

Application of the Vincula-ODS© Methodology in Scientific Research Integrating the Sustainable Development Goals: A step-by-step Guide

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Abstract: - This article presents a methodological guide for integrating the Sustainable Development Goals (SDGs) into academic projects through the structured application of the VINCULA-ODS© methodology. Through the analysis of 14 research projects conducted at Peruvian universities, the model's usefulness in guiding theses toward sustainability is validated. A qualitative approach is used, and the study is organized according to the phases of the IMRAD method. The results show significant improvements in problem formulation, methodological consistency, use of SDG indicators, and articulation of conclusions with social impact. The discussion highlights the relevance of the approach in higher education, while recognizing limitations and proposing improvements. The VINCULA-ODS© methodology is established as a replicable tool for aligning scientific production with global challenges of sustainable development.

Key-Words: - Sustainable development, Sustainable Development Goals (SDGs), Higher education; Research methodology, Scientific research, Sustainability indicators, Postgraduate education, Thesis development.

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1 Introduction

The 2030 Agenda establishes a comprehensive framework that guides scientific research toward addressing global sustainability challenges. The 21st century has brought a reassessment of the purposes of scientific research. It is no longer enough to generate rigorous knowledge; it is imperative that this knowledge actively contributes to the social, economic, and environmental transformation of the planet. In this context, the Sustainable Development Goals (SDGs), formulated by the United Nations General Assembly in 2015 as part of the 2030 Agenda, have established themselves as a global benchmark for guiding research efforts toward building more equitable, resilient, and sustainable societies, [1].

Although universities are widely using the SDGs in scientific research, there is a notable gap between institutional rhetoric and research practice. Authors such as Leal and Sachs warn that many universities superficially promote the SDGs without establishing concrete mechanisms for their implementation in research projects. They also point out that global indicators of progress toward the SDGs require contextualized research, which requires local scientific production aligned with these objectives, [2], [3].

To this end, some authors have delved into the transformative approaches needed for higher education and research to adopt models committed to sustainability, developing a framework of key competencies for sustainability that can serve as a basis for designing research aligned with the SDGs

and systematizing good implementation practices that showcase the diversity of possible approaches. UNESCO has also promoted international guidelines for integrating these goals into university education and research policies, [4], [5], [6], [7], [8], [9], [10].

Below is a systematization of the main authors and their most relevant contributions on the integration of the SDGs into scientific research:

Table 1. The main contributions of authors who have addressed the integration of SDGs into scientific research

AUTHOR		CONTRIBUTIONS ON SDGs
Mochizuki & Fadeeva (2010)	[4]	They highlighted the need for transformative learning approaches in education for sustainable development.
Barth & Michelsen (2013)	[5]	Enfatizaron el rol de las competencias investigativas en el desarrollo sostenible a través de prácticas educativas innovadoras.
Wals (2014)	[6]	Propusieron el aprendizaje como proceso emergente necesario para abordar la complejidad de los ODS.
UNESCO (2017)	[10]	Señalaron lineamientos globales para integrar los ODS en políticas educativas e investigativas en las universidades.
Leal et al. (2018)	[2]	The strategic role of universities in the local implementation of the SDGs was raised through applied research projects.
Sachs et al. (2019)	[3]	They analyzed global indicators of progress toward the SDGs and the need to generate contextualized knowledge for monitoring these indicators.
Brundiers et al. (2021)	[7]	They developed a framework of key competencies for sustainability in higher education. Furthermore, useful for structuring research aligned with the SDGs.
GUNI (2022)	[8]	They identified good practices for implementing the SDGs in higher education worldwide.

Source: Prepared by the authors based on the reviewed literature.

Table 1, presents a summary of the theoretical contributions to the SDGs by various authors, focusing specifically on educational, university, and research contexts.

Despite the growing consensus on the importance of aligning university research with the SDGs, scientific literature reveals a significant gap between theoretical guidelines and their practical application in research processes. Most existing proposals focus on conceptual frameworks, sustainability competencies, or institutional policies, but do not provide specific methodological procedures to guide researchers in systematic integration of the SDGs into the design, execution, and discussion of scientific research, [4], [5], [7].

In this regard, literature review identifies three significant gaps in the field of scientific research focused on sustainable development. First, while there are international guidelines which promote integration of the SDGs into higher education,

these primarily address them at a strategic or curricular level and do not translate them into operational methodological models from which theses or research projects can be directly derived. Secondly, it is observed that there are no structured and replicable methodologies that allow the SDGs to be operationalized in the rest of the classic research process processes, which range from the formulation of the problem to the objectives, the theoretical framework, the methodological design, the analysis of results and the conclusions. Third, there are few studies that empirically assess the methodological impact of including the SDGs in scientific research in terms of improving methodological coherence, social relevance of research, and connection of scientific results to the challenges of sustainable development.

All of this leads to a situation in which many studies refer to the SDGs in a declarative way or in context but fail to integrate them structurally into the scientific process, limiting their potential for real contribution to the 2030 Agenda. Therefore, it is necessary to build methodological models that promote conceptual incorporation of the SDGs, providing operational, verifiable, and evaluable tools for their application in scientific research, especially in training of researchers in postgraduate programs.

In response to this need, VINCULA-ODS© methodology was developed as a structured methodological model that integrates the Sustainable Development Goals into all stages of the scientific research process, from problem formulation to the development of conclusions and recommendations. This methodology proposes a sequence of interrelated phases designed to ensure coherence between the research problem, objectives, theoretical framework, methodological design, indicators used, interpretation of results, and their contribution to sustainable development.

However, for a methodological proposal to be recognized as a scientific contribution worthy of such consideration, we must not only refer to its theoretical formulation or its descriptive use, but we must also introduce empirical evidence that allows us to evaluate its applicability, demonstrate its consistency, and know what effects it has on the methodological quality of the research in which it is applied. Therefore, this work, in addition to describing VINCULA-ODS © methodology, also analyzes its use in postgraduate research projects and investigates the influence it has had on the methodological structuring of the work, not only to understand its characteristics as a methodology, but essentially to provide scientific evidence of its

usefulness as a tool for scientific guidance of research related to the Sustainable Development Goals.

Therefore, the objective of this article is to analyze the application of VINCULA-ODS© methodology and evaluate its contribution to improving methodological coherence and the integration of the SDGs in research projects developed in the university setting, with the aim of providing empirical evidence on its potential as a replicable methodological model in scientific research oriented towards sustainable development.

2 Literature Review

The VINCULA-ODS© Methodology consists of seven interconnected phases that range from visualizing the problem within the framework of the Sustainable Development Goals (SDGs) to formulating conclusions and recommendations aligned with these objectives in the research, [11], [12].

Phases of the VINCULA_ODS© methodology are presented below:

Phase I: Understanding the problem from the SDG perspective, focusing on recognizing the research question linked to one or more of the 17 goals and their specific global transformation targets, based on the detection of social, economic, or environmental gaps in the analyzed context. For this stage, we suggest using the problem-SDG alignment matrix, a tool that helps researchers directly relate the identified problem to the corresponding global goal, [3], [11], [13].

Phase II: Integration of SDGs into the formulation of objectives and questions, ensuring that their wording includes dimensions such as equity, environmental sustainability, or human development, as well as indicators associated with the SDGs, which will function as specific references or support points, [2], [11], [14].

Phase III: Conceptual and theoretical standardization, which consists of reviewing academic literature from a sustainable development perspective and selecting theoretical frameworks linked to social justice, the circular economy, human rights, and human capabilities, among others, thus supporting the incorporation of the SDG approach into research, [11], [15].

Phase IV: Methodological coherence, which involves developing the proposal in harmony with the principles of sustainability, determining the research approach (qualitative, quantitative or mixed), establishing the variables or categories in relation to the SDGs and basing the design on an ethical and transformation-oriented perspective, [11].

Phase V: Use of SDG indicators established by the United Nations Statistical Commission, adapting them to the specific context of the work being carried out. This includes combining them with indicators specific to the disciplinary area to enrich the analysis, integrating diverse perspectives with multiple data sources, and thus achieving a more complete understanding of the research object, [11], [16].

Phase VI: Critical analysis of the results based on the SDGs, evaluating them according to their contribution to each selected objective and taking into account the impact, existing gaps, and contextualized reflections on the scientific contribution generated, [7], [11], [17].

Phase VII: Integration into conclusions and recommendations, which involves verifying the coherence between both and their contribution to the SDGs, while maintaining their alignment with public policies and exemplary sustainable practices, [11], [12].

This methodology produces an academic and scientific contribution with social relevance, useful both for advancing disciplinary knowledge and for promoting the sustainable transformation of the contexts in which it is implemented. It seeks to go beyond the simple discourse of sustainability, proposing a technical, verifiable, rigorous, and replicable method of action in any disciplinary field. It also fosters the development of research competencies in sustainability, strengthening critical thinking and the social relevance of science and academic production, [11], [17].

3 Methods and Materials

This work is part of a methodological study that begins with preliminary validation whose objective was to evaluate the applicability and contribution of VINCULA-ODS© methodology in the process of methodological structuring of research projects in postgraduate programs. This is a type of study that

will analyze the operationality, internal consistency, and usefulness of a methodological model in which research is carried out in a real context, by combining qualitative and quantitative analysis modalities in order to obtain a global picture of the model's performance.

The design followed was a pre-experimental type with measurement before (pretest) and after (posttest) the application of the methodology (methodological pretest-posttest), complemented with qualitative analyses of the participating researchers' perceptions set.

The type of research design derived from this study allows us to assess changes in methodological coherence and the way in which the SDGs are integrated into research projects after the application of VINCULA - SDG© methodology. The model was applied to an intentional sample of 14 research projects corresponding to master's and doctoral students from two private universities in the city of Trujillo and one state university in the city of Cajamarca, Peru, during the period 2024-2025. The projects correspond entirely to the educational and public health areas. Projects selection was carried out through purposive sampling, considering the following criteria:

- a. Researchers should be in the design or reformulation phase of their research project;
- b. Researchers should agree to apply the VINCULA-ODS© methodology in their study;
- c. The project should present a problem that can be linked to one or more Sustainable Development Goals.

In applied and methodological research, the researcher intentionally chooses participants or cases to provide information about the problem or process of interest, rather than a representation of the population, [18].

The study implementation was developed in five stages:

1. Awareness and training: It was held a virtual workshop for participating researchers, in which the conceptual foundations of the Sustainable Development Goals and the structure of the VINCULA-ODS© methodology were presented, as well as examples of application in academic research.
2. Methodology application: The researchers applied the seven phases of the VINCULA-ODS© methodology in their respective research projects:
 - a. Visualizing the problem from the SDGs. perspective.

- b. Integrating the SDGs into objectives and questions.
- c. Conceptual and theoretical standardization.
- d. Methodological coherence.
- e. Use of SDG indicators.
- f. Critical analysis of results from the perspective of the SDGs.
- g. Articulating conclusions and recommendations.

3. Monitoring and feedback: During a period of two months, methodological support was provided through biweekly consultations and documentary review of the progress of each project. The objective was to verify the correct application of each phase of the methodology.

4. Methodological evaluation pre and post application: An evaluation of the methodological structure of each project was carried out before and after the application of VINCULA-ODS© methodology, in order to identify changes in methodological coherence.

5. Information analysis and systematization: Consistency matrices, preliminary versions and reformulated versions of the projects were collected, as well as semi-structured interviews with the participating researchers to gather their perceptions on the usefulness and difficulties of the methodology.

For the collection and evaluation of information, the methodological instruments developed within the framework of the VINCULA-ODS© Methodology were used, which make up the VINCULA-ODS Assessment Framework (VOAF). This framework constitutes a structured system designed to evaluate the degree of methodological integration of the Sustainable Development Goals (SDGs) within a scientific investigation, which allows a systematic analysis of the coherence between the components of the research process and the principles of sustainable development, [11].

The VOAF integrates qualitative and quantitative instruments that allow the evaluation of the SDGs incorporation in the different phases of the research process, ensuring traceability of sustainability from the problem formulation to the interpretation of the results and the formulation of conclusions. These were the instruments used:

VINCULA-ODS© checklist

Is a structured assessment tool that allows analysis of the SDGs integration in each of the seven phases of the VINCULA-ODS© methodological model:

1. Visualization of the research problem,
2. Integration of the SDGs into the objectives,
3. Conceptual standardization and theoretical framework,
4. Methodological coherence of the research design,
5. Integration of SDG indicators,
6. Interpretation of results with a sustainability focus,
7. Conclusions and recommendations oriented towards the SDGs.

Each phase was evaluated using an ordinal scale from 0 to 4 points, in which:

- 0 = No integration.
- 1 = Incipient integration.
- 2 = Partial integration.
- 3 = Adequate integration.
- 4 = Solid methodological integration.

This instrument made it possible to evaluate the presence and level of methodological integration of the SDGs within each research project analyzed.

VINCULA-ODS Index (IVO)

In order to quantify the level of global integration of the SDGs in each investigation, the VINCULA-SDG Index (IVO) is used. It is a quantitative index developed from the score collected from the VINCULA-SDG Checklist© and the weighting system that was given to each phase of the model according to the methodological weight that concerns each one.

The index was calculated using the following expression:

$$IVO = (\sum (S_i / 4) W_i) / 10$$

where:

- S_i = score obtained in phase i (scale 0–4),
- W_i = methodological phase assigned to i ,
- n = number of phases in the model [7].

The index generates a value on a scale from 0 to 10, which allows the level of methodological integration of the SDGs in research to be classified into the following levels:

Table 2. The classification criteria used to interpret the VINCULA-ODS Index (IVO)

X	Integration level
0.0 – 2.9	Non-existent integration
3.0 – 4.9	Weak integration
5.0 – 6.9	Moderate integration
7.0 – 8.9	Solid integration
9.0 – 10	Full methodological integration

Source: Prepared by the authors.

Table 2 presents a qualitative assessment scale, or Baremo, designed to measure the integration level of a given variable within a methodological study. This evaluative scale ranges from 0.0 to 10 across five progressive levels, interpreting results from a total absence of integration to full integration. This index made it possible to transform the integration of the SDGs, which is normally assessed qualitatively, into a quantitative measure comparable across studies.

Problem alignment matrix – SDGs

A problem-SDG alignment matrix was used as a document analysis tool in order to identify the relationship between the problem that gave rise to the research, the objectives for which the study was carried out and the specific goals, specifically those defined in the Sustainable Development Goals, allowing verification of the alignment and/or relationship between the research problem and the sustainable development problems addressed in each research.

Semi-structured interview guide

A semi-structured interview guide was applied to the participating researchers with the aim of collecting qualitative information on:

- Perceived usefulness of the methodology.
- Difficulties in applying the phases.
- Changes made to the research design.
- Perceived improvement in methodological coherence.

Interviews allowed quantitative evaluation to be complemented with qualitative information about the experience of applying the methodology.

Content validity through expert judgment

Content validity of the instrument was assessed using expert judgment. Ten specialists with doctoral or master's degrees and experience in research methodology, higher education, and

sustainable development participated in this process.

Experts evaluated each item of the VINCULA-ODS© Checklist following a five-point ordinal scale (1 = very low, 5 = very high), four evaluation criteria: sufficiency, clarity, coherence and relevance.

To estimate content validity, it was used the Aiken's V coefficient, which measures the agreement among experts regarding instrument's items relevance. Results revealed Aiken's V values exceeded 0.80 for all evaluated items, value which indicates adequate content validity. Overall mean Aiken's V coefficient was 0.92, which is interpreted as excellent content validity according to the criteria established in the methodological literature, [19].

Table 3. Checklist VINCULA-ODS© content validity through Aiken's V coefficient

Evaluated dimension	Aiken's V
Phase 1. Research problem	0.93
Phase 2. Research objective	0.91
Phase 3. Sustainable theoretical framework	0.92
Phase 4. Methodological coherence	0.94
Phase 5. SDG indicators	0.9
Phase 6. Results interpretation	0.89
Phase 7. Conclusions y recomendations	0.92
Aiken's V global	0.92

Source: Prepared by the authors based on expert judgment results.

In Table 3, it can be observed that, results indicate that the items of the VINCULA-ODS© Checklist are pertinent, clear, coherent and relevant for evaluating the methodological integration of the Sustainable Development Goals in scientific research.

Instrument reliability

Within the framework of different actions carried out in order to evaluate the internal consistency of the instrument, the Cronbach alpha coefficient was calculated from assigning ratings that the experts gave to the different items that make up the VINCULA-ODS© Checklist.

The results of reliability analysis show a Cronbach's alpha coefficient equal to 0.89, which demonstrates that the evaluative instrument has a high internal consistency, in accordance with what has been proposed from the methodological literature itself, in which a Cronbach's alpha coefficient greater than 0.80 is considered an

adequate value for evaluation instruments in scientific research work, [20].

Therefore, these results allow us to assert that the evaluative instrument presents an adequate internal consistency and that the items that compose it are perceived as coherently measured by the construct of methodological integration of the Sustainable Development Goals in scientific research.

4 Results

With the aim of establishing a benchmark that allows the methodological effect evaluation of the VINCULA-ODS© methodology application, the VINCULA-ODS Index (IVO) was calculated in the 14 research projects before the introduction of the methodology, which allows the degree of SDGs methodological integration measure in a particularized way in each initial state.

Now, we construct Table 4, which compiles IVO before and afterwards.

Table 4. VINCULA-ODS Index (IVO) before the methodology application

Project	IVO Before	Level (Before)	IVO Afterwards	Level (Afterwards)	Difference
Project 1	3.2	Weak	7.5	Solid	4.3
Project 2	4.1	Weak	8	Solid	3.9
Project 3	5	Moderate	8.5	Solid	3.5
Project 4	3.8	Weak	7.2	Solid	3.4
Project 5	4.5	Weak	7.8	Solid	3.3
Project 6	5.3	Moderate	8.4	Solid	3.1
Project 7	3.6	Weak	7.6	Solid	4
Project 8	4.8	Weak	8.1	Solid	3.3
Project 9	5.5	Moderate	8.7	Solid	3.2
Project 10	3.9	Weak	7.4	Solid	3.5
Project 11	4.2	Weak	7.9	Solid	3.7
Project 12	5.1	Moderate	8.3	Solid	3.2
Project 13	4.6	Weak	7.7	Solid	3.1
Project 14	5.4	Moderate	8.6	Solid	3.2
Medium	4.5	Weak	7.98	Solid	3.48

Source: Prepared by the authors from the application of the VINCULA-ODS© methodology.

Table 5 presents the values obtained for the VINCULA-ODS Index (IVO) in the research projects before and after the application of the VINCULA-ODS© methodology. These results show an increase in index values in all the research projects.

Overall, the index increased by an average of 3.48 points, indicating a shift from weak to strong integration of the Sustainable Development Goals (SDGs) within the research process. Before the methodology was implemented, the average index value was 4.50, reflecting weak integration characterized by references to the SDGs primarily in the study's justification or contextualization; at this stage, there was no structured methodological integration.

After the application of the methodology, the average value of the index rose to 7.98, which corresponds to a solid level of integration that implies that the SDGs are incorporated in the different phases of the research process, as well as the formulation of the problem, the objectives, the theoretical framework, the methodological design, the use of indicators and the interpretation of the results. Therefore, it is possible to affirm that, based on these results, the VINCULA-ODS© methodology contributes to strengthening the methodological coherence and structural integration of the Sustainable Development Goals in research projects.

In order to verify whether differences in the VINCULA-ODS Index (IVO), before and after the use of the VINCULA-ODS© methodology, are statistically significant, a related samples comparison test was carried out.

For the application of this test, data normality was previously checked through the Shapiro-Wilk test, which turned out to be adequate, since data did not follow a normal distribution ($p < 0.05$). Therefore, a non-parametric test was used with related samples. Similarly, the Wilcoxon signed-rank test was performed to compare two related measurements when normality was not assumed for the data.

The Wilcoxon test results showed statistically significant differences in the VINCULA-ODS Index values before and after the methodology was implemented ($Z = -3.29$; $p = 0.001$). This indicates that the VINCULA-ODS© methodology produced a significant change in the methodological integration of the Sustainable Development Goals in the analyzed research projects.

Table 5. Statistical comparison of the VINCULA-ODS Index before and after application of the methodology

Compariso n	N	Mean Befor e	Mean Afterwar ds	Z	p- valu e	Effec t size (r)
IVO Before – IVO Afterwards	1 4	4.5	7.98	- 3.2 9	0.001	0.

Source: Prepared by the authors from statistical analysis results.

As shown in Table 6 (Appendix), results of the Wilcoxon signed-rank test reveal statistically significant differences between levels of methodological integration of SDGs before and after application of the VINCULA-ODS© methodology ($Z = -3.29$; $p = 0.001$); because p is less than 0.05, the alternative hypothesis is accepted and it can be concluded that, the methodology has definitely produced significant changes in the ways of integrating the SDGs within the research process.

On the other hand, the effect size obtained ($r = 0.62$) also suggests that the magnitude of change produced is broad, which indicates that improvement detected is not only statistically significant but also methodologically relevant: in terms of results, it can be concluded that application of the VINCULA - SDGs © methodology allows research projects to move from low levels of linkage (mean = 4.50) to high levels of linkage (mean = 7.98), which shows a very significant increase in the way of being methodologically coherent with structural incorporation of the SDGs in the different phases of the research process.

These results allow us to conclude that VINCULA-ODS© is not only a conceptual guide for the integration of SDGs in scientific research, but also constitutes an effective methodological tool when it comes to significantly improving the articulations between the research problem, the objectives, the theoretical framework, the methodological design, the indicators and the interpretation of the results from the perspective of sustainability.

Combination of quantitative and qualitative results reveals that the increase in the VINCULA-ODS Index found in the research projects is related to structural changes in the methodological design of the research.

Triangulation of results using the convergent triangulation design reveals that quantitative improvements in the level of SDG integration are related to at least four methodological changes:

improved methodological coherence, redefinition of research objectives, inclusion of SDG-related indicators, and the role these indicators play in reinterpreting results from a sustainability perspective.

The qualitative results show that the VINCULA-ODS© methodology not only allowed the inclusion of the Sustainable Development Goals at a discursive level, but also transformed the methodological structure of research projects, especially with regard to the alignment between the research problem, the objectives, the study variables, the indicators and the discussion of the results.

These structural changes explain the increase in the VINCULA-SDG Index after the methodology was applied. The combination of quantitative and qualitative results also allows us to affirm that the VINCULA-SDG© methodology has a methodological character in the structure of the research, which means that it not only increases the integration of the SDGs, but also improves the internal coherence of the research design and orients studies toward problems related to sustainable development.

5 Discussion

The objective of this study was to evaluate the VINCULA-ODS© methodology, proposed as a methodological model for integrating the Sustainable Development Goals (SDGs) into postgraduate research projects. The quantitative and qualitative results showed that application of the methodology produced significant improvements in the methodological integration of the SDGs and in the internal coherence of the research design, the formulation of research objectives, the selection of indicators, and the interpretation of results.

Present study findings coincide with recent studies which have pointed out that a surprising challenge for universities with respect to the SDGs is not their incorporation as discourse in institutional documents, but rather their incorporation as an operation within the processes of teaching, research and knowledge transfer, [2], [12], [21].

This is also evident as while the SDGs have begun to be incorporated into university policy instruments and strategic planning, universities indicate that their integration into research project methodologies and postgraduate theses remains limited. The purpose of this study was to analyze

the VINCULA - SDGs © methodology, specifically how the SDGs are used in research.

In this regard, the results of this study provide empirical evidence supporting Kioupi and Voulvoulis assertion that the greatest challenge for higher education in relation to the SDGs is the development of operational frameworks that enable the integration of sustainability into curriculum design, research, and evaluation. Similarly, Lozano et al. indicate that achieving sustainability in higher education requires methodological tools that allow the operationalization of sustainable development principles in academic activities in general, including scientific research, [12], [21].

Similarly, qualitative results of the study showed how the VINCULA-ODS© methodology contributed to improving methodological coherence of research projects, which correlates with what Creswell and Creswell indicate, proposing that coherence between the research problem, objectives, theoretical framework and methodological design is one of the main quality criteria in scientific research, [18].

In this particular study, the integration of the SDGs became a central organizing principle that improved the methodological coherence of the research design components. Regarding the mixed methods approach, the integration of quantitative and qualitative results through joint display showed that the methodology not only increases the degree of SDG integration but also reveals how and why this methodological shift occurred, relating to the integration approach recommended in applied methodological studies for generating meta-inferences through data triangulation, [22], [23].

6 Conclusions

Based on the results obtained, it is concluded that the VINCULA-ODS© methodology constitutes an operational methodological model that allows for the structured integration of the Sustainable Development Goals into the different phases of the scientific research process.

First, the quantitative results showed a significant increase in the VINCULA-ODS Index after the application of the methodology, moving from levels of weak integration to levels of strong integration. The Wilcoxon statistical test confirmed that these differences are statistically significant, and the effect size showed that the magnitude of the change is large, allowing us to affirm that the methodology has a methodological effect on how research projects are designed and structured.

Secondly, the qualitative results showed that applying the methodology produced positive changes in the methodological structure of the research projects, especially in the coherence between the research problem, objectives, theoretical framework, methodological design, selection of indicators, and discussion of results. The integration of quantitative and qualitative results led to the conclusion that the methodology not only increases the level of integration of the SDGs but also improves the internal coherence of the research design, which constitutes an indicator of methodological quality.

Third, the study enabled the development and validation of a methodological evaluation framework comprised of the VINCULA-SDGs© Checklist, the VINCULA-SDGs Index (IVO), and the VINCULA-SDGs Evaluation Framework (VOAF), making the methodology an evaluable and replicable model. This is the study's main contribution, as it proposes not only a methodology but also an evaluation system that allows to measure the level of integration of the SDGs into scientific research.

Finally, it is concluded that the VINCULA-ODS© methodology constitutes a methodological model that allows the articulation of scientific research with the Sustainable Development Goals through a structured, evaluable and replicable approach, which represents a methodological contribution to the field of research in higher education and sustainability.

7 Recomendations

In the first recommendation, we suggest including the VINCULA-ODS© methodology in the study plans of postgraduate programs, especially in research methodology subjects, thesis seminars and research workshops at the master's and doctoral levels; the integration of this methodology into the training of researchers will allow research work to be directed towards problems related to sustainable development and will contribute to the social relevance of university scientific production

The second recommendation focuses on the design and implementation of teacher training programs in research related to the Sustainable Development Goals. In this regard, training teachers in research methodologies with a focus on sustainability is fundamental for the successful implementation of the model.

Third, we recommend promoting academic research communities of practice focused on sustainable development. Developing research

networks, research incubators, interdisciplinary working groups, and academic communities using the VINCULA-ODS© methodology will enhance the exchange of experiences, collaborative scientific production, and the continuous improvement of the methodological model.

These recommendations aim to consolidate the VINCULA-ODS© methodology as a tool for scientific innovation, serving research that is more committed to addressing the present and future social, environmental, and ethical challenges.

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APPENDIX

Table 6. The joint display used for integrating quantitative and qualitative findings

Project	Before IVO	After IVO	Change	Qualitative evidence	Category	Interpretation
P1	3.2	7.5	↑ 4.3	Problem reformulation and alignment with SDG 4	Methodological coherence	The methodology made it possible to align the problem, objectives and method with SDGs
P2	4.1	8	↑ 3.9	Modification of consistency matrix and inclusion of SDG indicators	Indicators	The methodology facilitated the incorporation of sustainability indicators
P3	5	8.5	↑ 3.5	Reformulation of objectives linked to SDG targets	Objetives	Objectives shifted from being disciplinary to being sustainability-oriented
P4	3.8	7.2	↑ 3.4	Sustainability literature inclusion in the theoretical framework	Methodological coherence	Coherence between theoretical framework and objectives was strengthened
P5	4.5	7.8	↑ 3.3	Problem and objectives reformulation with a SDG focus	Objetives	The methodology-oriented research towards sustainable development problems
P6	5.3	8.4	↑ 3.1	Incorporation of SDG indicators into operationalization	Indicators	Measurement of the research impact was improved
P7	3.6	7.6	↑ 4.0	Alignment between variables, objectives and SDGs	Methodological coherence	Internal consistency in the research design was achieved
P8	4.8	8.1	↑ 3.3	Inclusion of social and educational indicators	Indicators	The methodology made it possible to operationalize sustainability.
P9	5.5	8.7	↑ 3.2	Discussion of results linked to social impact	Discussion	Interpretation of results was broadened to include sustainability
P10	3.9	7.4	↑ 3.5	Reformulation of objectives and conclusions	Objetives	Research social orientation was strengthened
P11	4.2	7.9	↑ 3.7	Inclusion of SDGs in the discussion	Discussion	Results interpretation was broadened
P12	5.1	8.3	↑ 3.2	Use of SDG indicators in instruments	Indicators	Operationalization of variables improvement
P13	4.6	7.7	↑ 3.1	Aligning the problem with SDG goals	Methodological coherence	Methodological structure improvement
P14	5.4	8.6	↑ 3.2	Discussion focused on sustainability	Discussion	Interpretation of results improvement

Source: Prepared by the authors.

Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

- **Jean Carlo Zapata-Rojas:** Conceptualization, conceived the study and was responsible for the design and development of the data analysis. Writing: review & editing.
- **Tatiana Isabel Álvarez Becerra:** Project administration and reviewed the first draft of the article and provided supervision.
- **Reina López de Montoya:** Investigation, conducting a research and investigation process, specifically performing the experiments, or data/evidence collection.
- **Delsi Mariela Huaita Acha:** Writing: original draft, preparation, creation and/or presentation of the published work, specifically writing the initial draft.
- **Diorga Nélide Medina Hoyos:** Development or design of methodology; creation of models.
- **Regina Mariel Montoya López:** Application of statistical, mathematical, computational, or other formal techniques to analyze or synthesize study data.

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