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Scientific Articles

Diseño y validación de instrumento para evaluar un modelo automatizado de sostenibilidad ambiental como estrategia de calidad científica y sostenible

Design and validation of an instrument to evaluate an automated environmental sustainability model as a strategy for scientific quality and sustainable

Design e validação de instrumento para avaliar um modelo automatizado de sustentabilidade ambiental como estratégia de qualidade científica e sustentável

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Resumen

La validación de instrumentos de recolección de datos mediante jueces expertos fortalece la confiabilidad de resultados en la investigación científica al garantizar la calidad de los datos con preguntas/*ítems* claros, relevantes, coherentes y pertinentes. El objetivo del estudio fue validar el contenido del instrumento de recolección utilizado en el proyecto: "Modelo automatizado para la sostenibilidad de la infraestructura física educativa como estrategia para el desarrollo sustentable en el Instituto Tecnológico de Acapulco" evaluando la pertinencia, redacción y satisfacción de los *ítems* para analizar la factibilidad de implementar el modelo prototipo en instituciones de educación superior. El estudio contempló un análisis descriptivo y explicativo de validación del instrumento basado en el juicio de expertos y el método V de Aiken utilizando la plantilla 4.0 de CIFE 2021, herramienta que genera automáticamente cálculos estadísticos de conformidad con la validez de los *ítems* según la pertinencia, redacción y satisfacción. Los resultados determinaron alta validez del instrumento en pertinencia, redacción y satisfacción al alcanzar un valor de V de Aiken de 0.878 de manera conjunta. En el diseño, se observaron redundancias y desorganización en tres *ítems* con posibilidad de distorsionar sus interpretaciones; lo que requirió mejorar la coherencia y claridad del instrumento adoptando el método de validez del constructo conforme a observaciones del juicio de expertos. En conclusión, validar los instrumentos diseñados por el investigador asegura la recolección de datos precisos, fortalece el análisis, los índices de confiabilidad y calidad de resultados, contribuyendo a la sostenibilidad científica e investigativa.

Palabras clave: Calidad científica, desarrollo sostenible, instrumento de recolección de datos, juicio de expertos, validez de contenido.

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Abstract

The validation of data collection instruments through expert judgment strengthens the reliability of results in scientific research by ensuring data quality through clear, relevant, coherent, and pertinent questions/items. The objective of this study was to validate the content of the data collection instrument used in the project *"Automated Model for the Sustainability of Educational Physical Infrastructure as a Strategy for Sustainable Development at the Instituto Tecnológico de Acapulco"*, by evaluating the relevance, wording, and satisfaction of the items in order to analyze the feasibility of implementing the prototype model in higher education institutions. The study included a descriptive and explanatory analysis of instrument validation based on expert judgment and the Aiken's V method, using the CIFE 4.0 Template (2021), a tool that automatically generates statistical calculations in accordance with item validity in terms of relevance, wording, and satisfaction. The results indicated high instrument validity across these dimensions, achieving an overall Aiken's V value of 0.878. During the design process, redundancies and disorganization were identified in three items, which could distort interpretation; therefore, improvements in coherence and clarity were required by adopting construct validity methods based on expert feedback. In conclusion, validating researcher-designed instruments ensures accurate data collection, strengthens analysis, reliability indices, and result quality, and contributes to scientific and research sustainability.

Keywords: Scientific quality, sustainable development, data collection instrument, expert judgment, content validity.

Resumo

A validação de instrumentos de coleta de dados por meio do julgamento de especialistas fortalece a confiabilidade dos resultados na pesquisa científica ao garantir a qualidade dos dados, com perguntas/itens claros, relevantes, coerentes e pertinentes. O objetivo do estudo foi validar o conteúdo do instrumento de coleta utilizado no projeto *"Modelo automatizado para a sustentabilidade da infraestrutura física educacional como estratégia para o desenvolvimento sustentável no Instituto Tecnológico de Acapulco"*, avaliando a pertinência, a redação e a satisfação dos itens, a fim de analisar a viabilidade de implementar o modelo protótipo em instituições de ensino superior. O estudo contemplou uma análise descritiva e explicativa de validação do instrumento, baseada no julgamento de especialistas e no método

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V de Aiken, utilizando a Planilha 4.0 do CIFE (2021), ferramenta que gera automaticamente cálculos estatísticos de conformidade com a validade dos itens quanto à pertinência, redação e satisfação. Os resultados indicaram alta validade do instrumento, com valor conjunto de V de Aiken igual a 0,878. No entanto, foram observadas redundâncias e desorganização em três itens, com possibilidade de distorcer suas interpretações, o que exigiu o aprimoramento da coerência e da clareza do instrumento, adotando o método de validade do construto conforme as observações dos especialistas. Em conclusão, a validação dos instrumentos elaborados pelo pesquisador assegura a coleta de dados precisos, fortalece as análises, os índices de confiabilidade e a qualidade dos resultados, contribuindo para a sustentabilidade científica e investigativa.

Palavras-chave: Qualidade científica, desenvolvimento sustentável, instrumento de coleta de dados, julgamento de especialistas, validade de conteúdo.

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Introduction

Scientific research aimed at generating knowledge requires rigorous methodologies, precise procedures, and appropriate instruments for data collection. In both qualitative and quantitative research, the data collection process is carried out using techniques and instruments previously defined in the design phase, ensuring that the results are reliable, answer the research question, and guarantee the validity of the study (Cisneros-Caicedo *et al.*, 2022).

Several studies have shown that the validation and reliability of a data collection instrument strengthens methodological rigor, contributes to knowledge, and generates benefits by improving scientific learning processes (Van Wyk, 2020). Validation by expert judges ensures, with solid, verifiable foundations, that the designed instrument is appropriate for collecting accurate data that strengthens the analysis, strategically contributes to methodological sustainability, and enhances the efficiency of relevant research.

Data collection instruments, such as surveys and interviews, are tools designed by the researcher who formulates *items* or questions aligned with the evaluation parameters and/or aspects and the study methodology. These instruments, aimed at a target group, are often answered superficially, with quick responses and without giving due consideration to the study's importance, which reduces the quality of the information obtained. Factors

influencing the quality of responses and the usefulness of the data include context, time available, and level of participation; these factors diminish when the questions lack relevance, present comprehension problems, or are worded in a way that leads to erroneous or confusing interpretations.

The survey is the most widely used technical instrument in social science research, collecting data and information from people regarding characteristics of a subject of study (Salas, 2019). The interview is the data collection procedure associated with qualitative methods, involving interaction between two or more people through conversation or direct opinions. It is the primary tool that aids in understanding beliefs, dimensions, behaviors, and temporality (Vitorelli Diniz *et al.*, 2014).

The design and validation of an instrument allows for the analysis of its transferability to similar research and the planning of learning spaces based on its results in the data and information collection process (Bautista Pérez *et al.*, 2019). The design of a data collection instrument that has been validated through a method determines reliability and consistency during its application after a pilot test (Lozano Monsalve and Villamil López, 2021). A data collection instrument should be validated by expert judges in the field to ensure its improvement, redesign, and effective application in scientific research.

Satisfaction as a content validation criterion depends on the fulfillment and approval of all *items* in the data collection instrument at all stages, including variables and the study's objectives for collecting data and answering the research questions that guide the researchers' relationship. Approval of this criterion also depends on the scientific community's evaluation of the scale, parameters, participants, and other aspects (Haukås *et al.*, 2021).

Ambiguous and irrelevant data obtained through unvalidated instruments lead to problems in data processing and reliability. The lack of validation of an instrument in scientific research tends to generate inconsistencies in the results and erroneous interpretations of the items, as well as biases in the data and the construct's objectives, while also compromising the usefulness of the information.

Mexico's 2019-2024 National Development Plan prioritizes sustainable development, incorporating science and technology to benefit society and the environment. Sustainability has proven to be an essential factor for well-being; and in this context, sustainable development involves designing models based on environmental scenarios, guided by diverse approaches, and legitimizing them through consensus-building techniques to implement them as a sustainable action plan (Gutiérrez Barba *et al.*, 2010).

At the National Technological Institute of Mexico, Acapulco campus, there is concern regarding this issue, and the focus has been on developing strategic projects that contribute to the dimensions of sustainable development. The project "Automated Model for the Sustainability of Educational Physical Infrastructure as a Strategy for Sustainable Development at the Instituto Tecnológico de Acapulco" is an innovative proposal that integrates technologies and strategies to promote energy conservation, environmental stewardship, and the efficient use of resources in the institution's infrastructure. The prototype model was evaluated using instruments designed and applied with digital tools, taking into account social distancing measures due to the COVID-19 pandemic and the new normal. Validation is required to ensure the collection of relevant and reliable information regarding its potential implementation in the educational physical infrastructure.

The validation of an instrument It approximates the precision of the construct by seeking to obtain specific information related to the study. Many researchers are interested in working scientifically with validation (Jara Díaz, 2021). A valid instrument collects quality data that benefits the research process. This design and validation process relies on innovative tools and content validity techniques that facilitate data collection and processing, enabling the generation of truthful, reliable, and timely information. Furthermore, the integration of closed and open-ended questions in automated *Google Forms* contributes to and facilitates more efficient application.

The importance of validating data collection instruments in the scientific research process lies, firstly, in addressing design flaws and, secondly, in reviewing the *items* to identify details related to relevance, clarity in wording, and/or suggestions for improving the questions. Using validated data collection instruments tends to generate more reliable and useful information for the research.

The validation process allows researchers to identify and address areas for improvement, redesign or develop a new instrument, establishing its differentiating characteristics to obtain better data and information, and consequently, more reliable results. Validation of the instrument used in the study of an automated sustainable model for the physical infrastructure of educational institutions by expert judges is of utmost importance because it utilizes applications that determine reliable results due to the researcher's timely intervention.

The purposes of this study were focused on:

1) Analyze and design a relevant and practical validation instrument aimed at expert judges that evaluates the survey and interview instruments that were used in combination for data collection in the research project "Automated model for the sustainability of the educational physical infrastructure of the Instituto Tecnológico de Acapulco (ITA)", considering the development challenges and feasibility of implementing the prototype model in educational institutions.

2) Conduct content validation of the instrument with a group of expert judges, to determine the degree of relevance, writing, satisfaction and suggestions for improvement for each of the *items* or questions of the instrument.

3) Analyze and interpret the results of the evaluation, regarding the relevance, wording and satisfaction of the questions through a pilot group, with the support of automated tools, using the CIFE 4.0 expert judgment format template in accordance with Aiken's V rating index as a measure of *item validity*.

4) To describe in a technical and analytical way the content validity of the data collection instruments used and those redesigned for reuse with greater relevance and efficiency to promote scientific quality and research development.

Literature review

The process of constructing and validating instruments for data collection is a complex issue; where the research question is situated, seeking to systematize the information and propose recommendations based on the scientific literature on an appropriate methodological process to generate reliability and precision, applying various tests with statistical measurement techniques that ensure and guarantee a valid and reliable instrument in obtaining information (Rojas-Apaza *et al.*, 2022).

Measurement instruments are an integral part of research and are useful for generating scientifically sound results when used appropriately. The use of measurement instruments involves diverse resources and methodological stages that require skills and knowledge from different areas; therefore, the researcher must integrate methodologies and skills using tools that involve item design, rating scales, acceptance parameters, and measurement techniques that contribute to content validity *(*Coluci *et al.*, 2015).

The design of an instrument must be formulated with adequate understanding, precision and reliability for good interpretation by the pilot group; for this, it is necessary to quantitatively and qualitatively assess the content questions, taking into consideration the writing criteria and relevance through expert judgment (Martínez and Juárez Hernández, 2019).

The purpose of content validation by experts is to determine the extent to which an instrument designed for research adequately fulfills the content; where a systematic process of what is to be measured is required, involving criteria such as suitability, congruence, importance and transparency; and in this way ensure a valid tool, which comprehensively considers relevant elements and aspects; that biases or omissions in data collection are avoided, and that more solid results can be obtained that favor the reliability of the instrument, the results and the research process (Reyes Valenzuela *et al.*, 2022).

Validating an instrument through expert judgment and Aiken's V method ensures methodological rigor in scientific research, where the items are representative of the research topic. Applying a well-structured validation process will foster a rich foundation and sustained reliability for future research.

In evaluating the *items*, it is necessary to consider criteria such as sufficiency, clarity, coherence, congruence, and relevance, typically assessed on a scale from 1 (does not meet the criterion) to 5 (high level and compliance). An instrument that meets the validity criteria and has an Aiken's V indicator > 0.80 is considered effective and of acceptable relevance for its application. Furthermore, expert evaluation of the wording and formulation, including opinions on the structure of the questions, strengthens the foundation of the instrument's construction, positively impacting the applied research project and decision-making (Arango-Ramírez *et al.*, 2023).

Assessment using virtual tools facilitates the organization and systematization of the information contained in the *items*, as well as the structured record issued by expert judges in categories such as clarity, coherence, relevance, and sufficiency. The reliability of instruments under systematized processes is essential in research because it allows for the collection of relevant data that generate greater impact on the results. This implies making appropriate use of knowledge and organization in activities necessary to guarantee accurate, timely, and rigorous data collection processes (Galicia Alarcón *et al.*, 2017).

Scientific research

Science, technological development and the role of renewable energies demand research under an emerging equilibrium point that places the need to recognize intrinsic rights of a society integrated into a global world that envisions the solid conjunction and sustainability as a valid objective for the well-being of the environment (Perino *et al.*, 2021).

Sustainable development, as a relevant topic focused on the Sustainable Development Goals (SDGs) of the 2030 Agenda, has garnered significant interest among researchers in this field. SDG 4, Quality Education, aims to ensure quality education and promote learning opportunities. Meanwhile, the National Strategic Programs (PRONACES) seek to organize research efforts on specific problems, aiming for urgent attention and comprehensive, in-depth solutions. Addressing social problems through scientific research, using well-supported and validated methodologies, processes, resources, and data collection instruments, contributes to educational and scientific development.

Knowledge management is key to the transformation process, as it accelerates educational innovation by analyzing the effectiveness of practical activities and organizational methods. Several studies highlight that knowledge implementation involves transitioning between states focused on effectiveness and established goals. In this context, the design of relevant and practical questionnaires determines the level of content validity, knowledge, internal consistency, analysis, and improvement of the instrument based on expert judgment analysis for its application to a pilot group participating in the projects (Vázquez González *et al.*, 2020).

The development of projects focused on environmental stewardship has gained relevance due to climate change and the increasing negative environmental impacts that continue to affect society and the planet. A study centered on the validation of data collection instruments, designed to assess the feasibility of implementing a prototype model focused on environmental stewardship in educational institutions, requires evaluation criteria to determine a coherent and appropriate instrument, both in terms of wording and user satisfaction, for collecting reliable data from the target population. This study also relies on tools and indicators of content validity, such as Aiken's V index, applied by expert judges. Aiken's V index ≥0.700 defines the degree to which the items of a scale comprehensively sample the construct to determine acceptable content validity (Penfield & Giacobbi, 2004).

The infrastructure and facilities of public services in the country's surrounding municipalities are mostly old and, therefore, highly inefficient, resulting in high costs and operating expenses, primarily for lighting, water pumping, buildings, and other activities carried out by the Mexican population. For this reason, government administrations face significant challenges in cities that require an efficient and sustainable supply of electricity (SENER-FIDE, 2018).

The prototype model with an environmental care strategy implemented in the physical infrastructure of the Instituto Tecnológico de Acapulco was presented to environmental experts, students, professors and directors as a proposal for energy saving, control and security of resources using innovative technologies with the purpose of evaluating the model, knowing the performance, environmental and economic impact, and the feasibility of being implemented in educational institutions; for which the survey and interview instrument was designed (Bedolla Solano *et al.*, 2020).

The design of an instrument must be validated before its application to the target community to ensure that it collects specific and relevant data and yields reliable results. The design and validation of an instrument contribute to the effectiveness of the construct formulation and ensure the suitability of the content for data collection. Similarly, it provides suggestions for improvement aimed at correcting aspects of relevance and consistency, which, after its application in a pilot test, guarantees the instrument's reliability (García Magallanes *et al.*, 2024).

Validity and reliability of research instruments

The validity and reliability of a data collection instrument depend on the rigor of its design and the use of scales that are understandable and applicable to the target population. The importance of applying methods based on Aiken's V allows for determining content validity through expert judgment, ensuring the appropriateness of the included *items* in terms of variable characteristics, relevance, and clarity to improve wording. Statistical reliability can be estimated using Cronbach's alpha, especially when items are intercorrelated, which *guarantees* the consistency and stability of the measurement for the construct (Rodríguez Ugalde & Díaz Rojas, 2023).

Content validity, estimated using Aiken's V method and expert judgment, yields confidence intervals that reflect the robustness of the *items* in a measurement instrument for its applicability in the research design. Greater content reliability is obtained when

comparative estimates are made between two independent groups of experts, allowing for the identification of variability and strengthening interpretations of the coefficients obtained. In this sense, the use of Aiken's V method quantifies content validity and indirectly contributes to improving the instrument's reliability. This innovative validation process reinforces the methodological rigor and precision of the designed and validated instruments (Merino-Soto, 2023).

Aiken's V technique is a strategic procedure that determines construct congruence and content validity of instruments used to measure evaluative research processes. This method relies on a content validity analysis based on a qualitative review, incorporating observations, comments, and suggestions from expert judges to strengthen the relevance and clarity of the *items*. Applying Aiken's V to content validity facilitates assessment using scales, ensuring the reliability of the instruments used within the research process. This methodological approach to validating similar instruments in diverse academic and professional contexts provides theoretical soundness and construct rigor (Nurjanah et al., 2023).

The review through qualitative evaluation is fundamental because it identifies and corrects aspects of coherence, grammar, and organization in the *items* observed by expert judges. This type of assessment contributes significantly to the redesign of the instrument by offering specific suggestions for modifying wording, eliminating unnecessary questions, improving ambiguous formulations, and proposing new, more precise *items* directed toward the object of study, in relation to the variables and relevance of the construct (Hernández Briones *et al.*, 2024).

Aiken's V method of content validity allows for quantifying the degree of agreement and concordance among judges regarding the relevance of the *items*, with values ranging from 0.00 to 1.00, where 1.00 indicates maximum agreement. Judge participation in the instrument validation process must be voluntary. Participating experts must possess the necessary experience and specialized knowledge in the area or subject matter of the study (Torres-Malca *et al.*, 2022).

Methodology

Type of study

A content validity study was conducted using a descriptive and explanatory approach, applying Aiken's V technique to evaluate the relevance of the data collection instrument *items* using CIFE Template 4.0 (2021), a tool that automates statistical analysis. The instrument, designed for the applied research project, "Automated Prototype Model with a Sustainable Development Strategy," included 33 questions, from which 12 key *items were selected* for validation. The descriptive approach characterized variables in a specific and convenient group of participants (Manterola *et al.*, 2019). Eleven expert judges evaluated the relevance and wording of the *items*, as well as the feasibility of the model for educational infrastructure. Satisfaction was also analyzed, considering the level of compliance, acceptance, and suggestions aimed at improving clarity.

items with the objectives, variables, and characteristics aligned with the research question and the instrument's scale was analyzed. Likewise, the construct's structure was evaluated to verify its clarity, comprehension, and interpretation for the participants, and the formulation of the questions was assessed to minimize bias or response errors. Additionally, the satisfaction observed in the semantics and the degree of agreement of the expert judges regarding the relevance, wording, and fulfillment of the research objectives and purposes was evaluated (Celis Moreno & Vargas Peláez, 2023). From this perspective, content validity verifies and determines the degree to which the content mastery is adequately reflected for the target population and its methodological utility (Carrillo Ruiz & Luna Conejo, 2021).

The research also employed a mixed-methods design, combining quantitative and qualitative approaches, as well as documentary research. The quantitative approach, aimed at accurately measuring the perceptions of the selected population, according to Pasquotto Andreoli *et al.* (2022), was developed using automated statistical techniques with the Excel 4.0 template from the Center for Innovation, Training, and Entrepreneurship (CIFE) and the *Google Forms tool*. The qualitative approach relied on cognitive interviews with expert judges, considering domains of cultural equivalence, comprehensibility, acceptability, relevance, completeness, and technical equivalence that ensure the preservation of the original meaning (Carbajal-Vélez et al., 2023). The purpose was to gather feedback on the design, validation parameters, and suggestions for improving the wording and relevance of the *items*.

Documentary research, regularly present in all studies due to the analysis and study of art, according to Bedolla et al. (2023), is based on methodological knowledge.

Tools

The validation instrument was designed using *Google Forms* and administered to eleven expert judges from various higher education and postgraduate institutions, all with experience in the relevant field of study. Their evaluation assessed the questions regarding relevance, wording, and overall satisfaction, and allowed them to provide comments and suggestions for improving the formulation and clarity of the *items*. A comprehensive survey and interview instrument was designed to gather feedback on the development and implementation of the prototype model, which focuses on environmental stewardship and sustainability in educational physical infrastructure.

Table 1 presents the technical and statistical information of the eleven expert judges who collaborated with the validation of the instrument, where the general data, professional profile and information of scientific production that demonstrate and support the experience of participation in the study are classified in a structured way.

Table 1. Technical and statistical information of the expert judges participating in the study

General Information and Professional Profile		Frequency	Percentage (%)
Gender	*Men*	7	63.6%
	Women	4	36.4%
Education	*Completed PhD*	8	72.7%
	Incomplete PhD	0	0.0%
	Mastery	3	27.3%
	Specialization	0	0.0%
		Average	Standard Deviation (SD)
Age		51.82	10.09
Invitation-only lectures		20.64	14.15
Experience as a reviewer		3.45	0.50
Years of experience	*Teaching*	21.82	9.65
	Investigation	10.55	7.23
Publications	*Articles*	23.64	14.66
	Books	1.45	1.37
	Chapters	3.73	3.39
	Presentations	20.64	14.15
Continuing education	*Courses*	25.00	10.80

Source: Authors' own elaboration. Study conducted during the period: August-December 2021 and January-June 2022.

The instrument focused on specific questions related to the sustainable prototype model project for implementation in educational physical infrastructure, and the appropriate measurement scale for the questions was used. *Google Forms was used*, a tool that facilitated its application and distribution to expert judges. Graphical results of the responses were presented, and the information was exported as an Excel file for validation and technical analysis. The questions were evaluated according to the instrument's scales and assessment indicators, and the information from the proposed implementation of the model for educational institutions was systematically processed.

The level of the validation scales is described with parameters in the range of 1 to 5 such as:

Strongly agree (4.0 - 5.0): This is the highest response and represents the greatest agreement.

Agree (3.0 - 3.9): This is the medium-high response and represents some agreement.

Slightly agree (2.0 - 2.9): This is the low average response and represents little agreement.

Strongly disagree (1.0 – 1.9): This is the lowest response and represents no agreement or not significant.

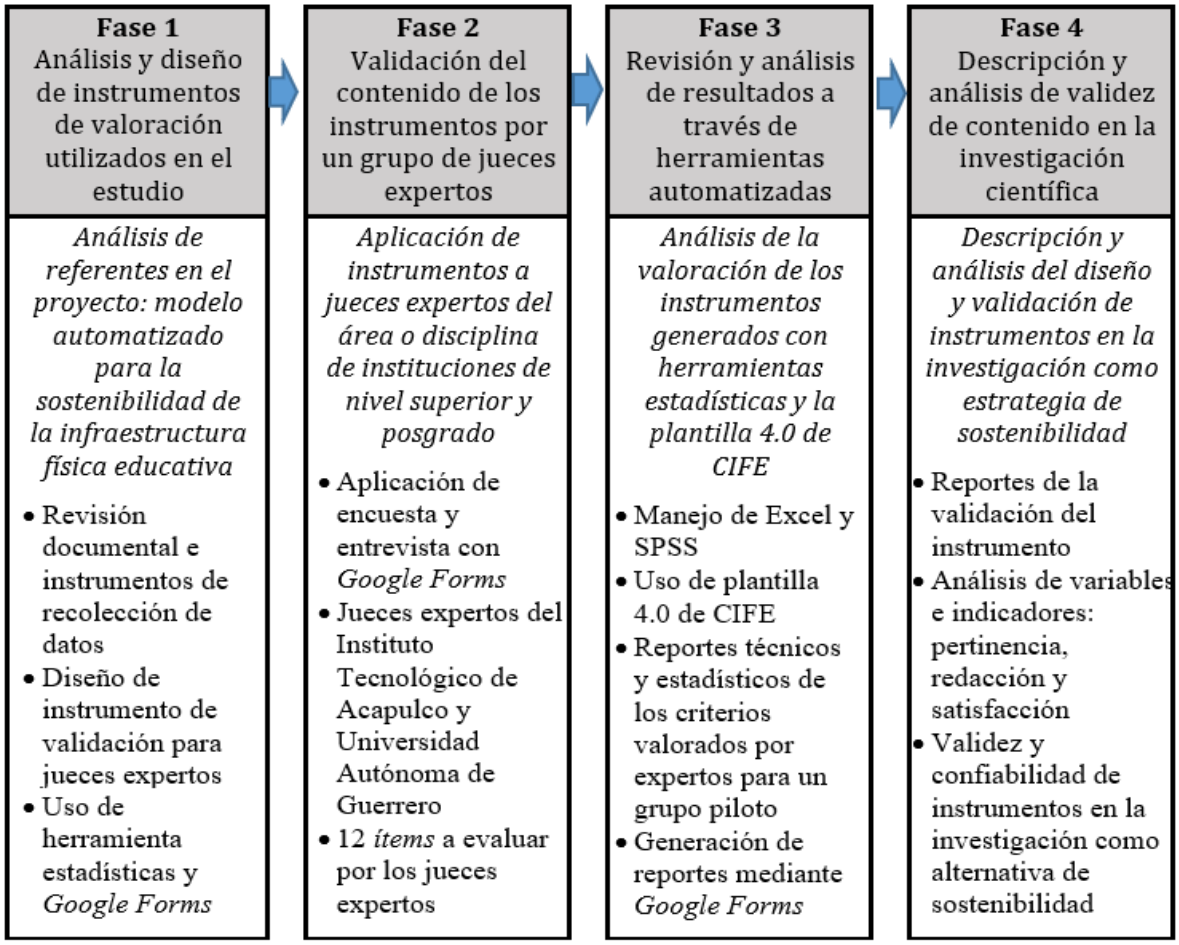
The value 3.0 represents the average level of agreement of the expert judges with respect to the relevance, wording and satisfaction of the *items*.

Aiken's V index >=0.700 establishes the statistical coefficient of content validity that indicates the degree of agreement between the items to determine the acceptance of the validation process.

Procedure

To carry out the development of the project, the process was systematically structured from the analysis and documentary design to the evaluation of the content validity of the data collection instrument used in the assessment of feasibility and relevance of the automated environmental sustainability model, seeking to support its applicability and guarantee scientific quality as a sustainability strategy in educational contexts (Figure 1).

Figure 1. Methodological scheme of the phases and/or stages of project development



Source: Authors' own elaboration.

Phase 1: Analysis and design of assessment instruments used in the study

In the first phase, a documentary analysis was conducted on content validation, the design of data collection instruments, and the use of automated statistical tools such as SPSS, Excel, and *Google Forms*. Initially, the survey and interview instrument used in the project evaluating the feasibility of an automated model focused on sustainability and energy savings for implementation in the physical infrastructure of educational institutions was analyzed. Subsequently, a validation instrument was designed with *items* directed at expert judges from various educational institutions, specializing in their areas of study/disciplines, using *Google Forms*.

The instrument design considered three main criteria for validating the construct *items*: relevance, wording, and satisfaction. For this process, 12 key questions were selected from a total of 33, as they were the most relevant and directly related to the feasibility of implementing the prototype model in educational settings.

Phase 2: Validation of the content of the instruments by a group of expert judges

In the second phase, the validation instrument was applied to experts. Eleven judges with experience in scientific research from the Instituto Tecnológico de Acapulco and the Autonomous University of Guerrero participated. The judges evaluated the 12 selected questions from the project developed in 2021, assessing relevance, wording, and satisfaction on a scale of 1 to 5, where 1 corresponds to a low or unsatisfactory level, and 5 to a level considered highly acceptable. In addition to the evaluation, comments and suggestions were included to enrich the construction of the *items* and improve the wording, formulation, and structure in order to ensure the methodological quality of the instrument.

Phase 3: Review and analysis of results through automated tools

In this third phase, the validation results were analyzed using SPSS, Excel, and the CIFE 4.0 template, which assessed the content validity of the instrument administered to a selected pilot group. The construct analysis presented the results for each of the assessed criteria (relevance, wording, and satisfaction) and their relationship to the parameters determined using Aiken's V. Systematized tables were generated with the content validation results and statistical information such as the arithmetic mean, standard deviation, lower limit, upper limit, and the Aiken's V value. The rating scale was also determined, considering measurement parameters from 1 to 5 to reflect the appropriate levels and degrees of acceptance of the *items*.

The reliability of the instrument was also supported by information obtained from a survey administered to 11 experts (8 PhDs and 3 master's degree holders) in the fields of technology, environment, regional development, and technological innovation, thus integrating a multidisciplinary approach. Finally, the use of automated tools facilitated data processing and the generation of technical and statistical reports that allowed for the comprehensive representation and interpretation of the results in terms of acceptance, validity, and reliability.

Phase 4: Description and analysis of content validity in scientific research

In the final phase of the study, a comprehensive analysis of the design and content validation of the applied instruments was conducted, taking into account the assessments and observations provided by expert judges regarding the *items*. This process allowed for the identification of areas for improvement and the establishment of adjustments aimed at

enhancing the relevance, clarity of wording, and overall satisfaction level of the questions. The validation instrument, designed for the project "Automated Model for the Sustainability of Educational Physical Infrastructure," was analyzed to address the observations for its potential redesign and to adjust questions based on the technical reports and statistical results obtained.

Based on the analysis of results, a technical description of the validation of the data collection instrument was made to highlight the importance of the technique that strengthens the scientific rigor of the research and the direct link with sustainable educational development to provide reliable and replicable strategies that favor the implementation of strategic research projects with environmental actions and positive impact on educational quality and the promotion of institutional sustainability.

Results

The results obtained are presented in an organized manner, in accordance with the purposes and methodological design: analysis and design of the data collection instrument evaluated in a pilot study; content validation of the instrument by expert judges; review and analysis of results through automated tools; and description and analysis of the reliability of instruments in scientific research and educational development as a sustainability strategy.

Analysis and design of the data collection instrument evaluated in a pilot study

The validation construct of the instrument designed to assess the feasibility of implementing a prototype energy-saving model in the physical infrastructure of educational institutions consisted of 33 questions organized into sections using a Likert-type scale, as well as general opinion items administered to a pilot group. Based on the analysis of the instrument, 12 key *items were selected*, considered the most relevant for obtaining accurate, interesting, and significant information during data processing. Based on this analysis and evaluation of the sample, an additional validation instrument was designed for expert judges to ensure the formulation, construction, clarity, and methodological consistency of the selected *items* (Table 2).

Table 2. Data collection instrument. *Items* selected in the study

No.	Wording of the item or question included in the validation instrument
1	Does promoting projects or proposals designed with innovative technologies contribute to technological development and consequently have an economic and social impact?
2	Do you consider that the use of sustainable automated systems provides an efficient use of energy and resources?
3	Does the implementation of home automation engineering and software support the design of smart spaces, and is sustainable architecture also considered?
4	If an automated system with a sustainable strategy were implemented in the infrastructure of educational institutions, would this be promoting sustainable development?
5	Am I aware of any strategic proposals with sustainable actions to be implemented at ITA that could impact social, environmental, and economic development?
6	Does the implementation and contribution of a technological development proposal and strategy for energy saving and resource security offer a sustainable development alternative?
7	Do you believe that automated systems facilitate procedures, contribute to reducing time and costs, and increase productivity?
8	Do you believe that a sustainable automated system addresses environmental and safety issues in an educational institution?
9	Is an automated model with sustainable technology necessary and a priority because it envisions strategies for environmental care and administrative control in educational institutions?
10	Does the development of multidisciplinary and sustainable projects lead to more comprehensive work and promote research in educational institutions by integrating diverse areas?
11	Does the design, development, and implementation of a strategic sustainable development project with automation that contributes to energy and economic savings generate significant contributions for educational institutions?
12	Am I aware of at least one automation project focused on environmental protection carried out at the Instituto Tecnológico de Acapulco?

Source: Authors' elaboration. Sample of key *items* used for the analysis of relevance, writing and satisfaction directed to expert judges, carried out in the period: August-December 2021 and January-June 2022.

The validation instrument was designed as a *Google Forms form* and administered via the *Microsoft Teams platform* as a practical and easy-to-understand questionnaire for expert judges, using closed-ended questions to validate the *items*. Regarding the criteria of relevance, wording, and satisfaction, a measurement scale was applied ranging from 1 (low level of acceptance or unsatisfactory) to 5 (high level of acceptance or greater satisfaction). Open-ended questions were also included to gather opinions on the construction and suggestions aimed at redesigning or improving the wording of the *items* (Table 3).

Table 3. Criteria and rating scales applied for the data collection instrument

Degree of relevance (congruence and coherence of the *items*)	Writing level (clarity, understanding and interpretation of the *items*)	Level of satisfaction (agreement of the expert judges with the *items*)
Scale 1. Problem Analysis. The question is appropriate for the context and purpose of the research.	Scale 1. The question clearly, precisely, and unambiguously defines the objective of what is to be known.	Suggestions for improving scale 1 Comment or suggestion to improve the writing
Scale 2. Critical analysis. The question presents a rigorous and necessary inquiry to achieve the objective	Scale 2. The question is well structured, allowing for the collection of reliable data for subsequent processing and analysis.	Suggestions for improving scale 2 Comment or suggestion to improve the writing
Scale 3. Conceptual analysis. The question aligns with the theoretical framework and accurately defines the variable and its relationship to the objective.	Scale 3. The question defines the precise concepts and ideas to avoid bias, improve the interpretation and formulation of the *items*	Suggestions for improving scale 3 Comment or suggestion to improve the writing
Scale 4. Systemic analysis. The question ensures interaction with the context to address the components of the study in a coherent and relevant manner.	Scale 4. The question is coherent and consistent within the structure of the instrument, allowing for a logical interrelationship to achieve the objective	Suggestions for improving scale 4 Comment or suggestion to improve the writing
Scale 5. Creative analysis. The question possesses originality and innovation to obtain relevant, high-quality data and significant contribution.	Scale 5. The question creatively expresses a clear, objective, and precise structure for obtaining data and information for knowledge.	Suggestions for improving scale 5 Comment or suggestion to improve the writing
General assessment. Assessment of complex thinking skills. The question interacts with the context and recognizes interdependence.	Overall evaluation. The construct structure is appropriate for the population. The wording of the question clearly guides its interpretation and formulation.	Quality of writing. It fulfills its purpose and refers to the agreement of the expert judges.

Source: Authors' elaboration based on the expert judgment validation construct.

Validation of the instrument's content by expert judges

The results of the content validation determined a favorable and sufficient level of relevance for the *items*, obtaining Aiken's V values ≥ 0.700. This confirms that the defined items maintain coherence with the variables and objectives of the study. Likewise, the expert judges accepted the rating scale, whose quantitative scores are above the mean, thus supporting a well-structured and intercorrelated theoretical construct. The validation considered statistical indicators such as the arithmetic mean, standard deviation, lower limit, upper limit, and

Aiken's V calculated with a 95% confidence interval. These results show the relevance assessment of the 12 questions by the 11 expert judges, with 11 valid responses, 0 missing values, as well as the corresponding means and standard deviations (Table 4).

Table 4. Statistical assessment of the relevance of the data collection instrument

Indicator	Relevance 1	Relevance 2	Relevance 3	Relevance 4	Relevance 5	Relevance 6	Relevance 7	Relevance 8	Relevance 9	Relevance 10	Relevance 11	Relevance 12
Valid Values	11	11	11	11	11	11	11	11	11	11	11	11
Lost Values	0	0	0	0	0	0	0	0	0	0	0	0
Average	3.55	3.73	3.64	3.00	3.27	3.64	3.45	3.45	3.18	3.55	3.36	3.55
Standard Deviation	1.036	.647	.674	1.183	.786	.674	.934	1.036	1.168	.688	.924	.688

Source: Authors' elaboration based on statistical tools and construct sampling under Aiken's V coefficient (Penfield and Giacobbi, 2004).

In validating the twelve selected questions, nine were found to have an adequate level of relevance, with Aiken's V values above 0.818. This indicates agreement, clear wording, and acceptable comprehension by the expert judges. Two questions had values of 0.788 for relevance and wording, demonstrating an acceptable level of comprehension, though adjustments may be necessary. However, one question scored 0.667, reflecting low relevance for obtaining specific information. Therefore, it requires redesign and adjustments to its wording to ensure it is understandable by the respondents. These results show that the *items* are consistent and relevant because they meet the criteria for a sound methodological assessment and review, ensuring the instrument's validity and reliability for application to a pilot group (Table 5).

Table 5. Validation of the instrument using the SPSS statistical tool

Validation	Assessment criteria	Average	Standard Deviation	V of Aiken*	Lower Limit*	Upper Limit
Scale 1	Relevance	4.08	2,290	1.028	0.966	0.980
	Drafting	3.55	0.891	0.848	0.691	0.933
Scale 2	Relevance	3.73	0.617	0.909	0.764	0.969
	Drafting	3.64	0.643	0.879	0.727	0.952
Scale 3	Relevance	3.64	0.643	0.879	0.727	0.952
	Drafting	3.73	0.445	0.909	0.764	0.969
Scale 4	Relevance	3.00	1.128	0.667	0.496	0.802
	Drafting	3.36	0.881	0.788	0.622	0.893
Scale 5	Relevance	3.36	0.771	0.788	0.622	0.893
	Drafting	3.45	0.656	0.818	0.656	0.914
Full Scale	Relevance	3.73	0.617	0.909	0.764	0.969
	Drafting	3.73	0.617	0.909	0.764	0.969
	Satisfaction	4.27	1.213	0.818	0.680	0.905

Source: Authors' elaboration, based on the CIFE Excel Template 4.0 tool (Tobón, 2025).

Study conducted in: August-December/2021 and January-June/2022.

Regarding the wording of the questions, the results show an acceptable level, characterized by clear and understandable formulation. Similarly, the correlation applied using CIFE's 4.0 digital template demonstrated the instrument's reliability, supporting its suitability for use in research aimed at evaluating the automated environmental sustainability model as a strategy for scientific and sustainable quality.

Review and analysis of results through automated tools

The analysis of the validation of the data collection instruments, carried out by expert judges in technology, environment, regional development and technological innovation, shows a favorable acceptance; reaching Aiken's V values >= 0.818. In general terms, the relevance and wording of the 12 validated questions obtained a value of 0.909, while satisfaction reached 0.818.

Regarding the rating scales that consider parameters ranging from 1 to 5, the "strongly agree" level (4.0-5.0) represented the highest level of agreement, followed by the "agree" level (3.0-3.9). Lower levels showed fewer responses, indicating some agreement. The

"somewhat agree" level (2.0-2.9) showed little agreement, and the "strongly disagree" level (1.0-1.9), representing no agreement, was not significant. The arithmetic mean (average of the 12 questions) was 3.73 for relevance and wording, and 4.27 for satisfaction. These results indicate an acceptable level of agreement for relevance and wording, and a high level for satisfaction, confirming that the instrument has good validity for use in research and for obtaining specific and relevant data (Table 6).

Table 6. Overall results of the instrument validation regarding the scale and criteria of relevance, wording and satisfaction

Validation	Assessment criteria	Average	Standard Deviation	V of Aiken*	Lower Limit*	Upper Limit
Full Scale	Relevance	3.73	0.617	0.909	0.764	0.969
	Drafting	3.73	0.617	0.909	0.764	0.969
	Satisfaction	4.27	1.213	0.818	0.680	0.905

Source: Prepared by the authors based on the SPSS statistical tool and the CIFE Template 4.0 (Tobón, 2025).

Description and analysis of content validity in scientific research and educational development as a sustainability strategy

The validation instrument applied to expert judges demonstrated content validity and satisfaction, supported by the results of the pilot study, through the use of SPSS statistical tools and the CIFE 4.0 template. Scores obtained for the relevance and wording criteria were above 3.0, exceeding the expected average on a scale of 1 to 5. Similarly, the satisfaction criterion achieved an average rating above the established mean, demonstrating compliance with the *item aspects* and acceptance of the instrument. Overall, most responses were above 3.5, reflecting that the judges gave favorable ratings to the questions, confirming the instrument's relevance, the clarity of the *item wording*, and its level of acceptance for application in research and impact on educational development (Table 7).

Table 7. Assessment of the instrument by expert judges, with respect to the scale

Judge	Scale 1		Scale 2		Scale 3		Scale 4		Scale 5		Full Scale		
	Relevance	Drafting	Relevance	Drafting	Relevance	Drafting	Relevance	Drafting	Relevance	Drafting	Relevance	Drafting	Satisfaction
1	4	4	4	4	4	4	4	4	4	4	4	4	5
2	4	3	4	3	4	3	4	3	4	3	4	4	5
3	4	4	4	4	4	4	4	4	4	4	4	4	5
4	3	4	3	4	2	3	2	3	3	3	4	4	3
5	1	1	2	2	3	3	1	1	2	2	2	2	1
6	4	4	4	4	3	4	3	3	4	4	4	4	5
7	4	4	4	4	4	4	1	4	2	4	4	4	5
8	4	4	4	3	4	4	4	4	4	4	4	4	5
9	4	4	4	4	4	4	3	4	3	4	4	4	5
10	4	4	4	4	4	4	4	4	4	3	4	4	4
11	2	3	4	4	4	4	3	3	3	3	3	3	4

Source: Authors' elaboration based on CIFE's Expert Judgment Template 4.0.

The results analysis confirms the instrument's suitability and reliability, as well as its compliance with the established evaluation criteria. The relevance and wording factors demonstrate that the questions used allow for the identification of whether respondents respond coherently with the research problem, question, and objectives. Based on the pilot study, it is recommended that the instruments continue to be validated to ensure their methodological rigor and suitability for application to a given sample. Furthermore, the questions designed to evaluate the feasibility of a prototype model for energy savings and sustainable architecture are related to the Sustainable Development Goals (SDGs 4: Quality Education and 13: Climate Action) of the 2030 Agenda and the focus of the National Strategic Programs (PRONACES), thus reinforcing their strategic contribution to educational development, sustainability, and scientific research with a priority focus.

Discussion

The construction of instruments with a design supported and validated by expert judges applying Aiken's V content validity, guarantees the obtaining of relevant and useful data and information for the effective fulfillment of the research objectives, since it ensures the technical and methodological quality of the instrument and its ability to generate real results in terms of consistency and relevance of the data collected (Angeles-Guzman *et al.*, 2024).

Several studies highlight the importance of expert judgment in ensuring the relevance and content validity of data collection instruments. This minimizes coherence deficiencies by addressing the logical relationship, clarity, and order among the *items*. Similarly, it

addresses a lack of congruence with the purpose, variables, and research context. A superficial definition of methods and references compromises data quality, traceability, processing, and consistency, limiting the reliability of the database and hindering the analysis and interpretation of results. Consequently, the instrument's precision is reduced, and construct validity is affected (Tenorio *et al.*, 2021).

Based on the study conducted, it can be stated that the evaluation instrument is appropriate for data collection and for evaluating the sustainable automated model designed for implementation in the educational infrastructure of the Instituto Tecnológico de Acapulco, using expert judgment as a basis. For their part, Corrêa *et al.* (2022) consider that the reflective construction of data collection instruments in research articulates the dimensions of the construct and the key elements that contribute to knowledge, which presents an opportunity for future rigorous research or studies.

The analysis of expert judges' evaluations of the instruments is fundamental for improving and adapting the wording of the *items*, as it ensures comprehension, interpretation, and the level of satisfaction (Ponce López *et al.*, 2020). Furthermore, expert judges' observations of the data collection instruments increase the reliability of the information, consolidate methodological quality, and strengthen the sustainability of environmental research projects by guaranteeing more precise and consistent measurements. In this sense, higher education and postgraduate institutions, as those responsible for research, must deepen their attention to relevant problems, offering solutions that impact sustainable development (Bedolla *et al.*, 2023).

The validation of the data collection instrument satisfies the construction of the items by relying on the acceptance parameters and scales used to assess the questions for the construct, which were found to be above the defined arithmetic mean. Lessa *et al.* (2021) consider that a coefficient above the established mean (>0.8) demonstrates the validity and reliability of the instrument, as well as sufficient precision of the *items*. Melo and Nascimento (2022), for their part, indicate that the validation structure involves verifying the *items* using a *Google Forms electronic form*, considering a content validity index (CVI) of 0.98 and a representative table with assessed parameters that impact research practice.

When evaluating the content using the instrument designed for expert judges, Aiken's V method, the value scale, the sample of items, and the criteria for measuring *item agreement* based on expert judgment were taken into consideration. The Likert-type scale, with intervals from 1 to 5, represents the level of acceptance or non-acceptance of the *item*; this will define

the degree of sufficiency and strength of agreement in addressing the object of study (Cabrera-Díaz *et al.*, 2022). Rubiales *et al.* (2025) demonstrated that the results obtained from expert validation demonstrate adequate understanding and sufficiency of the instrument; furthermore, they emphasize the importance of its application, focusing on the criteria of clarity, coherence, relevance, and sufficiency reflected in the theoretical structure of the construct.

The participating experts agreed that the *items* are clearly and precisely worded, ensuring their relevance and essentiality for assessing knowledge and the specific context of the study. This assessment reinforces the inherent content validity of the instrument, supporting its usefulness as an evaluative tool. Furthermore, the survey instrument's measurement was compared with the CIFE 4.0 template, which also employed a *Likert -type scale* with a range of 1 to 5.

The validation instrument designed by the researcher and used by expert judges facilitated the measurement of *items* regarding relevance, wording, and satisfaction, under the defined parameters and measurement scale. This determined the instrument's acceptance and reliability for its future replicability in similar studies. Similarly, Numminen *et al.* (2019) agree that the scores from the measurement scales provided in an instrument offer ample possibilities for developing interventions in educational projects; however, research should focus on additional validation measures, such as incorporating Cronbach's alpha internal consistency.

The validated instrument demonstrates compliance with key criteria and indicators for the relevance of a construct, as the assessment ensures robust results by aligning with the project's objective and a sustainable and effective strategy. The project management undertaken by the researchers relied on innovative methodological designs, technologies, and critical reviews that identified potential for descriptive and explanatory analysis of the information, considering statistical parameters, validation metrics, and suggestions from key professionals (Agyekum *et al.*, 2022).

Content validity is essential in any measurement instrument, regardless of its level of complexity, which ranges from the simple level to the most advanced applying rigorous methodological processes; the criterion of relevance, the proposal of a brief scale with objectivity and the precision of the most relevant indicators of the phenomenon being studied being decisive (Boluarte Carbajal and Tamari, 2017).

Finally, it is clear that the SDGs face significant setbacks, are far from being achieved, and that the 2030 Agenda represents the hegemonic discourse of sustainability that trivializes the complexity of the environmental crisis, placing environmental studies among the most neglected. This situation highlights the need to evaluate and develop projects that promote sustainability. In this sense, the validation of the instrument with rigorous methodological approaches for the project "Automated Model for the Sustainability of Educational Physical Infrastructure as a Strategy for Sustainable Development at the Instituto Tecnológico de Acapulco" represents an opportunity to generate reliable results that strengthen environmental and educational development research, and contribute to research that fulfills the SDGs.

Conclusions

The analysis of the data collection instrument designed to assess the feasibility of implementing an automated prototype model for sustainability in educational physical infrastructure, focused on environmental actions, identified a questionnaire with 33 questions. Twelve of these were selected as the most relevant, focusing on collecting specific and precise information about the study context. The selected *items* were included in a new validation instrument designed for application to eleven expert judges, who evaluated the operational design using *Google Forms*. Parameters and scales based on comparison intervals and Aiken's V estimation were established to assess the relevance, wording, and satisfaction of the *items*.

The content validation and the suggestions made regarding the *items* represented an opportunity to redesign the instrument. The goal was to collect accurate data for analysis, improve research outcomes, and enhance the impact on scientific and educational development. The instrument's new design was optimized using *Google Forms* ' innovative tools for better *item comprehension*, and the items were structured with greater rigor and clarity after applying Aiken's V method.

The implementation of Aiken's V methodology through interval-based inference and the use of automated tools such as SPSS, Excel, *Google Forms* and the CIFE 4.0 template for expert judgment facilitated the assessment of the data collection instrument, determining the relevance of content validity by obtaining a coefficient of 0.878 and a scale of 3.73 for the overall average of the *items*.

The analysis of results for the criteria of relevance, wording, and satisfaction showed significant acceptance of the instrument, achieving an overall Aiken's V of 0.878 for content validity, as determined by the judgment of eleven expert judges. Three of the twelve questions analyzed obtained validation values between 0.788 and 0.818, exceeding the reference mean. This also indicates an adequate level of *item congruence* within the instrument and consistency for the study's purpose. On the other hand, the wording criterion, assessed on a scale of 1 to 5, reflected an average validity score of 3.73. While this *item assessment* indicates minimal risks of ambiguity and data bias related to the scale, it necessitates improvements in the instrument's structure, interpretation, and redesign.

The description and dissemination of the results, based on the validation processes of Aiken's V, strengthened methodological knowledge for its application in the project with greater certainty and reliability, thus contributing to educational and research development. Scientific research, as the cornerstone of educational development, was methodologically grounded to ensure the quality of the collected data and the validity of the instrument. In this context, the data collection instrument applied in the project focused on environmental stewardship, "Automated Prototype Model for the Sustainability of Educational Physical Infrastructure," facilitated the acquisition of precise and useful information for analysis, processing, and the generation of significant results, aligning the research with Sustainable Development Goal 4: Quality Education and Goal 13: Climate Action, established in the 2030 Agenda.

Finally, it is concluded that the designed instrument possesses content validity for its application in the study with an environmental and sustainable focus. This validation, which directly contributes to data quality and the fulfillment of Sustainable Development Goals 4 and 13, opens up broad possibilities for the development of educational services and an opportunity for scientific research in projects with climate action initiatives such as energy savings through automation that promote sustainability.

Future lines of research

The validation study of data collection instruments for evaluating a prototype infrastructure model focused on environmental stewardship and sustainability could serve as a foundation for future scientific research, incorporating comparative studies between two independent groups of experts. This is particularly relevant when variability in content validity is estimated and differences in Aiken's V coefficients are observed. This comparative study between independent groups will strengthen methodological rigor and the precision of *item formulation. Furthermore, it will reflect* inter-rater reliability and consistency, impact the viability and sustainability of the automated model, and enhance its replicability with an innovative approach in diverse educational contexts. Comparing Aiken's V coefficient per item (content validity: relevance and wording) between two independent groups of expert judges will strengthen the estimation and analysis of differences through interval-based inference.

References

Agyekum, K., Botchway, S.Y., Adinyira, E. y Opoku, A. (2022). Environmental performance indicators for assessing sustainability of projects in the Ghanaian construction industry. *Smart and Sustainable Built Enviroment, 11(4),* 918-950. https://doi.org/10.1108/SASBE-11-2020-0161

Ángeles-Guzmán, C., Mondragón-Osorio, J. J., Martínez-Martínez, M. A., Gutiérrez-Hernández, J. C. y García-Reyes, P. C. (2024). Validación del instrumento de una investigación de mercado en Tabasco. *Huella Científica Revista de Investigación Multidisciplinaria, 1(1),* 24-44. https://huellacientifica.villahermosa.tecnm.mx/huella_cientifica/article/view/16/5

Arango-Ramírez, P. M., González-Rosales, V. M., Leyva-Hernández, S. N. y Galván-Mendoza, O. (2023). Validez y fiabilidad de un instrumento de medición de tipos de residentes desde el enfoque de las representaciones sociales. *Estudios sociales. Revista de alimentación contemporánea y desarrollo regional, 33(62)*. https://doi.org/10.24836/es.v33i62.1351

Bautista Pérez, G., Escofet Roig, A. y López Costa, M. (2019). Diseño y validación de un instrumento para medir las dimensiones ambiental, pedagógica y digital del aula. *Revista mexicana de investigación educativa, 24(83),* 1055-1075.

http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S1405-66662019000401055&lng=es&tlng=es

Bedolla Solano, J. J., Bedolla Solano, R. y Miranda Esteban, A. (2020). *Evaluación de un modelo de espacio inteligente como estrategia para el desarrollo sustentable en instituciones educativas.* In: FACTORES CRÍTICOS Y ESTRATÉGICOS EN LA INTERACCIÓN TERRITORIAL DESAFÍOS ACTUALES Y ESCENARIOS FUTUROS. Universidad Nacional Autónoma de México y Asociación Mexicana de Ciencias para el Desarrollo Regional A.C, Coeditores, Ciudad de México. https://ru.iiec.unam.mx/5115/

Bedolla Solano, J. J., Bedolla Solano, R. y Miranda Esteban, A. (2023). Prácticas digitales y sostenibilidad socioambiental en la educación básica de las Smart Cities. *Revista de Educación a Distancia (RED), 23(72)*. https://doi.org/10.6018/red.533831

Bedolla Solano, J.J., Luna Nemecio, J., Miranda Esteban, A. & Bedolla Solano, R. (2023). Automated model for the sustainability of the educational physical infrastructure in Smart Cities. *Journal of Positive Psychology & Wellbeing*, *7(1)*, 664-688, https://journalppw.com/index.php/jppw/article/view/15689 https://journalppw.com/index.php/jppw/article/view/15689/10091

Boluarte Carbajal, A. y Tamari, K. (2017). Validez de contenido y confiabilidad inter-observadores de Escala Integral Calidad de Vida. *Revista de Psicología*, *35(2)*, 617-642. https://doi.org/http://dx.doi.org/10.18800/psico.201702.009

Cabrera-Diaz E., Reyes-Gaspar, P. L. y Charry-Méndez, S. (2022). Análisis de concordancia inter-jueces para medir factores protectores en salud en universitarios. *Revista Ciencia Cuidado*, *19(1)*, 95-106. https://doi. org/10.22463/17949831.3055

Carbajal-Vélez, L., Ottman, K., Ahs, J.W., Nan Li, G., Simmons, J., Chorpita, B., Harris Requejo, J. y Kohrt, B.A. (2023). Translation and Adaptation of the Revised Children's Anxiety and Depression Scale: A Qualitative Study in Belize. *Journal of Adolescent Health*, *72(1)*, S34-S39. https://doi.org/10.1016/j.jadohealth.2022.05.026

Carrillo Ruiz, M. y Luna Conejo, M. B. (2021). Diseño y validación de un Instrumento para diagnosticar la atención de los problemas del contexto desde el enfoque socioformativo. *Forhum International Journal of Social Sciences and Humanities*, *3(5)*, 72-85. https://doi.org/10.35766/j.forhum2021.03.05.4

Celis Moreno, J. S. y Vargas Peláez, M. (2023). Adaptación transcultural y validez de contenido de un instrumento para determinar las necesidades paliativas en Colombia. *Horizonte sanitario, 22(1)*, 173-180. https://doi.org/10.19136/hs.a22n2.5222

CIFE. (2021). *Módulo 3.* Diseño y validación de instrumentos de investigación. Posdoctorado en Metodología de la investigación, Socioformación y Desarrollo Humano. https://www.cife.edu.mx/ecampus/main/lp/lp_controller.php?cidReq=PSM03&id_session=0&gidReq=0&gradebook=0&origin=.

Cisneros-Caicedo, A.J., Guevara-García, A.F., Urdánigo-Cedeño, J.J. y Garcés-Bravo, J.E. (2022). Técnicas e Instrumentos para la Recolección de Datos que apoyan a la Investigación Científica en tiempo de Pandemia. *Revista Científica Dominio de las Ciencias, 8(1)*, 1165-1185. http://dx.doi.org/10.23857/dc.v8i41.2546

Coluci, M. Z. O., Alexandre, N. M. C. y Milani, D. (2015). Construção de instrumentos de medida na área da saúde. *RevisÃo Ciênc. Saude Coletiva, 20(3)*, 925–36. https://doi.org/10.1590/1413-81232015203.04332013

CONAHCYT. (2023). Programas Nacionales Estratégicos. Consejo Nacional de Humanidades, Ciencias y Tecnologías. Gobierno de México. https://conahcyt.mx/pronaces/

Corrêa, F., Ziviani, F., Barbosa, D., Figueiredo, V. y Silva, F. (2022). Construction and Content Validation of an instrument for assessment holistic Knowledge Management. *Perspectivas em Ciência da Informação, 26(04)*, 151-171. https://doi.org/10.1590/1981-5344/37583

Galicia Alarcón, L. A.., Balderrama Trápaga, J. A. y Edel Navarro, R. (2017). Validez de contenido por juicio de expertos: propuesta de una herramienta virtual. *Apertura (Guadalajara, Jal.), 9(2)*, 42-53. https://doi.org/10.32870/ap.v9n2.993

García Magallanes, A. L., Corona Cruz, K., Hernández Briones, M. E., Hernández Ábrego, R. y Villapa Martínez, H. (2024). Diseño y validación de contenido por juicio de expertos de un instrumento para evaluar la efectividad del proceso educativo relacionado al emprendimiento en estudiantes de educación superior. *Revista Espacios, 45(04)*, 179-189. DOI: 10.48082/espacios-a24v45n04p14

Gutiérrez Barba, B. E. y Martínez Rodríguez, M. C. (2010). El plan de acción para el desarrollo sustentable en las instituciones de educación superior: Escenarios posibles. *Revista de la educación superior, 39(154)*, 111-132.

http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0185-27602010000200006&lng=es&tlng=es

Haukås, Å., Storto, A. y Tiurikova, I. (2021). "Developing and validating a questionnaire on young learners' multilingualism and multilingual identity". *The Languaje Learning Journal, 49(4),* 404-419. https://doi.org/10.1080/09571736.2021.1915367

Hernández Briones, M. E., García Magallanes, A. L., Corona Cruz, K., Villalpa Martínez, H. y Hernández Abrego, R. (2024). Diseño y validación de contenido por juicio de expertos de un instrumento para evaluar el impacto del COVID-19 en estudiantes de Educación Superior. *Revista Espacios, 45(6),* 73-82. https://doi.org/10.48082/espacios-a24v45n06p06

Jara Díaz, S.G. (2021). *Instrumentos para evaluar la calidad de vida en adultos mayores con diagnóstico de artrosis: Una Revisión Sistemática*. [tesis profesional de Médico Cirujano, Universidad César Vallejo, Trujillo. Perú]. Repositorio de la UCV. https://repositorio.ucv.edu.pe/handle/20.500.12692/87361

Lessa, A. D., Cabral, F. C., Tonial, C.T., Costa, C. A. D., Andrades, G. R. H., Crestani, F., Einloft, P.R., Bruno, F., Sganzerla, D., Mate, M.C.C., Fiori, H., Latour, J. M. & García, P.C. R. (2021). Brazilian Translation, Cross-Cultural Adaptation, Validity, and Reliability of the EMpowerment of PArents in THe Intensive Care 30 (EMPATHIC-30) Questionnaire to Measure Parental Satisfaction in PICUs. *Pediatr Crit Care Med, 22(6),* e339-e348. doi: 10.1097/PCC.0000000000002594

Lozano Monsalve, J.S. y Villamil López, J.A. (2021). *Diseño, validación y confiabilidad de un instrumento para medir el sentido de pertenencia en comunidades virtuales de intereses (amino).* [Proyecto de grado de Psicólogo, Universidad Antonio Nariño, Bogotá, Colombia]. Colecciones de la UAN. http://repositorio.uan.edu.co/handle/123456789/6255

Manterola, C., Quiroz, G., Salazar, P. y García, N. (2019). Metodología de los tipos y diseños de estudio más frecuentemente utilizados en investigación clínica. *Revista Médica Clínica Las Condes, 30(1),* 36-49. https://reader.elsevier.com/reader/sd/pii/S0716864019300057?token=E266DF16D0CB2B23835561C6D82277DCAE522FDF3B35B2F9B7C7D5D74A411BAD9FAA8EAAEA7EF444547054A203959113&originRegion=us-east-1&originCreation=20221230161859

Martínez, M. G. y Juárez Hernández, L. G. (2019). Diseño y validación de un instrumento para evaluar la formación en sostenibilidad en estudiantes de educación superior. *IE Revista de Investigación Educativa de la REDIECH, 10(19),* 37-54. https://doi.org/10.33010/ie_rie_rediech.v10i19.501

Melo, A. V. O. G. y Nascimento, M. A. L. (2022). Development and validation of a checklist for the safety of hospitalized children. *Texto Contexto Enferm*. [cited YEAR MONTH DAY]; 31: e20210189. https://doi.org/10.1590/1980-265X-TCE-2021-0189

Merino-Soto, C. (2023). Coeficientes V de Aiken: diferencias en los juicios de validez de contenido. *Revista en Ciencias del Movimiento Humano y Salud MH Salud, 20(1)*. 1-10. https://doi.org/10.15359/mhs.20-1.3

Naciones Unidas. (2015). *Objetivos de Desarrollo Sostenible*. Naciones Unidas. Disponible en: https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/. Consultado: 26 de junio de 2025

Numminen, O., Katajisto, J. y Leino-Kilpi, H. (2019). Development and validation of Nurses' Moral Courage Scale. *Nurs Ethics, 26(7-8),* 2438-2455. doi: 10.1177/0969733018791325

Nurjanah, S., Istiyono, E., Widihastuti, W., Iqbal, M. y Kamal, S. (2023). La aplicación del método V de Aiken para evaluar la validez de contenido de instrumentos que miden la implementación de evaluaciones formativas. *Revista de investigación y evaluación educativa, 12(2),* 125-133. http://dx.doi.org/10.15294/jere.v12i2.76451

Penfield, R. D. y Giacobbi, P. R. (2004). Applying a score confidence interval to Aiken's item content-relevance index. *Measurement in Physical Education and Exercise Science, 8(4),* 213-225

Perino, E. J., Kiessling Duran, R. A., Silnik, A. A., Perelló, A. D. y Perino, E. (2021). Energías renovables y sustentabilidad: una eficiente forma de gestionar los recursos naturales. *Revista Digital Universitaria (rdu), 22(3),* 29-39. doi: http://doi.org/10.22201/ cuaieed.16076079e.2021.22.3.4

Ponce López, I., Juárez Hernández, L. G. y Tobón Tobón, S. (2020). Construcción y validación de un instrumento para evaluar el abordaje de la sociedad del conocimiento en docentes. *Apuntes Universitarios, 10(1),* 40-65. https://doi.org/10.17162/au.v10i1.417

Reyes Valenzuela, R., Marrón Ramos, D. N., González Torres, A., Juárez Rodríguez, R. y Mendoza Montero, F. Y. (2022). Análisis de validez de contenido por criterio de

jueces de un instrumento para evaluar un manuscrito. *RIDE. Revista Iberoamericana para la Investigación y el Desarrollo Educativo, 12(24),* e037. https://doi.org/10.23913/ride.v12i24.1183

Rodríguez Ugalde, E. y Díaz Rojas, A. (2023). Construcción y validación de la escala de bienestar en el aula en entornos virtuales. *Ciencia Latina Revista Científica Multidisciplinar, 7(1),* 9146-9161. https://doi.org/10.37811/cl_rcm.v7i1.5110

Rojas-Apaza, Z., Torres Ramos, G., Garavito Chang, E. L., Castañeda, S. y López, R. P. (2022). Construcción y validación de instrumentos de medición en el ámbito de la salud. Revisión de literatura. *Spor [Internet]. Odontol Pediatr, 21(1),* 46-52. https://op.spo.com.pe/index.php/odontologiapediatrica/article/view/206/162

Rubiales, J., Bakker, L. y Paneiva Pompa, J. (2025). Construcción y validación de contenido: Cuestionario de Conocimiento Docente del Perfil Neurocognitivo de Aprendizaje del TDAH. *Revista Costarricense De Psicología, 44(1),* 1–13. https://doi.org/10.22544/rcps.v44i01.08

Salas Ocampo, D. (2020). *Investigación.* La encuesta y el cuestionario. Investigalia. Disponible en: https://investigaliacr.com/investigacion/la-encuesta-y-el-cuestionario/

Secretaría de Energía (SENER) – Fideicomiso para el Ahorro de Energía Eléctrica (FIDE). (2018). *Eficiencia Energética. Proyecto de eficiencia y sustentabilidad energética en municipios (PRESEM).* Boletin de Eficiencia Energética. https://www.gob.mx/cms/uploads/attachment/file/377241/Bolet_n_04_Eficiencia_Energ_tica_Agosto_2018_acc.pdf. Consultado: 27 de julio de 2025

Tenorio, F.M., Dos Santos, M., Simões Gomez, C.F., Araujo, J.C. y De Almeida, G.P. (2021). THOR 2 Method: An Efficient Instrument in Situations Where There Is Uncertainty or Lack of Data. ," *in IEEE Access, 9,* 161794-161805. doi: 10.1109/ACCESS.2021.3132864

Tobón, S. (2025). Metodología de validez de contenido para el diseño y validez de instrumentos de investigación con enfoque interdisciplinario. CIFE

Torres-Malca, J. R.., Vera-Ponce, V. J., Zuzunaga-Montoya., Talavera, J. E. y De La Cruz-Vargas, J. A. (2022). Validez de contenido por juicio de expertos de un instrumento para medir conocimientos, actitudes y prácticas sobre el consumo de sal en la población peruana. *Revista Facultad de Medicina Humana URP, 22(2),* 273-279. https://revistas.urp.edu.pe/index.php/RFMH/article/view/4768

Van Wyk, M.M. (2020). Student Teachers' Lived Experiences of an ODeL Flipped Instructional Design. *International Journal of Online Pedagogy and Course Design, 10(4)*. http://dx.doi.org/10.4018/IJOPCD.2020100102

Vázquez González, G. C., Jiménez Macías, I. U. y Juárez Hernández, L. G. (2020). Construcción-validación del cuestionario sobre madurez de la gestión del conocimiento para la innovación educativa en universidades. *Apertura (Guadalajara, Jal.), 12(1),* 132-151. https://doi.org/10.32870/ap.vl2nl.1767

Vitorelli Diniz, L. F. K., Almeida Magalhães, A., Dos Santos Campos, C. C., Garcia Lopes Alves, C., Mônica Ribeiro, P. y Mendes, M. A. (2014). Hablando de la Observación Participante en la investigación cualitativa en el proceso salud-enfermedad. *Index de Enfermería, 23(1-2),* 75-79. https://dx.doi.org/10.4321/S1132-12962014000100016

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