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University Professors and Their Sustainable Training. An Opportunity to Improve Public Education in Northern Sinaloa, Mexico

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Abstract: *The sustainable training of higher education teachers at a Sinaloa university is analyzed, in its academic units in the north of the State. The objective was to identify areas of opportunity in such training, so that HEIs have information that allows them to empower teachers as agents of change in sustainable matters. The approach of the study was quantitative, descriptive-transversal, applying a Likert-type instrument through the Google Forms platform to 239 teachers from a universe of 488 that make up the study area in 7 academic units (see table 2). The instrument was subjected to internal consistency measurement using McDonald's Omega coefficient, yielding an adequate value of W=0.874. The findings show that there are challenges for the educational institution and the teachers themselves in aspects of training, better self-management and programs that strengthen sustainable training are required, so the SDGs and the 2030 Agenda can help improve the situation. Research is recommended that supports what this study postulates, as well as institutional and personal initiatives on leadership issues that promote the proper role of the actors involved.*

Keywords: *transition; public university; social impact and social responsibility.*

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Introduction

Currently, the context of higher education plays a crucial role in the society of any region in the world, as it is where young people are trained to lead governments and oversee economic, political, social, cultural, and environmental interests, among others, where the people and many other variables are part of the social fabric. In this sense and emphasizing two variables directly related to the above—education and sustainability—this study analyzes the sustainable training of higher education teachers at a public university. It examines the actions and opinions of teachers inside and outside the classroom to identify areas of opportunity for better sustainable training, as well as to encourage universities to empower them as agents of change and promoters of social responsibility and sustain-able development. Thus, continuing previous work on this important topic but in different geographical areas covered by the studied university, the research analyzed the sustainable education environment among a significant number of faculty members from schools and faculties belonging to the northern zone of the university in the state of Sinaloa (Los Mochis, Juan José Ríos, and El Carrizo). To address the topic, three study variables were defined: individual knowledge about sustainability, sustainability and society, and sustainable training for teachers.

Sustainable development has emerged as a support tool to address the environmental challenges our world faces, such as desertification, torrential rains, climate change, and other issues (Chaudhary et al., 2024). If universities incorporate these topics into pro-jects grounded in sustainability and social responsibility, the resulting changes will have a significant positive impact on university communities and society as a whole. As Bahadorestani et al. (2024) point out, social projects play a crucial role in helping communities transition from a state of low environmental responsibility to one where sustainability becomes a key priority due to its significance. Similarly, Torsdottir et al. (2024) argues that different social groups must adopt sustainability-oriented measures, primarily by developing the necessary competencies to influence others.

Hisherik & Paul-Binyamin (2024) state that the role of educators as agents of change is crucial for achieving social objectives and fostering socially and environmentally re-sponsible citizens. Researchers such as Nguyen et al. (2022) argue that current teacher training requires a reorientation toward sustainability, a process in which higher education institutions (HEIs) will play a key role in facilitating these transitions. In this regard, Chen & Huang (2024) emphasize that teachers' identity and training will determine the guidelines for

promoting and integrating sustainable development within the classroom. Similarly, Merma-Molina et al. (2023) conducted a study on sustainability education among higher education faculty, concluding that such training remains highly limited. This, in turn, poses a significant obstacle to achieving the goals outlined in the 2030 Agenda and fulfilling the Sustainable Development Goals (SDGs).

Methodology

This study is based on a quantitative-descriptive cross-sectional methodology (see Table 4). The data was collected through a Likert-type survey, a common technique in social research (Memmedova & Ertuna, 2024). The survey was presented to respondents in a structured format comprising 20 items (see Tables 5, 6, and 7) categorized into three subcategories: (1) individual knowledge about sustainability, (2) sustainability and society, and (3) sustainable teacher training. The survey was conducted via Google Forms platform. According to Question Pro (2025) a digital platform specializing in creating online surveys, a structured questionnaire is a data collection instrument composed of a series of predefined questions on a specific topic or topics. This site claims that this is a very efficient quantitative tool for obtaining data.

The sample was drawn from a population of 488 faculty members (see table 1), re-quiring a minimum of 216 participants; however, a higher representativeness was achieved with 329 respondents. These participants are faculty members affiliated to seven academic units across three municipalities within the study area (see table 2). The present study had a simple random probability sample, which according to Otzen & Manterola (2017, 228) is one that "Guarantees that all individuals that make up the target population have the same opportunity to be included in the sample, independent of the probability that the rest of the subjects that are part of the target population have".

The reliability of the instrument was assessed using McDonald's omega ($\omega = 0.874$) and Cronbach's alpha ($\alpha = 0.869$), yielding favorable reliability results. Data processing was conducted using the JASP Team statistical software and was scientifically supported by previous studies and the methodology proposed by (Frías-Navarro, 2022,; Galindo Domínguez, 2020; Torres et al., 2006).

Table 1. Sample Calculation.

Where:

Parameter	Variable	Value
Population size	N	488
Confidence level (95%)	Z	1.96
Probability of success	P	50.0%
Probability of failure	Q	50.0%
Margin of error	D	4.00%
Sample size	n	329 respondents

Table 2. Distribution of Surveys by Academic Units (Faculties or Schools).

No.	Academic Units in the Study Area	Population	Sample
1	Business Academic Unit	84	37-84
2	Faculty of Engineering Mochis	80	35-64
3	Faculty of Nursing Mochis	132	58-67
4	Faculty of Social Work Mochis	28	12-26
5	Higher School of Agriculture of the Carrizo Valley	10	4-5
6	Faculty of Agriculture of the Fuerte Valley	63	28-30
7	Faculty of Law and Political Sciences	91	40-53
Total		329	

Source: Own elaboration.

Statistical Analysis.

Once the survey data were collected, the open-source software JASP 0.18.1 was used to determine McDonald's omega (ω) and Cronbach's alpha (α) coefficients, as previously mentioned. This was done to provide greater reliability to the instrument used, as well as to validate the results obtained through it (see Table 3).

Table 3. Reliability Statistics of the Instrument.

Estimate	McDonald's ω	Cronbach's α
Point estimate	0.874	0.869
95% CI lower bound	0.854	0.848
95% CI upper bound	0.894	0.889

Source: Own elaboration. using JASP 0.16.1 software.

Thus, the values reported in Table 3 correspond to McDonald's omega (ω) and Cronbach's alpha (α) coefficients, which show very similar figures of 0.874 and 0.869, respectively. This indicates that the instrument is appropriate for measuring internal reliability, as it assesses the consistency with which the scale items reflect the underlying construct. According to Galindo Domínguez (2020) values above 0.7 are considered reliable for both McDonald's omega and Cronbach's alpha. The analysis conducted demonstrates that both coefficients indicate the instrument's items measure the construct robustly, establishing that the scale is valid and reliable for research purposes.

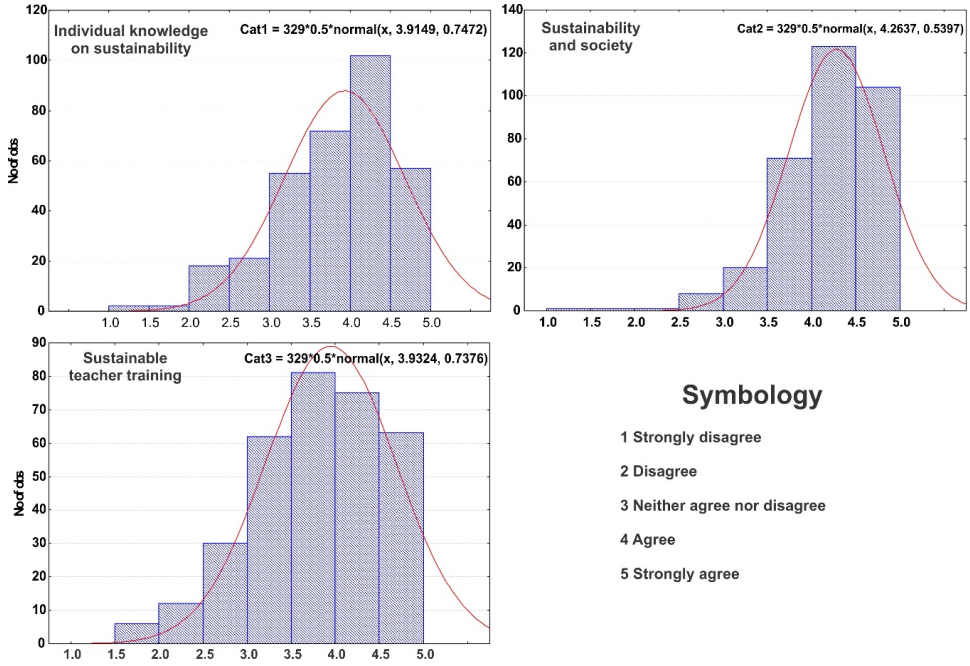
The instrument is divided into three subcategories, each grouping a specific number of items:

- Subcategory 1 (Individual knowledge about sustainability): 8 items.
- Subcategory 2 (Sustainability and society): 8 items.
- Subcategory 3 (Sustainable teacher training): 4 items.

Responses were based on a Likert scale, where: 1 = Strongly Disagree, 2 = Disagree, 3 = Neither Agree nor Disagree, 4 = Agree, 5 = Strongly Agree.

Histograms were generated based on the average responses per subcategory for each respondent to observe response trends. A wider distribution of responses was observed in Individual knowledge about sustainability and Sustainable teacher training, ranging from 1 to 5. The highest values for Individual knowledge about sustainability were between 4 and 4.5, while for Sustainable teacher training, they ranged from 3.5 to 4. In contrast, the Sustainability and society subcategory concentrated its averages between 2.5 and 5, peaking in the 4 to 4.5 range.

Figure 1. Histogram of Trends by Subcategory.

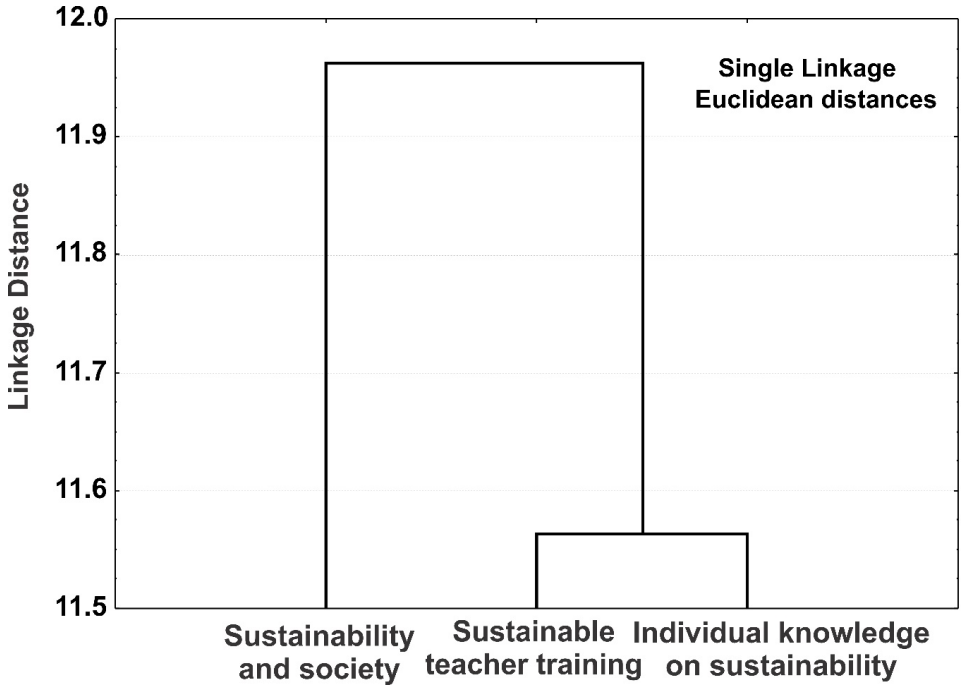


Source: Own elaboration. using JASP 0.16.1 software

Conversely, Figure 2 presents a graphical representation using a dendrogram, applied in the hierarchical clustering analysis. This approach is used to classify objects—in this case, variables or concepts related to sustainability—into groups based on their similarity or distance. The Single Linkage method was applied in this analysis, using Euclidean distances.

The concepts "Sustainable teacher training" and "Individual knowledge on sustainability" form the first cluster, indicating a closer relationship between them in terms of proximity within the Euclidean space. Subsequently, this group merges with "Sustainability and society" at a greater distance, suggesting that the latter concept has lower similarity with the first two compared to their internal relationship.

Figure 2. Graphical representation of the clustering of subcategories using a dendrogram.



Source: Own elaboration. using JASP 0.16.1 software

Pilot Test

To avoid bias in the data (self-reports) and information management, in addition to seeking to verify feasibility, identify design and implementation issues, and better manage time and resources, the designed instrument was pilot tested, undergoing a small-scale, rigorous analysis with 10 specialists in the research topic (academics), as well as in instrument design. This provided valuable information for the final design and implementation, clarifying key concepts and specific factors specific to the topic, such as the cultural factors (language, customs, education, among others) of the region where it was applied.

Referential theoretical framework

Transformative Learning Theory

For Mezirow, the pioneer of this theory, this represents a series of changes in the way an individual thinks and acts, which are directly related to mental processes and behavioral habits, as well as to beliefs, expectations, and true opinions that lead to appropriate individual behavior.

According to Félix Prado (2021) transformational learning consists of changing adults' predefined thoughts so that they can grasp ideas from their perspective. This encourages students to reflect on their own experience and thus make a comparison, thereby assessing what they have learned, reinforcing their critical thinking.

As can be seen, the underlying theory of this study is the one proposed by Mezirow, as it is one of the leading theories worldwide that addresses the environments and characteristics of adult learning, as well as its limitations. Similarly, social responsibility plays a crucial role and maintains a close connection with the theory of transformative learning, since both relate to the variables analyzed in this study, such as sustainability, social, environmental, and economic aspects.

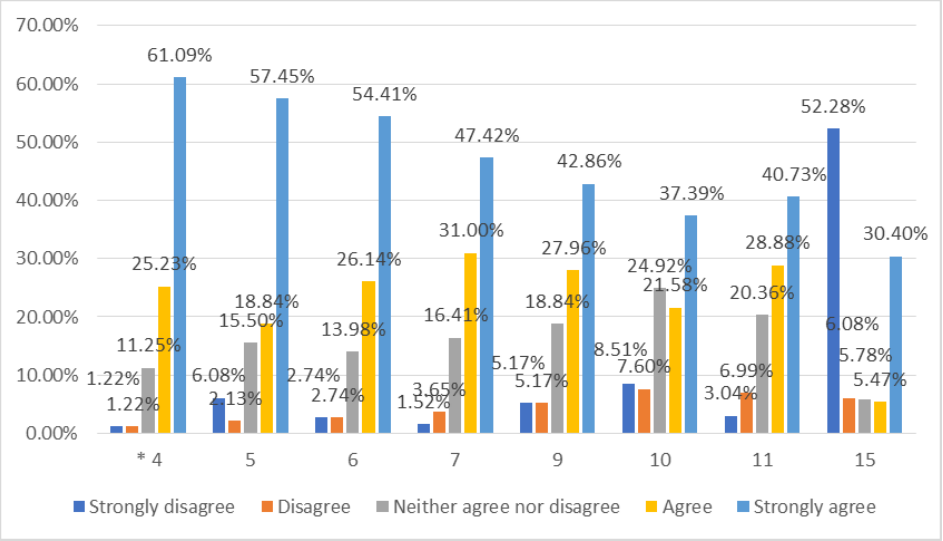
Table 4. Methodological summary

Methodological Basis	Quantitative
Approach	Descriptive
Study Timeframe	Cross-sectional
Instrument Feasibility	Pilot test
Potential Limitations	• Self-report (discarded) • Regional specificity (discarded)
Sample	329 teachers surveyed out of 216 in the sample
Sampling Method	Simple random sampling
Data Collection Method	Survey
Data Collection Instrument	Structured questionnaire
Population	488 teachers
Academic Units Studied	7 (all those that comprise the region studied)
Data Analysis / JASP Software for Relationships between Variables	McDonald's Omega and Cronbach's alpha = high reliability >0.7

Source: Own elaboration.

Results and discussions

Figure 3. Analysis of the subcategory: Sustainability and Society.



Source: Own elaboration based on study data.

The numbers 4, 5, 6, 7, 9, 10, 11, and 15, represented on the y-axis, correspond to the items that make up the proposed subcategory, with the following meanings:

Table 5. Survey items comprising the subcategory Sustainability and Society.

No.	Items
4	I am informed about the current excessive use of plastic and its environmental impact.
5	I know the 3R rule for helping the planet.
6	I understand what causes the greenhouse effect.
7	I can identify the relationship between pollution generated by different economic sectors and the greenhouse effect (e.g., livestock farming, agriculture, mining, etc.).
9	I know what the Sustainable Development Goals (SDGs) refer to.
10	I know what the 2030 Agenda is and agree with its objectives.
11	I understand the relationship between the following variables: economic activity (e.g., agriculture), consumption and production patterns, excessive use of resources, and sustainable development.
15	Water is an unlimited resource.

Source: Own elaboration based on study data.

Following the order shown in Table 4 for the analysis, Graph 1 clearly highlights a key advantage: educators in this study area are well aware of the

current issue of excessive plastic use and its environmental consequences, with 86.31% acknowledging this problem. However, from a research perspective, this also presents an opportunity for improvement among educators, faculty authorities, and the educational institution itself, given that 13.69% of respondents exhibit either a lack of knowledge or interest in this issue, which is noteworthy.

According to Huseyin et al. (2025) the United Nations University (UNU) aims to raise environmental awareness among educators worldwide, as they play a crucial role in social life and achieving the Sustainable Development Goals (SDGs). Similarly, Merma-Molina et al. (2023) highlight the need to integrate sustainable development topics into university curricula, as current programs lack sufficient quality in this regard.

Silva Lopes (2024) conducted a study similar to the present one, concluding that sustainable education is essential for promoting development, particularly through curriculum design and providing educators with relevant information and training. This is especially important due to the lack of courses and actions addressing environmental issues such as climate change and pollution.

Another significant opportunity for improvement was found regarding the 3R rule: 23.71% of educators either do not know about it or are indifferent to its importance. Furthermore, 5.48% of professors lack knowledge about the greenhouse effect, which is alarming for higher education faculty. Additionally, 13.98% of respondents are indifferent to learning about this impact, meaning that 19.46% of educators exhibit a knowledge gap that needs to be addressed.

Vargas-Merino et al. (2025) argue that incorporating sustainable development perspectives into educational environments is a complex process with significant challenges, particularly regarding competencies. Therefore, educational institutions face a considerable challenge. Another improvement area was identified regarding the relationship between pollution generated by different economic sectors and the greenhouse effect. In the study area, key economic activities include livestock farming, agriculture, fishing, and mining. However, 21.58% of respondents either lack interest in (16.41%) or are unaware of (5.17%) this relationship, while 78.42% claim to understand it.

Regarding the statement, "I know what the Sustainable Development Goals (SDGs) refer to," 10.34% of educators admitted to being unaware of them, while 18.84% showed indifference. This clearly indicates a gap in sustainable education among faculty members, which leads to a lack of

promotion of sustainability-related topics due to either disinterest or ignorance.

Research by Yan et al. (2025) confirms that higher education instructors' green and environmental initiatives are strongly linked to their education and social responsibility. These researchers propose integrating social responsibility strategies into curricula to educate and train both faculty and students on sustainability issues.

Similarly, Zhang et al. (2025) argue that university professors should maintain sustainable leadership both inside and outside the classroom, always aiming to influence student and societal development positively. The SDGs play a crucial role in this. Bui et al. (2024) also stress the urgency of global changes aligned with sustainable development, given the degradation of the environment and the overexploitation of resources. They emphasize that higher education institutions (HEIs) should adopt the SDGs as a tool for promoting sustainability initiatives in both teacher and student education. Leal et al. (2024) highlight that university students' sustainable attitudes are closely related to their education—what they are taught in their curricula—as well as factors such as age and gender. Therefore, institutions must focus on fulfilling their role as educators, with faculty sustainability training playing a crucial role in this regard.

When asked about the 2030 Agenda and its objectives, 16.11% of educators demonstrated a lack of knowledge, making this another area for improvement in faculty education. Furthermore, 24.92% of educators showed indifference or did not care about this important sustainable development action plan. In total, 41.03% of respondents represent a significant group that needs sustainability training and could also become key stakeholders in promoting sustainable development.

Significant advances in higher education aligned with the 2030 Agenda should be a priority in today's world. The commitments made in 2015 to achieve progress toward the SDGs between 2020 and 2030 should be central to national education policies and the development of new university programs (Paz Reyes, 2023). For Lacruhy Enríquez (2024) integrating the 2030 Agenda into universities means providing high-quality sustainable education. However, the current challenge is precisely that: universities must generate and transmit knowledge and sustainability education through teachers and their subjects.

Similarly, in a report on the implementation of the 2030 Agenda in universities, Miñano & García Háro (2020) argue that: "One of the most important ways universities can help society achieve the Sustainable

Development Goals (SDGs) is by leveraging their training potential to empower individuals responsible for implementing these goals" (p. 6).

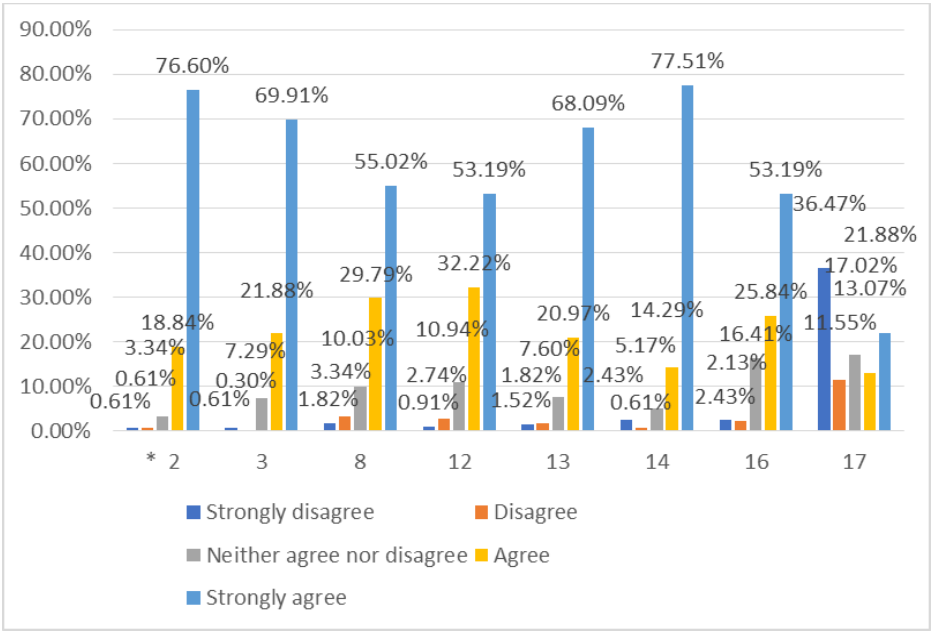
In another aspect, regional economic activity plays a significant role in local development. When analyzing the relationship between economic activity, consumption and production patterns, excessive resource use, and sustainable development, 10.3% of educators failed to identify these connections, which highlights a lack of awareness of their local environment and the impact of economic activities on sustainability—such as agriculture and its environmental repercussions, including resource overexploitation. Additionally, 20.36% of respondents stated they were indifferent to this relationship.

According to Kozar (2023), from an academic perspective, assert that economic activity and its sustainability impact can be positively influenced through various means, particularly by integrating technology into production systems. Farinmade et al. (2018) also emphasize that the quality of ecosystems largely depends on economic activities, as informal sector activities can have particularly harmful environmental consequences. Similarly, Li et al. (2024) argue that economic activity and mass resource exploitation degrade the environment. They propose that the education sector can help address these issues by implementing strategies that promote structural and widespread transformation toward sustainable development.

Additionally, Haladu et al. (2025) emphasize the need to promote sustainable strategies through education to mitigate environmental issues caused by economic activities and raise awareness of sustainability-related information. Studies such as (Jaafar & Maideen, 2012) suggest that economic activities negatively impact sustainability and recommend implementing innovative actions to mitigate these effects. Similarly, Roy et al. (2021) assert that economic activities threaten the sustainable stability of countries, highlighting the necessity of transitioning toward more sustainable practices.

Although 69.61% of respondents claimed to understand the relationship between economic activity and sustainability, which is encouraging, 30.66% of educators lack this knowledge, making it a priority area for improvement that university authorities and faculty should address to enhance their education and professional development in modern times. Finally, the subcategory surprisingly concluded with a statement claiming that "water is an unlimited resource," to which 35.87% of university educators agreed. This result strongly confirms a significant lack of information on sustainability and environmental issues, presenting not only a training opportunity but also a serious knowledge gap on a critical social issue that must be addressed.

Figure 4. Analysis of Subcategory 2: Individual Knowledge on Sustainability.



Source: Own elaboration based on study data.

The numbers 2, 3, 8, 12, 13, 14, 16, and 17, represented on the y-axis, correspond to the survey items that make up the subcategory presented, as detailed below:

Table 5. Survey items comprising the subcategory: Individual Knowledge on Sustainability.

Table 6. Survey items comprising the subcategory: Individual Knowledge on Sustainability.

No.	Items
2	Talking about sustainable development involves addressing environmental, economic, and social issues.
3	I know the word sustainability and understand its meaning.
8	Population health depends on how environmental governance and sustainability issues are addressed.
12	In my daily life, I implement actions to conserve water, recycle, and reuse materials.
13	In my daily life, I save electricity (turning off lights, air conditioning, etc.).
14	In my daily life, I dispose of waste in the correct place.
16	I care about the future of society, which motivates me to take action to protect nature and the planet through activities within my reach, e.g., taking 5-minute showers, using bath and laundry water for plants, composting organic waste.
17	I use solar panels as a sustainable alternative for clean and renewable energy.

Source: Own elaboration based on study data.

When presented with the statement that discussing sustainable development means addressing environmental, economic, and social issues, only 1.22% disagreed, meaning they do not identify these topics as aligned with this variable. However, 18.84% of educators demonstrated a lack of interest in this issue, which should be considered an area for improvement in teacher training.

A revealing insight, which also represents an opportunity for improvement, is that 5.16% of respondents do not believe that population health depends on how environmental governance and sustainability issues are managed. Regarding this, Kamate & Rajagopal (2025) state that there is a very close relationship between social governance, environmental sustainability, pollution, natural resource use, and public health.

Similarly, Khan & Khan (2024) emphasize that environmental governance is a crucial factor for achieving positive changes toward sustainable development and is directly linked to variables such as environmental damage and public health. This is supported by Naseer et al. (2025), who explain that economic governance is directly related to the impacts of economic activities, environmental factors, and sustainability. Additionally, 11.25% of educators—comprising those who disagreed or showed indifference—do not implement daily actions to conserve water, recycle, or reuse materials. These are well-known activities that can significantly improve environmental conditions, both locally and globally.

On this matter, Mayo Lara et al. (2023) argue that education for sustainability is essential for societal well-being and must be promoted both inside and outside the classroom, at individual and collective levels, to generate a positive impact on people's surroundings. In line with this, Nambo de los Nambo de los Santos (2023) highlights the link between sustainability and education, explaining that education can create appropriate spaces inside and outside the classroom for both students and society. Similarly, Burgos Briones et al. (2019) emphasize that teachers play a crucial role in sustainable education, influencing not only their students but also various stakeholders inside and outside the classroom. The authors further state that educators contribute to global awareness starting at the local level.

Alternatively, 10.94% of educators are indifferent to or unwilling to implement energy-saving actions, while 8.21% do not care about properly disposing of waste. Within the same context, 48.02% of educators do not use solar panels as an alternative energy source, representing another opportunity for raising awareness about clean energy solutions. However, it is also important to consider that the high cost of these technologies may be a limiting factor for many individuals.

Figueroa-Moctezuma et al. (2022, 38) state that "alternative energy sources provide a means of obtaining energy different from conventional sources. These types of energy have significant advantages: they do not pollute, they are renewable (i.e., they do not deplete), and they do not harm the environment".

According to Aguilar de la O (2021) Mexico requires time for a proper energy transition, as society and the government have not yet taken that step. The country lacks legal mechanisms and requires greater ambition in this regard. Similarly, Silva Rodríguez de San Miguel (2019, 1) points out that "Mexico has made progress in financing renewable energy projects. However, political, administrative, bureaucratic, and socio-political deficiencies still persist." This clearly indicates that Mexico must undergo a transitional phase to advance in sustainable energy adoption.

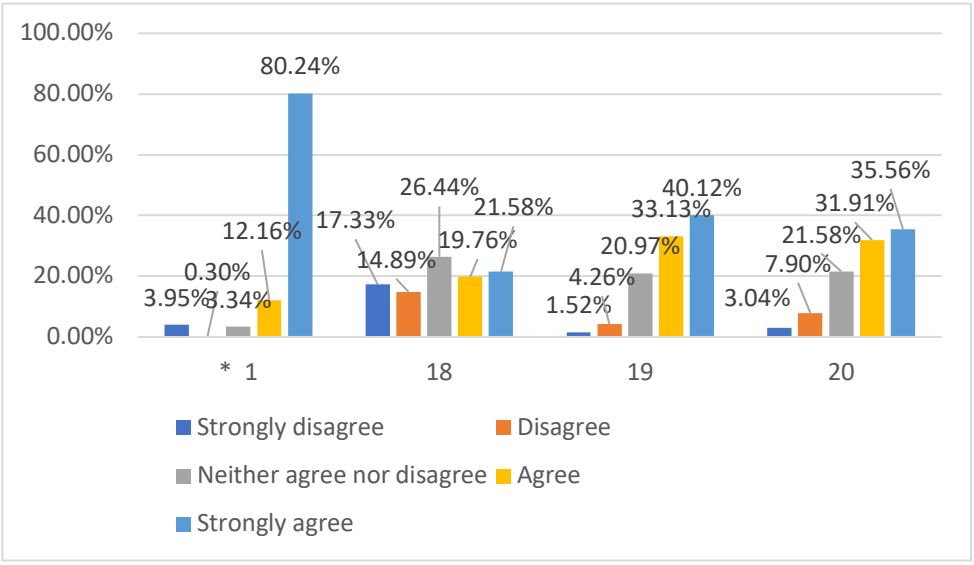
When presented with the statement, "I care about the future of society, which motivates me to take action to protect nature and the planet," only 4.56% disagreed. However, 16.41% of educators showed indifference to this issue, revealing a significant group that lacks concern and engagement in sustainability efforts. Addressing this population through awareness programs and training could be highly beneficial. Regarding this issue, Cantó Doménech et al. (2013, 642) emphasize that "with adequate preparation, teachers can contribute to better learning and sensitization of future educators toward sustainable behaviors, care, and respect for the environment in the broadest sense."

According to UNESCO (2023) an example of successful sustainability education can be found at Luangprabang Teacher Training College (LBTTC) in the Lao People's Democratic Republic, where teacher support programs have been implemented to guide educators on how to improve sustainable education both inside and outside the classroom in response to growing global environmental concerns. Furthermore, according to UNESCO's guidelines for reorienting teacher education toward sustainability, "we must examine the fundamental principles of sustainable development and apply them to teacher education and training" (UNESCO, 2005, 13).

Through the analysis of Figure 2, several key issues were identified that can be addressed by university authorities and educators themselves. However, it is also important to highlight positive aspects, such as the high level of awareness among educators regarding the importance of sustainability-related information, particularly in items 2, 3, 13, and 14The concepts "Sustainable teacher training" and "Individual knowledge on sustaina-bility" form the first cluster, indicating a closer relationship between them in terms of proximity within the Euclidean space. Subsequently, this

group merges with "Sustainabil-ity and society" at a greater distance, suggesting that the latter concept has lower similari-ty with the first two compared to their internal relationship.

Figure 5. Analysis of Subcategory 3: Sustainable Training for Teachers



Source: Own elaboration based on study data.
*. The numbers 1, 18, 19, and 20, represented on the y-axis, correspond to the items that make up the mentioned subcategory, and their meaning is presented below:

Table 7. Survey Items Comprising the Subcategory of Sustainable Teacher Training.

No.	Items
1	I consider it important to be informed and prepared on topics related to sustainable development.
18	Institutionally (at my workplace), I receive training on sustainable development topics: climate change, circular economy, ecology, environment, environmental governance, sustainable policies, social health, social responsibility, among others. E.g., conferences, congresses, courses, workshops, debates, etc.
19	Personally, I seek ways to train myself and stay informed on sustainability-related topics, environmental protection, pollution and its effects, the green economy, among others.
20	I have basic preparation to disseminate or inform about sustainability topics, environmental issues, climate change, renewable energy, water conservation, waste management, recycling, reuse of objects, social health, green economy, among others.

Source: Own elaboration based on study data.

Figure 5 and Table 5 specifically address aspects of sustainable teacher training, whether through institutional or personal initiative. In this regard, the most significant aspects identified as opportunities for improvement were the following:

Regarding institutional training, a considerable percentage of teachers (32.22%) emphasized that they do not receive such training, in addition to 26.44% who refrained from giving an opinion, possibly due to a lack of knowledge on the subject. However, the key point is that this represents 58.66% of teachers highlighting the lack of training provided by educational institutions—a crucial aspect for improvement. A study by Yan (2008) on sustainable training initiatives for teachers in China suggests the development of intercultural programs addressing sustainability topics, which, according to research, lead to long-term favorable outcomes for the environment.

Similarly, Calavia et al. (2023) point out that teachers face complex challenges in their daily activities but that there are methodologies that can help improve their training in relevant topics like sustainability. One such method is Design Thinking (DT), based on the Think-Create-Teach (TCT) methodology. For Nguyen et al. (2022) educational institutions should prioritize sustainable development training for teachers, a poorly explored area with limited information available. Likewise, Buerkle et al. (2023) highlight the challenges in sustainable teacher training, including the gap between intended goals and actual implementation in areas such as the Sustainable Development Goals (SDGs).

On the other hand, 20.97% of teachers expressed indifference toward personal training, and an additional 5.78% do not take on this responsibility at all. This results in 26.75% of teachers who do not actively pursue self-management in sustainability training. According to Najjarpour (2024, 1) in his study on teacher self-management, "achieving goals and aspirations, as well as managing emotions, thoughts, and behaviors in different situations, are key components of self-management competency." Thus, attitudes, skills, ways of thinking, and the ability to navigate different contexts determine teachers' self-management and initiative in training on sustainability issues.

A study by (Pečiuliauskienė, 2025) underscores that a major challenge in teacher self-management—including personal training efforts—is the ability to search for information effectively, which limits professional development. Similarly, in their research on teacher self-management in educational settings, Aristizábal Cárdenas & Jiménez Guzmán (2022) conclude that today's educators must adapt to changing environments and societal expectations, especially regarding attitudinal and strategic aspects related to sustainability.

Further, Barrón Tirado et al. (2022) emphasize in their study on educational self-management that teachers should actively seek professional development opportunities, including training programs and initiatives that address current global challenges.

Lastly, 10.94% of respondents indicated that they do not feel prepared to discuss or disseminate sustainability-related topics such as climate change, pollution, and renewable energy. Additionally, 21.58% showed disinterest or indifference toward being trained in these key areas. According to Silva Lopes (2024) sustainability and climate change education in universities must regain prominence, through the implementation of strategies that promote awareness and the development of research initiatives in educational practices.

Conclusion and recommendations

Undoubtedly, the topic analyzed is of shared impact and global interest, as demonstrated throughout the entire manuscript (particularly through the theoretical and reference contributions, as well as the discussion of the findings). Likewise, the study's findings are crucial for positive changes in the mindset of individuals (teachers) and their actions toward their own sustainable development and commitment to society, as emphasized by the underlying theory of the work. In this sense, the contribution of research such as this one, especially in the field of education, guarantees the generation of novel knowledge and a positive impact on society.

The research aimed to identify areas for improvement in sustainable training for higher education teachers in the northern region of a university in Sinaloa, Mexico. While positive aspects were found regarding teachers' knowledge of sustainability topics, the primary goal of this study is to equip higher education institutions (HEIs) with data to empower educators as agents of sustainable change within universities. Thus, the study emphasizes the need for teacher training and professional development in sustainability, as these aspects are fundamental to the societal transitions currently required to ensure well-informed individuals on issues of global importance.

Educational institutions play a crucial role in training their faculty, and the study indicates that there is still progress to be made—both in terms of training outcomes and the initiatives and programs that institutions design and implement. conversely, teacher self-management in professional development is lacking, with insufficient professionalism and proactive attitudes regarding sustainability, both inside and outside the classroom.

Sustainability remains a modern yet poorly understood concept among certain segments of society. This study clearly indicates that teachers must take responsibility as professionals guiding society's learning processes

in all aspects and through contextually relevant training approaches. Integrating the SDGs and the 2030 Agenda as cornerstones for teacher training will help clarify and streamline this process.

Finally, the study highlights that significant challenges persist regarding sustainability in education. Even with available information and dissemination methods, some key actors are not fulfilling their roles. Further research will be essential for proposing solutions and tools to strengthen the efforts of all stakeholders involved.

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