eliminated, the dimensions of the instrument were adjusted and six items were corrected in their wording in response to the experts' suggestions. Likewise, in the research by Borboa -Álvarez and Delhumeau -Rivera (2016), questions were merged based on the panelists' observations and items were also eliminated. In the specific case of this study, although it was not recommended to eliminate items, the corresponding adjustments were made according to the experts' suggestions.

Construct validity

Factorial analysis

The validity of the construct is supported by a KMO (Kaiser-Meyer- Olkin) value of 0.738, which exceeds the minimum acceptable threshold of 0.5 (Martínez - Ques *et al*., 2022). For Hong and Yan (2022), a coefficient of 0.6 can be considered acceptable, while the KMO obtained in this study meets the statistical requirement for sampling adequacy.

Bartlett's test of sphericity contrasts the identity matrix with the observed correlation, under the null hypothesis (H0) that the variables are not correlated (p value > 0.05), and the alternative hypothesis (H1) that the variables are correlated (p value < 0.05) (Pizarro -Romero and Martínez-Mora, 2020). In this study, since the significance level is less than 0.05, H0 is rejected, indicating that Bartlett's test of sphericity is significant (Table 2). Once the aforementioned statistical criteria have been met, it is concluded that the factor analysis is feasible to continue with the validation of the construct of the instrument.

Table 2. Bartlett's KMO and Sphericity Test

Kaiser-Meyer- Olkin measure of sampling adequacy		.738
Bartlett's test of sphericity	Approx. Chi squared	1494,651
	gl	406
	Next.	,000

Source: self made

After carrying out the analysis of the 29 items, it is observed that the communalities are greater than 0.5 in the column called “extraction” (table 3). In this regard, it is worth specifying that communalities indicate “the proportion of the variance that is explained by the common factors and is obtained by the sum of the squared factor weights in each of the rows ” (Girarte -Guillén and Del Valle-López , 2020, p. 158). Likewise, the component analysis is based on the assumption that the variations are common and, before performing the extraction, the communalities are found with a value of one (Vega -Falcon *et al* ., 2023). Furthermore, the explanation of the factors must be in an interval from zero to one and must be greater than 0.5 (Botello -Hermosa *et al* ., 2019).

Table 3. Communalities

Communalities	Initial	Extraction
I1	1,000	.793
I2	1,000	.822
i3	1,000	.819
I4	1,000	.716
i5	1,000	.667
i6	1,000	.840
i7	1,000	.846
I8	1,000	.866
I9	1,000	.508
I10	1,000	.750
I11	1,000	.634
I12	1,000	.721
I13	1,000	.783
I14	1,000	.905
I15	1,000	.829
I16	1,000	.712
I17	1,000	.777
I18	1,000	.547
I19	1,000	.787
I20	1,000	.810
I21	1,000	.665
I22	1,000	.680
I23	1,000	.678
I24	1,000	.784
I25	1,000	.762
I26	1,000	.772
I27	1,000	.755
I28	1,000	.729
I29	1,000	.598

Source: self made

As detailed in Table 4, the components show the following behavior:

- The first component explains 40.497% of the variance and consists of five questions.
- The second 9.184% of the variance with four questions.
- The third accounted for 8.056% of the variance and was made up of eight questions.
- The fourth 6.939% of the variance with five questions.
- The fifth accounts for 5.785% of the variance and is made up of three questions.
- Finally, the sixth component explains 3.858% of the variance with four questions.

Table 4. Total variance explained

Component	Initial eigenvalues			Squared charge extraction sums			Rotation sums of charges squared		
	Total	% variance	% accumulated	Total	% variance	% accumulated	Total	% variance	% accumulated
1	11,744	40,497	40,497	11,744	40,497	40,497	4,213	14,526	14,526
2	2,663	9,184	49,680	2,663	9,184	49,680	3,999	13,791	28,317
3	2,336	8,056	57,737	2,336	8,056	57,737	3,815	13,156	41,473
4	2012	6,939	64,676	2012	6,939	64,676	3,641	12,556	54,029
5	1,678	5,785	70,461	1,678	5,785	70,461	2,996	10,330	64,359
6	1,119	3,858	74,320	1,119	3,858	74,320	2,888	9,960	74,320
7	.997	3,439	77,759						

Source: self made

The rotated component matrix takes as a parameter a value greater than 0.40 for the weight of each factor (Nunnally and Bernstein, 1994). Table 5 shows that all factorial weights are greater than 0.40, which allows the integration of the items into each of the new components.

Table 5. Rotated component matrix

	Component					
	1	2	3	4	5	6
I26	.826	.238	.124	.045	.095	.082
I27	.776	.059	.187	.302	-.109	.109
I25	.723	.248	.072	.131	.383	.092
I28	.697	.3. 4. 5	.340	-.021	.056	.065
I24	.666	-.033	.140	.358	.435	-.048
i7	.029	.850	.314	.139	-.039	-.056
i6	.318	.824	.061	.204	.037	.118
I8	.122	.803	.255	.296	.231	.008
I29	.489	.551	.107	-.052	.097	.177
I16	.086	.339	.721	.047	.194	.173
I17	.152	.328	.714	.164	.239	.228
I19	.2. 3. 4	.160	.597	-.189	.540	.152
I10	.486	.256	.576	.245	.105	.213
I11	.251	.022	.558	.102	-.093	.491
I18	.088	-.051	.519	.139	.445	.224
I9	.217	.198	.518	.303	.157	.192
i5	.279	.475	.486	.356	-.017	-.014
I2	.115	.148	.037	.852	.096	.223
I1	.051	.257	.056	.838	.118	.073
i3	.214	.159	.247	.820	.114	.048
I23	.452	-.133	.098	.480	.464	.014
I4	.313	.428	.391	.479	.225	-.031
I21	.007	.095	.012	.298	.746	.106
I20	.083	.360	.362	-.160	.706	.135
I22	.257	-.007	.222	.216	.687	.213
I14	.068	-.030	.101	.119	.147	.924
I15	-.041	.010	.276	-.019	.214	.840
I12	.242	.317	.360	.283	.085	.588
I13	.321	.522	.132	.247	.195	.540

Note: Extraction method: principal component analysis. Rotation method: Varimax with Kaiser normalization. The rotation has converged in 8 iterations.

Source: self made

Regarding the analysis carried out, six components that make up the infrastructure variable were identified, which together explain 74,320% of the variance. Given that the percentage of explained variance is significant and the components have factorial weights greater than 0.40, as well as communalities above 0.50, it is possible to point out that the constructs have an empirical relationship with the theory (Rodríguez -Jasso *et al., 2023) when applying the* Varimax rotation method .

Reliability analysis

To consider the coefficient between acceptable and good, it should be greater than 0.70 (Cortina, 1993; Rave -Gómez *et al*., 2023). In the present study, Cronbach's alpha was 0.942 for the 29 items of the final instrument. Although the ISO 9001 (2015) standard proposes four dimensions, the factor analysis allowed an increase of two to be determined, that is, six dimensions were finally identified that better group the items. The Cronbach's alpha obtained is acceptable for each component (table 6).

Table 6. Final components

Components	Items	Cronbach's alpha
Information processors	I26, I27, I25, I28, I24	0.882
Cybersecurity and telecommunications	I7, I6, I8, I29	0.887
Electronic devices, internet service and transportation	I16, I17, I19, I10, I11, I18, I9, I5	0.865
Physical and virtual space	I2, I1, I3, I23, I4	0.809
Information exchange and storage	I21, I20, I22	0.724
Ergonomics and ventilation in the workspace	I14, I15, I12, I13	0.861

Source: self made

Once the matrix of rotated components was obtained, they were named according to the definition and aspect asked in each of the items integrated into the new components. These designations are based on the review of the reviewed literature that provides basis for each item.

From this, the infrastructure can be evaluated under the six components or factors that the analysis revealed. These aspects offer greater objectivity and clarity for organizations, while the ISO 9001:2015 standard proposes four dimensions, it does not explicitly define or provide specific elements of which each of these dimensions is composed, nor does it provide a method by which can evaluate these elements.

Discussion

Validating and giving rigor to measurement instruments generates confidence in all research. Regarding the panel of experts, Medina -Parra 's (2020) research validates the content by grouping a certain number of experts to make judgments about the appropriateness of the dimensions, questions and, in general, the instrument, although there must be rigor and avoid bias among participants. For their part, Escobar -Pérez and Cuervo-Martínez (2008) and Martínez -Ques *et al*. (2022) use the criteria of clarity, relevance and pertinence to assess each of the items. In this research, the instrument is validated with the three mentioned criteria, meeting the objective of content validity. However, it is not limited to these criteria, since authors such as Dorantes -Nova *et al*. (2016) propose four others: sufficiency, clarity, coherence and relevance, while Best *et al*. (2021) work with relevance, clarity and writing. Regarding the Likert scale, De Clifford -Faugère *et al*. (2022) use five points to evaluate the three criteria. In this research, an analogous process is followed, which highlights the relevance of using the scale in subsequent research.

Likewise, factor analysis provides a relevant adaptation of components, since it better groups the items using the KMO technique and Bartlett's sphericity test, as shown in the studies of Leigh -González. *et al*. (2022), Rave -Gómez *et al*. (2023), and De Groot *et al*. (2023), who meet the KMO adequacy measure greater than 0.5 and significant Bartlett sphericity less than 0.05. With this, the construct in this study is validated. Likewise, the reliability with Cronbach's alpha coefficient obtained is within acceptable values, such as those present in studies by Schuler and Matuszczyk (2022), Fernández- Hernández *et al*. (2022), Bautista -Espinel *et al*. (2022) and Rodríguez -Jasso *et al*. (2023). However, other authors evaluate reliability using the Kuder -Richardson analysis (Terán -Bustamante *et al*., 2020; Durán -Pérez and Lara -Abad, 2021) and McDonald's omega (Moscoso *et al*., 2019; Steger and Hilt, 2023).

Finally, the limitations that emerged are mainly related to the sample used for the pilot test, since people tend not to answer electronic questionnaires, which shows a possible lack of interest in participating. However, it is important to highlight that organizations can raise awareness of the positive impact that infrastructure assessment could have.

Conclusions

The relevance of having instruments that contribute to improving products and/or services, ensuring quality and creating adequate work environments is essential. To achieve this, organizations and companies must collect information, which can be achieved with surveys. Therefore, having a tool is relevant to optimize processes and maintain or increase competitiveness. In the first instance, the instrument met the relevance to collect said information.

On the other hand, it can be stated that in this work the general objective of designing and validating the instrument was achieved. Likewise, specific objective one, which consisted of validating the content through a panel of experts, was carried out satisfactorily. Likewise, specific objective two was met by validating the construct using factor analysis, KMO and Bartlett's test of sphericity; while objective three consisted of the reliability of the instrument, through Cronbach's alpha coefficient.

In summary, the strengthening of instrumental research has allowed the final instrument to be applied in various sectors. However, the criteria of the researcher, the management staff and the academic community to adapt the survey is valid, as long as they maintain the relevant scientific rigor to obtain the most objective results possible.

Among the main findings is the adaptation to six dimensions of the infrastructure variable, proposed by the ISO 9001:2015 standard. The new dimensions were called information processors, cybersecurity and telecommunications, electronic devices, internet service and transportation, physical and virtual space, information exchange and storage, and ergonomics and ventilation in the workspace. The organization that obtains results based on these new dimensions may be able to plan improvements and prioritize those of greatest importance to detect areas where workers show greater discontent and discomfort. In short, the main contribution of the study is the measurement instrument, which has a scope for any sector.

Future lines of research

Future lines of research can focus on applying other statistical techniques to validate the instrument, such as alternative reliability analyzes or internal consistency analysis. Furthermore, the sample could be expanded to confirm the assertion that the proposed instrument has scope in all productive sectors and in different organizational contexts.

Another promising area of research could be to take other elements that are capable of adapting to a quality environment, following the guidelines of the ISO 9001:2015 standard, and evaluate how these elements affect quality perception and organizational performance.

Additionally, the creation of more complex statistical models that involve a greater number of variables could be explored, allowing for more robust results to be obtained.

References

Abualoush, S, Masa'deh, R., Bataineh, K. and Alrowwad, A. (2018). The role of knowledge management process and intellectual capital as intermediary variables between knowledge management infrastructure and organization performance. *Interdisciplinary Journal of Information, Knowledge, and Management*, *13*, 279-309. https://doi.org/10.28945/4088

Almenares-Rodríguez, K., Álvarez-Lauzarique, M. E., Pría-Barros, M. del C., Quelle-Santana, L., Nodarse-Silva, J., Tenorio-Moirón, C. y Gálvez-Medina, D. (2022). Instrumento para identificar barreras ambientales percibidas por personas mayores en el contexto cubano. *Revista Cubana de Medicina General Integral*, *38*(3), 1-17. https://revmgi.sld.cu/index.php/mgi/article/view/1856

Álvarez-Ríos, J. N., Aristizábal-Vélez, P. A., Torres-Pavas, D. M. y Jurado-Alzate, V. (2019). Validación de un instrumento para medir la vulnerabilidad en relación con la capacidad de respuesta de la comunidad ante desastres. *Revista Geográfica de América Central*, (62), 278-301. https://doi.org/10.15359/rgac.62-1.11

Ammar, M., Haleem, A., Javaid, M., Walia, R. and Bahl, S. (2021). Improving material quality management and manufacturing organizations system through Industry 4.0 technologies. *Materials Today: Proceedings*, *45*, 5089-5096. https://doi.org/10.1016/j.matpr.2021.01.585

Amon, C., King, J., Colclasure, J., Hodge, K. and DuBard, C. A. (2022). Leveraging Accountable Care Organization infrastructure for rapid pandemic response in independent primary care practices. *Healthcare*, *10*, 1-5. https://doi.org/10.1016/j.hjdsi.2022.100623

Ayala, Ñ. E. y Gonzales, S. S. (2015). *Tecnologías de la información y la comunicación*. Fondo Editorial de la UIGV. http://repositorio.uigv.edu.pe/bitstream/handle/20.500.11818/1189/Libro%20TIC%20%282%29-1-76%20%281%29.pdf?sequence=1

Barrera-Ovando, C. E., Chán-Quijano, J. G. y Hernández-Triano, L. (2023). Factores de la cultura y del clima organizacional modificadores del desempeño del trabajador académico universitario: un modelo estructural ajustado. *Hitos de Ciencias Económico Administrativas*, *29*(83), 123-147. https://doi.org/10.19136/hitos.a29n83.5667

Bautista-Díaz, M. L., Franco-Paredes, K. y Hickman-Rodríguez, H. (2022). Objetividad, validez y confiabilidad: atributos científicos de los instrumentos de medición. *Educación y Salud Boletín Científico Instituto de Ciencias de la Salud Universidad Autónoma del Estado de Hidalgo*, *11*(21), 66-71. https://doi.org/10.29057/icsa.v11i21.10048

Bautista-Espinel, G. O., Velandia-Galvis, M. L., Ortega-Cadena, N., Amanda-Chaves, C., Ureña-Molina, M. del P. y Gonzales-Escobar, D. S. (2022). Adaptación cultural y validación del instrumento EMCC-14, de competencia cultural en profesionales de salud colombianos. *Index de Enfermería*, *31*(2), 120-124. https://scielo.isciii.es/scielo.php?script=sci_arttext&pid=S113212962022000200015

Bernal-García, M. I., Salamanca-Jiménez, D. R., Perez-Gutiérrez, N. y Quemba-Mesa, M. P. (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

Best, S. R., Ré, N. E., Corcoran, L. y McGuckin, C. (2021). Validez de contenido del Cuestionario de Ciberagresión. *Revista Evaluar*, *21*(2), 1-16. https://revistas.unc.edu.ar/index.php/revaluar

Bonett, D. G. and Wright, T. A. (2014). Cronbach's alpha reliability: Interval estimation, hypothesis testing, and sample size planning. *Journal of Organizational Behavior*, *36*(1), 1-13. https://doi.org/10.1002/job.1960

Borboa-Álvarez, E. P. y Delhumeau-Rivera, S. (2016). Validez de contenido de un instrumento para medir la responsabilidad social de las empresas bancarias. *Revista de Estudios en Contaduría, Administración e Informática*, (12), 1-29. https://www.redalyc.org/articulo.oa?id=637967183003

Botello-Hermosa, A., García-Jiménez, M., Santana-Berlanga, N. del R. y Ruiz-Ferrón, C. (2019). Diseño y validación de un instrumento para medir los conocimientos y actitudes de las mujeres jóvenes ante la menstruación: escala METCON (BOTELLO-HERMOSA 2018). *Feminismo/s*, 33, 225-247. https://doi.org/10.14198/fem.2019.33.09

Candía, A. G. y Olivera, S. M. (2021). Índice de vulnerabilidad del sector salud en México: la infraestructura hospitalaria ante la COVID-19. *Horizonte Sanitario*, *20*(2), 218-225. https://doi.org/10.19136/hs.a20n2.3891

Contreras-Bravo, A. y González-Méndez, R. (2022). Validación de un instrumento evaluativo que mide la competencia lectora con grado de dificultad progresiva mediante la taxonomía de Barret en estudiantes de segundo año medio. *Revista de Estudios y Experiencias en Educación*, *21*(47), 75-95. https://doi.org/10.21703/0718-5162202202102147004

Cortina, J. M. (1993). What Is Coefficient Alpha? An Examination of Theory and Applications. *Journal of Applied Psychology, 78*(1), 98-104. https://doi.org/10.1037/0021-9010.78.1.98

De Clifford-Faugère, G., Laporte, G., Gélinas, C., Lavallée, A., Fontaine, G., Feeley, N., Colson, S. and Aita, M. (2022). French Translation, Adaptation, and Initial Validation of the Nurses' Attitudes and Perceptions of Pain Assessment in Neonatal Intensive Care Questionnaire (NAPPAQ). *Pain Management Nursing, 23*(2), 204-211. https://doi.org/10.1016/j.pmn.2021.04.003

De Groot, B., Gorr, N. D. N., Kret, M. E., Rieffe, C., Tsou, Y. T. and Mendoza-Straffon, L. (2023). Development and preliminary validation of a questionnaire to measure parental support for drawing. *Thinking Skills and Creativity, 47*, 1-14. https://doi.org/10.1016/j.tsc.2022.101228

De Oliveira, D. P., Ribeiro-Dantas, M. L., Cyreneu-da Silva, D. and Dos Santos-Celestino, M. (2018). Application of importance and performance matrix to assess the quality of services provided by business incubators. *Iberoamerican Journal of Entrepreneurship and Small Business, 7*(3), 1-29. https://doi.org/10.14211/regepe.v7i3.704

Dorantes-Nova, J. A., Hernández-Mosqueda, J. S. y Tobón-Tobón, S. (2016). Juicio de expertos para la validación de un instrumento de medición del síndrome de burnout en la docencia. *Ra Ximhai, 12*(6), 327-346. https://www.researchgate.net/publication/309735958_Juicio_de_expertos_para_la_validacion_de_un_instrumento_de_medicion_del_sindrome_de_burnout_en_la_docencia

Dueñas-Peña, A., Campo-Espinosa, C. and Veloza-Lancheros, C. K. (2022). Analysis of Microcredits Impact and Other Types of Financing on Microenterprises in Bogota: Measuring Instruments and Their Validation. *Journal of Language and Linguistic Studies, 18*(4), 292-309. https://www.jlls.org/index.php/jlls/article/view/4986

Durán-Pérez, F. B. y Lara-Abad, G. E. (2021). Aplicación del coeficiente de confiabilidad de Kuder Richardson en una escala para la revisión y prevención de los efectos de las rutinas. Impacto de la pandemia derivada del covid-19. *Boletín Científico de la Escuela Superior Atotonilco de Tula, 8*(15), 51-55. https://doi.org/10.29057/esat.v8i15.6693

Elangovan, N. and Sundaravel, E. (2021). Method of preparing a document for survey instrument validation by experts. *MethodsX, 8*, 1-9. https://doi.org/10.1016/j.mex.2021.101326

Escobar-Pérez, J. y Cuervo-Martínez, A. (2008). Validez de contenido y juicio de expertos: una aproximación a su utilización. *Avances en Medición*, (6), 27-36. https://www.researchgate.net/publication/302438451_Validez_de_contenido_y_juicio_de_expertos_Una_aproximacion_a_su_utilizacion

Fernández-Hernández, J. L., Herranz-Hernández, P. y Segovia-Torres, L. (2022). Actitudes de los profesionales de la salud mental ante la capacidad y el internamiento no voluntario en anorexia nerviosa: construcción, validación y resultados del cuestionario. *ACINOVAN. Revista Colombiana de Psiquiatría, 51*(3), 168-175. https://doi.org/10.1016/j.rcp.2020.11.010

Frederiksen, N., Gottlieb, S. C. and Leiringer, R. (2021). Organising for infrastructure development programmers: Governing internal logic multiplicity across organizational spaces. *International Journal of Project Management, 39*, 223-235. https://doi.org/10.1016/j.ijproman.2021.01.004

Gallo-León, J. P. (2017). La evaluación de infraestructuras y edificios de biblioteca: Faulkner-Brown frente al cuestionario de la IFLA. *Investigación Bibliotecológica: Archivonomía, Bibliotecología e Información, 31*(72), 81-111. https://doi.org/10.22201/iibi.0187358xp.2017.72.57825

García-Depestre, R. A., Dávila-Medina, L. y Alba-Moya, J. E. (2021). Indicaciones sobre la evaluación de la infraestructura de carreteras para Cuba. *Revista de Arquitectura e Ingeniería*, (3), 1-12. https://www.redalyc.org/articulo.oa?id=193969257006

Girarte-Guillén, J. L. y Del Valle-López, J. A. (2020). Validación de un instrumento sobre habilidades informativas. *Apertura. Revista de Innovación Educativa, 12*(1), 152-162. http://dx.doi.org/10.32870/Ap.v12n1.1812

Hernández-Sampieri, R., Fernández-Collado, C. y Baptista-Lucio, M. del P. (2014). *Metodología de la investigación*. McGraw-Hill. https://www.uca.ac.cr/wp-content/uploads/2017/10/Investigacion.pdf

Hong-Zhang, X. and Yan-Li, Ch. (2022). Research on the Influencing Factors of Problem-Driven Children's Deep Learning. *Frontiers in Psychology, 13*, 1-7. https://doi.org/10.3389/fpsyg.2022.764121

International Organization for Standardization [ISO]. (2018). *ISO 27000:2018 Information technology — Security techniques — Information security management systems — Overview and vocabulary*. Ginebra: Suiza. https://akela.mendelu.cz/~lidak/IPI/ISO_IEC_27000_2018.pdf

Kobeissi, M. M. and Hickey, J. V. (2023). An Infrastructure to Provide Safer, Higher-Quality, and More Equitable Telehealth. *The Joint Commission Journal on Quality and Patient Safety, 49*, 213-222. https://doi.org/10.1016/j.jcjq.2023.01.006

Koma, B. S., Bergh, A. M. and Costa-Black, K. M. (2019). Barriers to and facilitators for implementing an office ergonomics programme in a South African research organization. *Applied Ergonomics, 75,* 83-90. https://doi.org/10.1016/j.apergo.2018.09.003

Lara-Flores, E. (1999). *Primer curso de contabilidad* (2.ª ed.). Trillas. https://vparrales.files.wordpress.com/2012/08/14074128-primer-curso-de-contabilidad-elias-lara-flores-trillas-16a-edicion2.pdf

Laudon, K. C. y Laudon, J. P. (2012). *Sistemas de información gerencial* (12.ª ed.). Pearson. https://juanantonioleonlopez.files.wordpress.com/2017/08/sistemas-de-informacic3b3n-gerencial-12va-edicic3b3n-kenneth-c-laudon.pdf

Leigh-González, C., Leigh-González, E. y Gómez-Zuloaga, S. (2022). Aplicación de la escala de afrontamiento frente a riesgos extremos en el profesorado de preescolar en Chile en el contexto de emergencias masivas: estudio de caso. *Revista Educación, 46*(1), 1-16. https://doi.org/10.15517/revedu.v46i1.43853

Martínez-Ques, A. A., Braña-Marcos, B., Martín-Arribas, C., Vázquez-Campo, M., Rumbo-Prieto, J. M., López-Castro, J., Herrero-Olivera, L. y Gómez-Salgado, J. (2022). Diseño y validación de un instrumento sobre calidad de la planificación anticipada de decisiones para profesionales. *Gaceta Sanitaria, 36*(5), 401-408. https://doi.org/10.1016/j.gaceta.2021.11.002

Matas, A. (2018). Diseño del formato de escalas tipo Likert: un estado de la cuestión. *Revista Electrónica de Investigación Educativa, 20*(1), 38-47. https://doi.org/10.24320/redie.2018.20.1.1347

Medina-Parra, R. I. (2020). Validez de contenido de un instrumento de medición de ventaja competitiva del sector hotelero. *NOVA RUA, 12*(21), 1-15. https://doi.org/10.20983/novarua.2020.21.2

Mercader-Alarcón, M., Miralles-Sancho, J., Pérez-Carbonell, A., Nolasco-Guiro, V., Antón-Latour, M. A. y Miras-García, M. M. (2023). Resultado de la implementación de un sistema de gestión de la calidad en base a la Norma ISO 9001:2015 en una unidad de cuidados intensivos quirúrgica. *Revista Española de Anestesiología y Reanimación, 70*(1), 26-36. https://doi.org/10.1016/j.redar.2021.09.013

Miranda, M. L., Muñoz-Campos., A. y Maldonado-Payan, J. C. (2017). La infraestructura física educativa de las escuelas multigrado. *Congreso Nacional de Investigación Educativa. COMIE*, 1-17. https://www.comie.org.mx/congreso/memoriaelectronica/v14/doc/2718.pdf

Moscoso, M. G., Villarreal-Zegarra, D., Castillo, R. y Bellido-Boza, L. (2019). Validez y confiabilidad de la escala de satisfacción de los usuarios de consulta médica ambulatoria en

Perú. *Revista Peruana de Medicina Experimental y Salud Pública, 36*(2), 167-177. https://doi.org/10.17843/rpmesp.2019.362.4621

Norma Oficial Mexicana [NOM]. (2008). *NOM-001 Edificios, locales, instalaciones y áreas en los centros de trabajo-condiciones de seguridad*. https://www.stps.gob.mx/bp/secciones/dgsst/normatividad/normas/nom-001.pdf

Nunnally, J. C. and Bernstein, I. H. (1994). *Psychometric theory* (3.ª ed.). McGraw-Hill. https://kupdf.net/download/nunnally-bernstein-psychometric-theory-3ed-1994_58ed3368dc0d60536bda97f3_pdf

Organización Internacional de Normalización [ISO]. (2015). *ISO 9001:2015 Sistemas de Gestión de la Calidad - Requisitos*. Ginebra: Suiza. http://www.congresoson.gob.mx:81/Content/ISO/documentos/ISO_9001_2015.pdf

Organización Internacional de Normalización [ISO]. (2021). *ISO 10013:2021 Sistemas de Gestión de la Calidad - Orientación para la información documentada*. Ginebra: Suiza. https://cdn.standards.iteh.ai/samples/75736/0c43916d973149f5834ee4581f2ce73a/ISO-10013-2021.pdf

Ortega-Arjona, J. L. (2000). Software: tecnología para el procesamiento de información. *Revista Humanidades.* 1-8. https://www.researchgate.net/publication/294260238_Software_Tecnologia_para_el_Procesamiento_de_Informacion

Pacheco-Martínez, N. J. (2021). Evaluación del impacto de la infraestructura física educativa. *Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 12*(22), 1-34. https://doi.org/10.23913/ride.v11i22.940

Peña-Casanova, M. y Anías-Calderon, C. (2020). Modelo para la gestión de infraestructuras de tecnologías de la información. *TecnoLógicas, 23*(48), 31-51. https://doi.org/10.22430/22565337.1449

Pizarro-Romero, K. y Martínez-Mora, O. (2020). Análisis factorial exploratorio mediante el uso de las medidas de adecuación muestral kmo y esfericidad de bartlett para determinar factores principales. *Journal of Science and Research, 5,* 903-924. https://revistas.utb.edu.ec/index.php/sr/article/view/1046

Prieto, A. (2012). La apertura del espacio de trabajo. *Revista ARQ*, (82), 12-15. http://www.redalyc.org/articulo.oa?id=37525388018

Quesada-Chaves, M. J. (2019). Condiciones de la infraestructura educativa en la región pacífico central: los espacios escolares que promueven el aprendizaje en las aulas. *Revista Educación, 43*(1), 1-19. https://doi.org/10.15517/revedu.v43i1.28179

Rave-Gómez, E. D., Moreno-Hernández, J. E. y Pérez-Castañeda, S. S. (2023). Diseño y validación de instrumento para la internacionalización de pymes, a partir del modelo Uppsala y las capacidades dinámicas. *Economía & Negocios*, *5*(1), 175-193. https://www.doi.org/10.33326/27086062.2023.1.1539

Rivas-Hernández, D. V., López-Ortíz, M. A. y Tobar-Portillo, S. E. (2017). La carencia de infraestructura propia y adecuada en la Policía Nacional Civil (PNC) de El Salvador y sus repercusiones en el desarrollo organizacional y territorial, así como en la atención integral a la ciudadanía, año 2014. *Revista Policía y Seguridad Pública*, *2*(7), 1-60. https://doi.org/10.5377/rpsp.v7i2.5467

Rodríguez-Jasso, A. F., Rodríguez-Jasso, L. de J., Sánchez-Limón, M. L. y Delgado-Rivas, J. G. (2023). Propuesta y validación de instrumento de medición del comportamiento climático en las universidades. *Acta Universitaria*, *33*, 1-23. http://doi.org/10.15174/au.2023.3775

Salazar-Otálora, G. E., Manrique-Joya, G. M. y Cuy-Rojas, A. L. (2023). Capacidades logísticas como factores determinantes para la internacionalización de las pymes: una revisión sistemática de literatura. *Revista CEA*, *9*(19), 1-30. https://doi.org/10.22430/24223182.2126

Sánchez-Correa, L. M., Arroyo-Martínez, S. y Avalos-Pelayo, R. (2021). Diseño y validación de un instrumento teórico-empírico para evaluar la innovación administrativa en la industria de la construcción en vertical en México. *Acta Universitaria*, *31*, 1-14. http://doi.org/10.15174.au.2021.2915

Sánchez-Sánchez, R. (2021). El tema de validez de contenido en la educación y la propuesta de Hernández-Nieto. *Latin-American Journal of Physics Education*, *15*(3), 1-5. https://dialnet.unirioja.es/servlet/articulo?codigo=8358273

Schuler, M. and Matuszczyk, J. V. (2022). A Multi-Domain instrument for safety Climate: Military safety climate questionnaire (MSCQ) and NOSACQ-50. *Safety Science*, *154*, 1-9. https://doi.org/10.1016/j.ssci.2022.105851

Shun-Lin, S., Zhou, A. y Long-Shen, S. (2023). Optimal construction method evaluation for underground infrastructure construction. *Automation in Construction*, *152*, 1-17. https://doi.org/10.1016/j.autcon.2023.104921

Sommerville, I. (2011). *Ingeniería del software* (9.ª ed.). Pearson. https://gc.scalahed.com/recursos/files/r161r/w25469w/ingdelsoftwarelibro9_compressed.pdf

Stair, R. y Reynolds, G. (2010). *Principios de sistemas de información. Un enfoque Administrativo* (9.ª ed.). Cengage Learning. https://dokumen.tips/documents/principios-de-sistemas-de-informacion-un-enfoque-administrativo.html?page=1

Steger, G. E. y Hilt, J. A. (2023). Validez y confiabilidad de la escala de prácticas parentales. *Revista Internacional de Estudios en Educación, 1*(23), 67-86. https://doi.org/10.37354/riee.2023.231

Supo, J. (2013). *Cómo validar un instrumento. Aprende a crear y validar instrumentos como un experto*. Biblioteca Nacional del Perú. https://www.cua.uam.mx/pdfs/coplavi/s_p/doc_ng/validacion-de-instrumentos-de-medicion.pdf

Tebar-Betegon, M. A., Baladrón-González, V., Bejarano-Ramírez, N., Martínez-Arce, A., Rodríguez-De Guzmán, J. y Redondo-Calvo, F. J. (2021). Quality Management System Implementation Base on Lean Principles and ISO 9001:2015 Standard in an Advanced Simulation Centre. *Clinical Simulation in Nursing, 51*, 28-37. https://doi.org/10.1016/j.ecns.2020.11.002

Terán-Bustamante, A., Ramírez-Castillo, C. E. y Martínez-Velasco, A. (2020). Confiabilidad y validez de un instrumento de selección de capital humano. *Revista Mexicana de Economía y Finanzas Nueva Época, 15*, 435-454. https://doi.org/10.21919/remef.v15i3.516

Ulloa-Bocanegra, S. G., Javez-Valladares, S. S., Tello-De la Cruz, E. y Cruz-Salinas, L. E. (2020). Gestión de Calidad bajo ISO 9001:2015 para aumentar la satisfacción del Cliente en C.E.L Conache S.A.C,2020. *Journal of Business and Entrepreneurial Studies*, *4*(3), 1-11. https://www.redalyc.org/articulo.oa?id=573667939006

Vázquez-Moctezuma, S. E. (2015). Tecnologías de almacenamiento de información en el ambiente digital. *Revista e-Ciencias de la Información, 5*(2), 1-18. http://www.redalyc.org/articulo.oa?id=476847248008

Vega-Falcon, V., Leyva-Vázquez, M. Y. y Batista-Hernández, N. (2023). Desarrollo y validación de un cuestionario para evaluar el conocimiento en metodología de la investigación. *Revista Conrado, 19*(S2), 51-60. https://conrado.ucf.edu.cu/index.php/conrado/article/view/3232

Yamoah-Agyemang, D., Wah-Fong, P. S. and Kissi, E. (2019). The influence of organizational infrastructure on organizational efectiveness in the constrution industry. *CIB World Building Congress 2019*, 1-17. https://ira.lib.polyu.edu.hk/handle/10397/88027

Contribution Role	Author(s)
Conceptualization	Jesús Guillermo Sotelo Asef
Methodology	Jesús Guillermo Sotelo Asef the same as Sergio Ivan López Domínguez
Software	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández
Validation	Sergio Ivan López Domínguez.
Formal Analysis	Sergio Ivan López Domínguez
Investigation	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández
Resources	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández
Data curation	Sergio Ivan López Domínguez
Writing - Preparation of the original draft	Sergio Ivan López Domínguez
Writing - Review and editing	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández
Display	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández
Supervision	Jesús Guillermo Sotelo Asef
Project management	Jesús Guillermo Sotelo Asef
Fund acquisition	Jesús Guillermo Sotelo Asef equals Sergio Ivan López Domínguez equals Manuela Vargas Hernández

Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

Annex 1. Measuring instrument

This form has the objective of obtaining information that supports the evaluation of the infrastructure in accordance with point 7.1.3 of the ISO 9001:2015 standard.
You are cordially requested to give your opinion on the degree of appropriateness of the following statements by assigning a value from 1 to 5, where 1 is the minimum value on the scale (Strongly disagree) and 5 is the maximum value (Strongly agree).

No.	Item	Scale				
		1	2	3	4	5
1	I believe that the organization has the appropriate physical and virtual space to share documents					
2	I believe that the organization has the appropriate physical and virtual space to share information related to projects and other tasks.					
3	I believe that the organization has the appropriate physical and virtual space to address issues of common interest.					
4	I believe that the organization provides adequate internet service to perform its functions and exchange information freely.					
5	I consider that the organization provides an adequate network connection to connect computer equipment, allowing electronic communications.					
6	I consider that the organization provides security in computer systems and data protection, for the availability of information so that it is accessible and usable by an authorized entity or individual.					
7	I consider that the organization provides security in computer systems and data protection, for the privacy of the information.					
8	I consider that the organization provides security in computer systems and data protection, for the integrity of safeguarding all assets (tangible and intangible).					
9	I believe that the organization provides adequate switchboard telephony.					
10	I believe that the organization provides adequate desktop computing equipment.					
eleven	I consider that the organization provides adequate multifunctional equipment (printers, scanners, etc.)					
12	I consider that the organization provides ergonomically appropriate office furniture such as: desks, chairs, tables, bookcases, among others.					
13	I consider that the organization provides office furniture in adequate conditions such as: desks, chairs, tables, bookcases, among others.					
14	I consider that the organization provides artificial ventilation (air conditioning or heating) for the comfort of the worker.					
fifteen	I consider that the organization provides artificial ventilation (air conditioning or heating) as a requirement to better carry out the activity.					
16	I consider that the organization provides servers (set of computers) suitable for the execution of *software* (set of programs to perform an infinite number of tasks on a computer.					
17	I consider that the organization provides the associated documents (information) and data so that the *software* (set of programs to perform a multitude of tasks on a computer) operates correctly.					
18	I consider that the organization provides vehicles for transporting personnel					

19	I consider that the organization provides devices (USB, hard drive, among others) for sending and receiving documents in digital format					
twenty	I consider that the organization provides a cloud storage service (virtual storage, for example: Google Drive, Dropbox) to collect data that is accessed over the Internet through a web service, through a browser					
twenty-one	I consider that the organization provides an email (Hotmail, Yahoo , Gmail, Live and institutional) for the exchange of ideas and documents, as well as teamwork between people who are located at small or large distances.					
22	I consider that the organization provides the ease in the use of instant messaging (WhatsApp, Hangouts, Messenger, Snapchat, Telegram , Line, Skype, Vibre) for the exchange of ideas and documents, as well as teamwork between people who meet at small or great distances					
23	I consider that the organization provides the ease of use of social networks (Facebook, Twitter, Instagram, Blog, Vine, Tumblr) for the exchange of ideas and documents, as well as teamwork between people who are at small or great distances.					
24	I consider that the organization uses documented information managed by *software -based systems* (a set of programs to perform an infinite number of tasks on a computer).					
25	I believe that the organization provides tools to control changes in information					
26	I consider that the organization provides programs to process accounting information					
27	I consider that the organization provides programs to process administrative information					
28	I believe that the organization provides tools for different types of information to be digitized (sounds, text, images, animations) and transmitted through the same media.					
29	I consider that the organization provides a telecommunications system that combines video and telephone call capabilities with transmission of data or documents (video conferencing) when necessary					
Observations:						

Source: self made