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SUSTAINABLE TEACHER TRAINING IN HIGHER EDUCATION AT A MEXICAN PUBLIC UNIVERSITY: OPPORTUNITIES FOR IMPROVEMENT IN THE NORTH-CENTRAL REGION OF SINALOA

FORMACIÓN SUSTENTABLE DE DOCENTES DE EDUCACIÓN SUPERIOR EN UNA UNIVERSIDAD PÚBLICA MEXICANA: OPORTUNIDADES DE MEJORA EN LA REGIÓN CENTRO-NORTE DE SINALOA

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Resumen

Se analiza la formación sustentable en docentes de nivel superior, con el fin de identificar áreas de oportunidad para que las IES (Instituciones de Educación Superior) empoderen como agentes de cambio a profesores. El estudio es cuantitativo, descriptivo y transversal. Se midió la consistencia interna mediante una encuesta basada en la escala de Likert, que se aplicó a través de Google Forms a 133 de los 171 profesores de una universidad pública de Sinaloa, México. La medición mediante Omega de McDonald (ω =0.883) fue adecuada. Se encontraron oportunidades de mejora, los maestros se sienten preparados para promocionar algunos temas sustentables, aunque el tema es poco común dentro y fuera del aula, y cuentan con poco apoyo institucional para capacitarse. Las IES deben tomar su rol como agentes de cambio y promotores de políticas sustentables.

Palabras clave: Sustentabilidad; medioambiente; agentes de cambio, agenda 2030; docencia.

Abstract

Higher Education Institutions (HEIs) are communities of people that must seek and promote global sustainable development through knowledge generation and teaching with an emphasis on sustainability. Education and sustainability are two key tools for achieving actions toward ideal sustainable development across all spheres of society. This research examines the teaching environment through a sustainability lens within public higher education institutions; this required analyzing the work and practices of faculty members regarding sustainability-focused education in order to identify opportunities for improvement. Thus, the study analyzes sustainability training among higher education faculty to identify areas where HEIs can empower professors to act as agents of change. The study employs a quantitative, descriptive, and cross-sectional approach. A Likert-scale survey was used, divided into three subcategories: 1) individual knowledge of sustainability, 2) sustainability and society, and 3) teacher training in sustainability. The survey was administered via Google Forms to 133 of the 171 professors across three faculties/schools at the main public university in Sinaloa, Mexico. To ensure high-quality, accurate, and timely results, the instrument's internal consistency was measured using McDonald's Omega coefficient [ω] via JASP 0.16.1 software; the resulting ω of 0.883 indicated that the proposed items were appropriate. The study results reveal deficiencies suggesting a need for a more comprehensive approach. Various opportunities for improvement were identified regarding faculty training in sustainability; while professors feel prepared to

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promote certain sustainability topics, the subject is rarely addressed inside or outside the classroom, and they receive limited institutional support for training. Higher education institutions must embrace their role as agents of change and promoters of sustainable policies; training on sustainability issues will always be a crucial tool in social development, and education will help shape personalities and behaviors, as well as correct courses of action, address and resolve social problems or phenomena, provide guidance, and achieve diverse objectives that generate a positive impact.

Keywords: Sustainability; environment; agents of change, 2030 Agenda; teaching.

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1. Introduction

This research observes the teaching environment under a sustainable approach in public universities at a higher level; for this purpose, it was necessary to analyse the work and actions of teachers in the search for sustainable education, to identify opportunities for improvement. The context of sustainable and environmental education was studied in the faculties and/or schools belonging to the north-central zone of a public university located in the state of Sinaloa, as the area of study, for which Three study variables were formulated: individual knowledge about sustainability, sustainability and society and, finally, sustainable teacher training.

Sustainable development must be immersed in all the activities that society, productive sectors and scientific community develop (Chu et al., 2023). In this way, it is in universities where profound social changes are promoted and where efforts to achieve suitable sustainable changes are grouped (Dlouhá & Pospíšilová, 2018). These institutions have been immersed in processes of sustainability performance evaluation in their campuses and staff (Adenle et al., 2021).

According to Hernández-Barco et al. (2022) “sustainability has recently become a common context for teaching and promoting universal values” (p. 1). Oinonen and Paloniemi (2023) argues that young people can be drivers of sustainability, depending on their commitment to and knowledge of the natural environment, in this way, the contribution and empowerment of young people play a key role in achieving green goals (Rexhepi et al., 2018).

Fu et al. (2023) point out that there are social inertias and stimuli that make people participate or not in activities as sustainability. Thus, sustainable teacher training can be a powerful tool for positive social change (Miśkowiec, 2023). Filho et al. (2021) highlight that universities are working to achieve adequate sustainable development; however, face challenges in implementing strategies. An important enabler for achieving sustainability goals will always be education (Buerkle et al., 2023). Universities have a moral duty to align the curriculum to this important development factor and to train their teaching staff to do so. The results show shortcomings that suggest the need to adopt a more holistic approach, the aim of this research is to identify what sustainable training higher education teachers have, and, and as professionally educated population remain empowered as agents of change.

Regarding the Latin American region, there are a variety of studies that clearly point to the need for education more aligned with the Sustainable Development Goals (SDGs) and the 2030 Agenda, as UNESCO itself states: "Without teachers, there is no quality education. Without education, there is no sustainable development" (UNESCO, 2025). In addition to the teacher

shortage, the region is facing a lack of teacher training, with a lack of sustainable-aligned training, the International Organization points out.

Similarly, Samaniego-Luna (2025) emphasizes that sustainable training for university professors is essential to achieving sustainable goals. There are challenges, such as the need for universities to train their professors in this regard, as well as to foster inter-institutional collaboration in this regard, to raise awareness and promote green initiatives.

For their part, Sánchez-Contreras & Murga-Menoyo (2019) argue that it is very clear that teachers lack sustainable training and, therefore, that institutional strategies must be implemented to increase teacher participation in training issues in this regard.

Supporting the above, Corbetta (2018) argues that environmental education is a shortcoming in the Social Sciences. Universities aligned with this branch of study have regressed in this training, including teaching pedagogy, which requires immediate attention.

Finally, García-Rangel et al. (2022) argue that:

University teaching must be revalued in terms of its contribution to sustainable development, since through its practice, the social relevance of professional training is realized through the development of practices and content that bring students closer to the economic, social, and environmental realities in which they live. (p. 48)

A study on sustainable education in Mexico, including the state of Sinaloa, concluded that while HEIs have sought to migrate toward a more environmental education approach, the effort has not been sufficient, nor have the results. Requiring fewer disciplinary barriers and greater teacher training programs, as well as better public policies for improvement (Sánchez et al., 2022).

In another case study in Sinaloa, Mexico, according to Cervantes-Rosas et al. (2024), university teaching should always be linked to the 2030 Agenda and its sustainable goals, but professors must maintain a series of initiatives and practices consistent with this, through activities such as research, recycling, family gardens, among others, as well as teaching.

Continuing, Ramírez López et al. (2018) argue in a study on the environmental situation and sustainability in Sinaloa that sustainable education is lacking, and the variable of sustainable culture is unknown, much less applicable.

As can be seen, the Latin American region and Sinaloa, Mexico, require greater attention to the variable of sustainable education from HEIs. Teachers, as bastions of support for achieving this, play a decisive role in this regard, but they lack support and training in this regard.

In this way, the following objectives, questions and hypotheses are raised in relation to the study:

1.1. Research objectives

To identify, in terms of sustainable education, what teachers lack in their training.

Identify, for HEIs and their teachers, areas of opportunity or improvement for sustainable training

That HEIs and their teachers become agents of social change aligned with sustainable development.

1.2. Hypothesis

University teachers lack comprehensive sustainable training, so HEIs must take care to provide them with adequate training in terms of SDGs, Agenda 2030 and/or Sustainable Development, an aspect that will make them agents of social change.

2. Methodology

A cross-sectional quantitative-descriptive methodology was used. A survey was designed and applied using Google Forms to 133 of 171 teachers (see Table 1), attached to 3 academic units in the study area (see Table 2), as proposed by (Torres et al., 2006).

Tabla 1

Sample calculation

Parameter	Variable	Value
Population size	N	171
Confidence level (95%)	Z	1.96
Probability of success	P	50.0%
Probability of failure	Q	50.0%
Accuracy	D	4.00%
Sample size	n	133.3 ≈ 133

Where:

$$n = \frac{N \times Z_a^{\,2} \times p \times q}{d^2 \times (N-1) + Z_a^{\,2} \times p \times q}$$

Tabla 2

Distribution of surveys by academic units

Academic units in the study area	Number of teachers	Teachers surveyed
Academic unit 1	75	56
Academic unit 2	60	49
Academic unit 3	36	28
Totals	171	133

To analyse the variables, the instrument used was structured in 20 Likert-type items, a common technique in social research (Memmedova & Ertuna, 2024) and divided into 3 subcategories: 1 Individual knowledge about sustainability, 2 sustainability and society, and 3 sustainable teacher training. The questionnaire was subjected to internal consistency measurement (McDonald's Omega coefficient (ω) through the JASP 0.16.1 software, supported by the University of Amsterdam (MacDougall, 2024), obtaining a value of ω=0.883, which according to Frías-Navarro (2025), is adequate, i.e., the items are consistent.

2.1. Statistical análisis

Once the information was obtained, a normality analysis was performed using the Kolmogorov-Smirnov test, finding that both the category and its subcategories had a p-value of 0 (less than 0.05), which suggests abnormal data Arias and Molina (2017), (see Table 3). Thus, it was decided to use Kendall's nonparametric Tau-B test:

Tabla 3

Kendall's Tau-B non-parametric test

	Kolmogorov-Smirnov	
	Statistic	Sig.
Sustainable and environmental education	0.282	0.000
Individual knowledge of sustainability	0.306	0.000
Sustainability and society	0.273	0.000
Sustainable teacher training	0.240	0.000

Kendall's Tau statistic evaluates the intensity of the relationship between two continuous random variables, identified as X and Y, in relation to the relative order of each possible pair of elements, and is therefore used to analyse the relationship between qualitative variables of an ordinal nature or continuous variables whose observed values are replaced by discrete categories; When contrasting the category 'Sustainable and environmental education' with the subcategories 'Individual knowledge on sustainability', 'Sustainable teacher training' and the

category 'Sustainability and society' using this statistical test, statistically significant correlations were identified, with a value of less than 0.05 between the category and its respective subcategories (see Table 4).

Tabla 4

Correlations between sustainable and environmental education with the subcategories

Category	Subcategory	Correlation value	Type of correlation	Significance level
Sustainability and environmental education	Individual knowledge of sustainability	0.743	Strong	0.000
	Sustainability and society	0.471	Moderate	0.000
	Sustainable teacher training	0.735	Strong	0.000

These correlations are categorised according to the proposal of Rajbahadur et al. (2022) whereby the results show that 'Sustainable and environmental education' clearly specifies a strong correlation between 'Individual knowledge on sustainability' and 'Sustainable teacher training' and presenting a moderate correlation with the dimension 'Sustainability and society'.

It is important to note that to validate the instrument used to collect data, what was proposed by López Fernández et al. (2019) was used, who proposes validating in various ways, among these, the judgment of experts in order to ensure that the reagents, items or questions, as the case may be, fulfilled their function of adequate measurement of the subject or variables studied, as well as subjecting the instrument to a pilot test to identify possible problems in its writing or understanding.

3. Analysis and discussion of results

3.1. Individual knowledge about sustainability

Figure 1

Analysis of values obtained regarding dimension 1: individual knowledge of sustainability and the items that comprise it

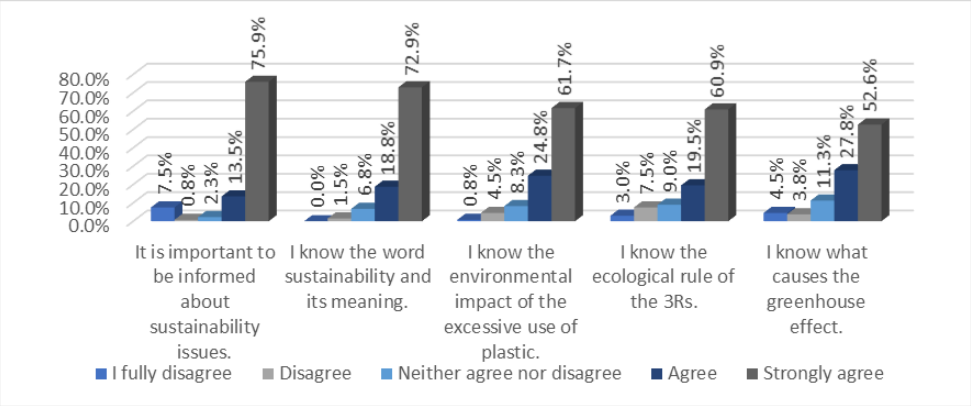


Figure 1 shows that 8.3% of teachers do not consider important to be informed about sustainable topics, 1.5% do not identify the word sustainability and its meaning, 5.3% do not know the environmental impact of the excessive use of plastic, 10.5% do not know what the ecological rule of the 3Rs is, which to mention an example, mainly occurs in the food industry, where waste management is a latent problem worldwide (Yeung et al., 2020). 8.3% do not know what the greenhouse effect and its negative effects are, which according to Scheiner (2023) is a process by which gases in the earth's atmosphere that absorb infrared radiation trap heat and thus influence the climate.

Thus, the five aspects discussed in previous paragraphs are factors that university authorities should consider improving with the implementation of actions such as sustainable training courses for teachers.

The 89.4% of teachers feel well prepared to manage and promote information related to sustainability. In this regard, Fekih Zguir et al. (2021) state that several countries are working on institutionally implementing topics such as the SDGs (Sustainable Development Goals), however, this adoption process has become very difficult due to several challenges in terms of policies, strategies and actions.

In an item-by-item analysis, regarding whether the respondent knows the word sustainability, and in particular about the public that requires attention in training on the topic (6.8% say they do not care and 1.5% say they do not know this term and its context), Lopes et al. (2023) point out that universities and their teachers have challenges to meet in this regard. Similarly, graph 2a shows that the 91.7%, clearly identify what the term sustainability refers to, however, as corroborated in the section on environmental facts (see Figure 2), not all of them take actions to change the course for a better society and planet in sustainable aspects.

As to whether the respondent feels informed about the current situation of the excessive use of plastic and its environmental impact, 5.3% of the teachers surveyed said they were not

informed, which, although not a very high number, shows that there are still teachers uninformed about these issues, which has implications for their own professionalism and for student education. 86.5% said they were informed and 8.3% were indifferent, which, as noted above, implies the same apathy and lack of interest in these issues.

Regarding to whether teachers identify the 3Rs rule, 10.5% of the them and 9.0% of the teachers who do not care whether they know about it or not, are the group of interest that needs to be educated on this important aspect, since the rest, 60.9% of the teachers said they know this technique very well, representing the teaching professionals of this regional unit as well informed about it, which is undoubtedly good news. For Dawodu et al. (2022) and Zainudin et al. (2021), sustainable development strategies and solutions for many countries should emanate from universities, such as the 3R technique and proper waste management.

About the relationship between pollution generated in sectors of the economy and the greenhouse effect, Du et al. (2023) state that If society tends to be concerned about the environmental state of the surroundings in which it exists, this can help reduce the pollutants emitted by companies.

The teachers' answers show that they identify the negative impact on the environment generated by economic activities, 81.9% said so. On the other hand, greater attention should be given to the group of teachers who do not know about such effects, 8.3%, as well as teachers who did not express themselves in favour or against this phenomenon, 9.8%, perhaps due to lack of interest or ignorance of the subject, but representing an opportunity for improvement for 18.1% of those surveyed.

Regarding this situation in Latin America and the Caribbean, UNESCO has generally raised the issue of a lack of sustainably trained or quality teachers in the region's classrooms, which they argue represents a negative impact on the sustainable development of young people (UNESCO, 2025).

Al respect, Avendaño & Febres Cordero-Briceño (2019) they point out that the challenges in the educational field in this century demand proactive and self-critical training from the educator, which means that he or she must use different paths to approach and understand the environmental dynamics with which he or she interacts from the complexity.

For López-Leyva (2024) who conducted a study on sustainable education in Latin America, although in recent decades the region has been at the world average of teachers educated for sustainability, this has currently decreased due to the lack of policies that strengthen the training of academic staff.

In a study conducted in Mexico on university teacher training, it was found that more than half of these teachers are having problems integrating sustainable topics into their educational experience (Yépez González et al., 2023).

Figure 2

Analysis of values obtained for dimension 1: Individual knowledge of sustainability and its component items

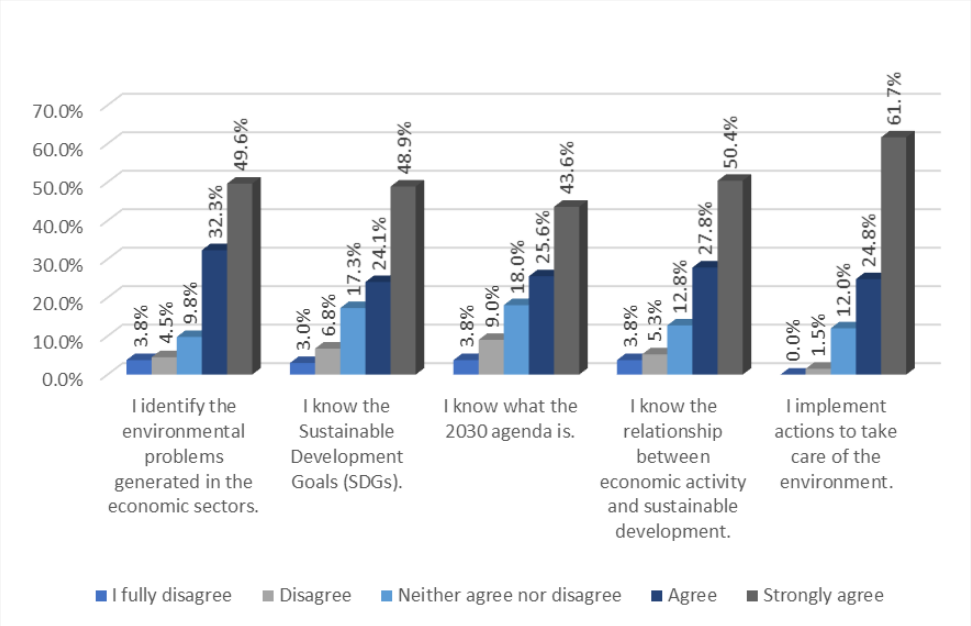


Figure 2 shows that some teachers can improve to become agents of change and development for society. It was found as opportunities for improvement that 8.3% of those surveyed do not identify the environmental problems generated by the economic sectors and their activities (agriculture, livestock, fishing and others), in addition to the fact that 9.8% do not care whether they identify such phenomena. It is important to point out that 81.9% are clear about the environmental problems generated by economic activity, However, historical reality dictates that it is not enough to be clear about what to do, but to do it.

Regarding the identification of the SDGs (Sustainable Development Goals) and their purposes, 9.8% do not know about them, an aspect that needs to be improved by training management by the institution itself or by the teacher in a self-taught way. In this regard, 73% of teachers do identify such objectives. it represents a significant number of teachers who might not be interested in such an important topic today. For Lacruhy Enríquez (2024) teachers and HEIs in Mexico must focus on training students who understand the SDGs, this will provide them with transversal skills when they enter the labor market.

According to an academic work by Huerta-Estévez et al. (2023) in Mexico, education based on the 2030 Agenda has not met its objectives; of the planned goals, progress has only been made on two of them.

In this regard, the graph above shows that 69.2% of the respondents know about the 2030 agenda and its aims, while a percentage to be considered, 13.7%, together with those who do not care whether they know about this topic or not, 18.0%, are a public that requires professional training on this current topic.

Another point addressed was the relationship between economic activity and sustainable development, and 78.2% of the teachers surveyed acknowledged that they strongly agreed that they were aware of this relationship. However, it is worth noting that 9.1% do not understand the relationship between the variables, which should represent an opportunity for improvement in the training of teachers who do not know how economic activity is intertwined with various factors of sustainable development, together with the 12.8% who were neutral in their response on this relationship, which together would mean 21.9%.

When relating economic activity and sustainability, these two variables have a direct impact on economic development and growth, however, adequate levels of these cannot be achieved without giving the necessary attention to one of the dimensions that frames sustainability, which is the environment, where ecological and pollution aspects, among others, are contemplated. London et al. (2021) clearly point out that intensive natural resource exploitation activities are a challenge for sustainable development. In this sense, Mexico's economic growth model has maintained this trend throughout its productive history.

In this regard, the Mexican government, through its agency responsible for sustainable development and the environment, believes that "one of the main challenges facing our country is decoupling economic growth from environmental degradation and, at the same time, promoting sustainable development that fosters better well-being for Mexicans" (Secretaría de Medio Ambiente y Recursos Naturales [SEMARNAT], 2021, p. 1).

Finally, dimension one addressed the respondent's day-to-day actions to care for the environment. The responses obtained in this parameter show that 86.5% of teachers say that they agree with actions such as caring for water, recycling and reusing, i.e. they say that they do carry out such activities. Likewise, 12% of the respondents indicate to be neutral to the implementation of such actions, so in relation to Escario et al. (2020) who tell us that waste-related behaviours reported by an individual are affected by environmental attitudes. According to the above analysis; in the case of Mexico, according to Sánchez-Contreras & Murga-Menoyo (2019) a significant portion of teachers require aligning their teaching skills, as

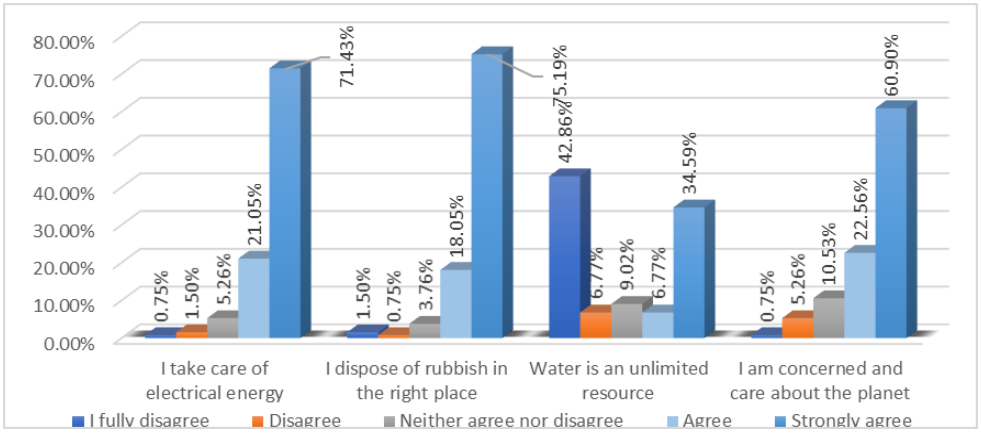
well as teaching and training strategies, to sustainable development, that is, they require better training on this subject.

3.2. Sustainability and society

In social work on sustainable issues, there is an opportunity for improvement since, although 2.25% of teachers do not agree with the current care given to electrical energy, which, added to the 5.26% who are indifferent to this issue, represents 7.51%. It is important to point out that 92.4% of the teachers strongly agree with the care of electrical energy and the economic benefits that this implies (See Figure 3).

Figure 3

Dimension 2 sustainability and society and the items that comprise it



Abdallah et al. (2021) mention that buildings of different sizes and housing consume a lot of energy due to cooling demand; especially in hot and arid climates. 21.1% chose to agree, which can be directly reflected in the economic benefit to teachers through the reduction of electricity consumption costs.

93.24% stated that it is very important in their daily activity to deposit waste in the right place, coinciding with Jin et al. (2023) researchers who point out that the classification of waste determines the efficiency of recycling and increases the sorting capacity of it. In that sense, 2.25% of the teachers indicated that it is not important to deposit the rubbish in its place, while 3.76% of them are indifferent to where it is deposited. These last two data can be seen as an area for improvement, due to the sensitivity of the issue.

Regarding whether the respondent identifies water as an unlimited resource, the answers clearly indicate that 41.36% of the teachers are wrong with their answer, since this important percentage of teachers stated that water is unlimited, which is a problem that needs to be

addressed as an area for improvement. 49.63% stated that water is a limited resource and 9.02% were indifferent.

As can be seen in the previous paragraph, identifying basic aspects is complicated for some teachers. In this regard, for Colín-Mercado et al. (2020) the Mexican educational system, including its teaching staff, still has challenges to achieve, mainly related to teacher training and education to offer quality education with a focus on sustainable development.

It can be mentioned that for human consumption purposes groundwater is the main source of water, as stated by Pham et al. (2023) who state that the purpose of groundwater use depends on the perception that people have of its quality and thus the confidence for its use and consumption, in contrast to the above response 34.6% of the teachers strongly agree that water is an unlimited resource, which is alarming as it may lead these people to indiscriminate and irrational use of water as mentioned by Dowlati et al. (2023) who point out that the impact of climate change and human consumption patterns on water resources is vulnerable.

In a study carried out in Mexico by Figueroa-García (2023) on how HEIs influence society's behavior in terms of sustainable or unsustainable consumerism, it is concluded that the training provided by teachers is not a determining factor in this variable, as interest groups are, although it recognizes that institutions are beginning to change this role.

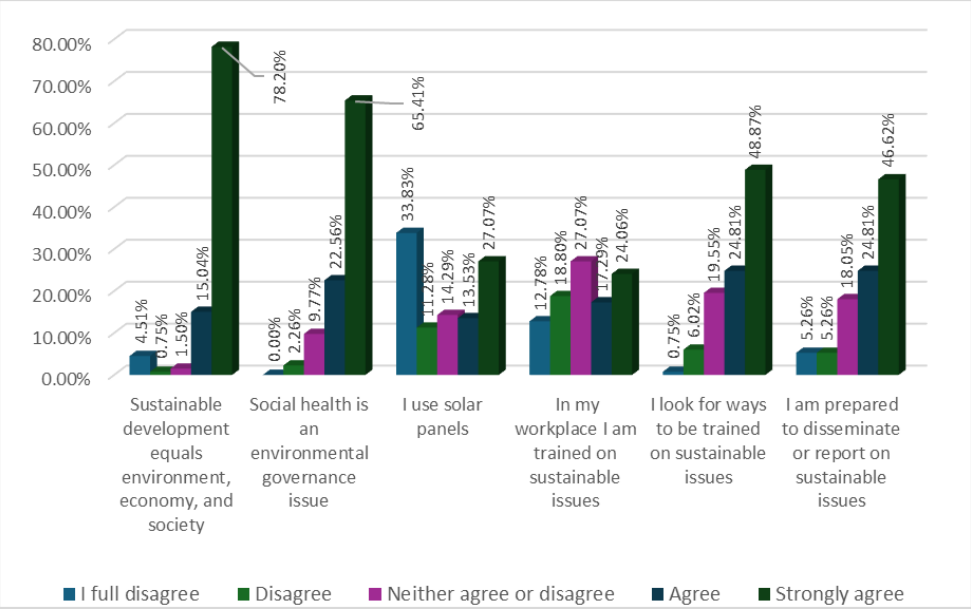
On the aspects about actions on sustainable and prospective issues as a society, 83.46% of the teachers expressed concern and engagement with the future of the planet. Hermundsdottir & Aspelund (2022) comment that it is important for academics to understand how the adoption of sustainability strategies and innovations influences social and economic developments. In this variable it was also found as an opportunity for improvement that 6.01% of the teachers stated that they were not concerned and/or engaged in pro-planetary activities, on the other hand, 10.5% of the teachers said they remained neutral towards these activities.

Finally, disdain the Latin American perspective, for authors such as Núñez-Paula (2019) sustainable development must be aligned with higher education, including social responsibility and sustainability practices that key actors must replicate in all contexts where they develop, including teachers, who must be adequately trained by the HEI.

3.3. Sustainable teacher training

Figure 4

Dimension 3 sustainable teacher training and its component items



On Figure 4 analysis, as areas of opportunity it was found that 5.26% of the teachers consider that sustainable development is not the same as environmental, economic and social well-being, when these three terms are the guiding principles of sustainability in any sphere or social sector. 93.24% said that they are the same thing.

Droubi et al. (2023) point out that "to achieve a just transition, education systems need to be transformed; this implies moving away from neoliberal educational practices, primarily with curricula that can achieve sustainable growth" (p. 1). In this sense, Monforte García et al. (2017) explain that higher education teachers in Mexico have a generalized idea of the concept of sustainability, but in practice there is much to be done in this regard.

Frizon & Eugénio (2022) underline that the whole world faces environmental, social and economic problems, which can be mitigated through a sustainable deal approach. Universities need to adequately rethink their contributions to a more sustainable society (economically, socially and environmentally) (Fernándes-Sánchez et al., 2022). Singh and Segatto (2020) point out the perception of the dimensions addressed in sustainability, economic, social and environmental, on the part of students and everyone, must be in direct coherence with sustainable development.

For example, in Latin America, a study by López-Albán et al. (2022) shows that university professors need to transition their pedagogical work towards eco-environmental variables, assuming their role as educators of today and tomorrow. Teachers acknowledge the lack of effective communication strategies with students on environmental issues, as well as the lack of projects or interaction with communities.

Regarding social health as an issue of environmental governance, it is detected as a problem to be addressed that 2.26% of respondents have the perspective that social health does not have much to do with the work of the government for it to be adequate. Although this does not represent a scandalous figure, added to the 9.77% who remained disinterested or neutral in this regard.

On the other hand, 87.97% of the teachers surveyed strongly stated that social health depends to a large extent on what is done and/or not done by the government in terms of environmental governance, because many of the diseases that occur in the population can be generated by environmental pollutants (Cazzolla Gatti et al., 2023; Chen et al., 2024).

According to García Jiménez (2022) in Mexico, strategies have been established so that the government, together with educational institutions, reach levels of, for example, adequate environmental governance, to address problems such as climate change, among others.

As Thrall et al. (2023) put it in a study on environmental and social movements and governance, in which exemplifies the attention given to this type of phenomenon by the administration or government of President Biden of the United States of America. Other studies such as that of Kühnel et al. (2023) analyse critical aspects of environmental governance, concluding that in some situations incorrect governance is related to social health problems, such as environmental and pollution.

About the use of solar panels for the use and exploitation of clean and renewable energies, 33.8% are inclined to strongly disagree with these actions, which indicates a degree of misinformation and an area of opportunity about the benefits of using them as suggested by Song et al. (2023) authors who state that individuals and businesses need to understand the challenges involved in balancing factors such as energy costs, reliability and sustainability.

Continuing, 27.1% of the teachers chose the option to strongly agree and 13.5% to agree with the use of solar panels as a sustainable alternative, this indicates that they are aware of the benefits of using such alternatives, as suggested by Liu et al. (2023) to adjust the structure of the energy industry and infrastructure to produce low-carbon energy to promote the sustainable development of the energy industry and the utilization rate of clean energy.

In the case of Mexico, and in particular the role of education in paradigm shifts regarding the use of alternative energies such as those mentioned above, Larrondo Montalvo, (2025) director of the Bachelor's degree in Energy Technology Engineering at the Universidad Panamericana in Aguascalientes, Mexico, points out that "it is not only about teaching about renewable energies, but also about improving the efficiency in the use of current energy resources and

promoting innovation in energy storage." (p. 1). In this way, by promoting these factors, the use of this type of energy is being promoted by society in general, including teachers themselves.

Regarding institutional training for teachers on sustainable development issues, the largest number of respondents, 27.1%, remained indifferent, i.e. neither agreeing nor disagreeing, perhaps because they opt for self-taught training, representing a loose end and an opportunity for improvement for the educational institution, together with 31.6% respondents, who state that they do not receive institutional training, while 41.35% indicated that they do (72.41%).

The above analysis indicates the absence of institutional training in sustainable issues, which is relevant as Caffaro et al. (2022) mention that training influences safety and health at work and has a notable impact on the sustainability of companies. However, the perspective of sustainability has often focused mainly on environmental and economic concerns, leaving social and labour aspects in the background.

Similarly, to train on sustainable issues, but managed personally by the teacher, 48.9% of respondents strongly agree to seek training and be informed about issues related to sustainability, care for the environment, pollution and its effects, green economy, society-environment relationship, among others, and 24.8% of teachers strongly agree to carry out such activities on a personal basis, this aspect shows the interest and awareness that teachers have in particular in training and informing about sustainability and environmental issues, which is vital for their daily professional work as mentioned by Yeh and Barrington (2023) who state that teachers' roles have become even more influential in the success and well-being of students, and are fundamental to the effectiveness of any school-wide improvement, which has enormous social and economic implications.

Finally, the question of whether teachers feel prepared to disseminate information about sustainable and environmental issues was addressed. In this regard, the responses were very convincing, 71.4% feel prepared in a basic way to disseminate or inform about the sustainable issues mentioned above.

This shows the readiness of teachers to raise awareness, research and dissemination on the relevant topics of this research, since according to Fekih Zguir et al. (2022) who tell us that the level of awareness must increase as decision makers are confronted with the dangers and irreversible damages of the increasing trends of wasteful consumption and production. On the other hand, but perhaps more relevant than the above, it is detected that 18% of teachers remain neutral in stating that they feel prepared to develop, inform and disseminate on sustainability issues. As a further problem to be addressed, 10.5% of teachers do not feel trained for the above-mentioned tasks.

Finally, Cruz (2024) emphasizes that in Mexico dimensions such as sustainability and the environment are not addressed firmly, especially in legal aspects, not because the resources in that sense do not exist, but because the Mexican state does not do so.

3.4. Sustainable and environmental education

When grouping the items in the Three dimensions (individual knowledge about sustainability, sustainability and society and sustainable teacher training) it is possible to identify the context of sustainable and environmental education, it was found that 12.53% of the respondents do not feel that they have the necessary skills for the tasks mentioned above. This represents a challenge for improvement for educational institutions in terms of training their staff in such an important social issue, something that, in the same way, occurred with respect to their capabilities, where 24.82% said so.

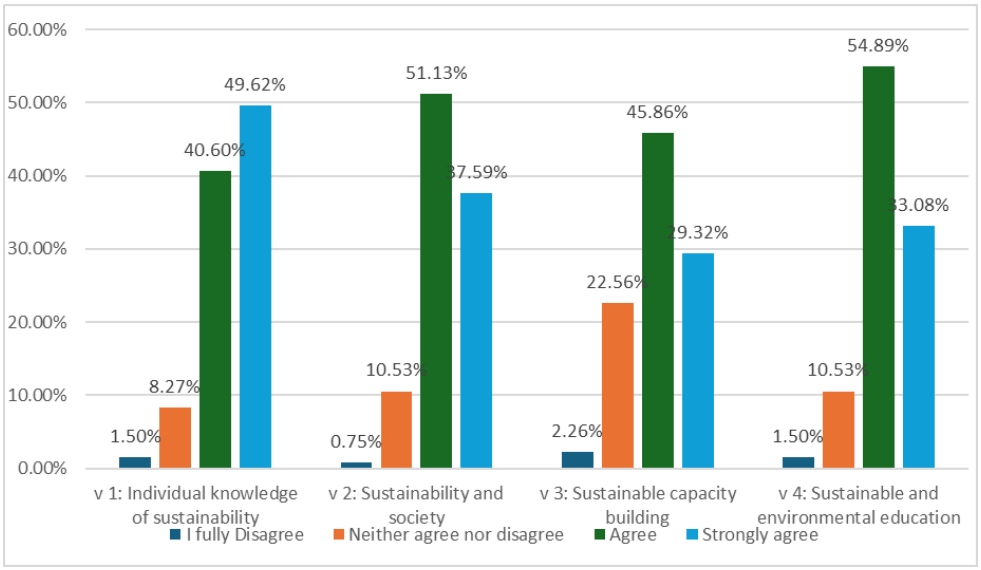
On the other hand, 11.78% of the teachers clearly stated that there is a lack of knowledge of terms such as sustainability, perceived as an area for improvement for HEIs (Higher Education Institutions), so that efforts will also be required to socialize and identify these issues more among their participants (see Figure 1). In this respect, 9.77% of the respondents do not feel well about being informed on sustainable issues, and, in some way, addressing them in their subjects, which should be attended by the authorities of the faculties and schools.

Similarly, most of the teachers consider that the environmental, economic and social dimensions are directly related to the issue of sustainable development (93.2%), while 5.3% of the teachers consider that these Three dimensions are not related to sustainable development. Finally, it is concluded that most of the respondents are confident about their knowledge on the analysed topics, and although strategies are required to help strengthen the sustainable education of teachers, there are aspects that denote that they are currently doing well in their sustainable work (see Figure 5).

As an important aspect to consider to complete the writing, Ortiz Palafox (2021) states that in countries like Mexico, social actors pursue economic interests more than sustainable development, while in relation to environmental education, Martínez-Gallegos (2021) highlights that environmental education is only a political discourse that aims to make the population believe that we want to achieve ecological balance and promote social justice, "the hegemonic definition of sustainable development is promoted as satisfying the current needs of people without compromising the capacity of future generations, when currently the needs of the present cannot even be satisfied" (p. 530).

Figure 5

Behaviour among the Three *dimensions analysed (individual knowledge on sustainability, sustainability and society and sustainable teacher training) and environmental education*



4. Conclusions and recommendations

Latin America as a region represents a significant array of challenges and opportunities in diverse areas, sustainable education being one of them. While the topic of sustainable development is not new, the regional context lacks relevant information and actions that favor the environmental, social, and economic environment. Even though HEIs may seem to be a path to achieving this, the path requires adjustments aimed at the real achievement of green objectives. That is, they need to channel information analysis, knowledge generation, and teaching, placing greater emphasis on sustainability and its three guiding principles. In this regard, teachers will have to play their role as agents of social change. In this regard, the study concludes with the following considerations:

Education helps to address and solve social problems or phenomena, to guide and achieve objectives of positive impact for regions and the planet, it can provoke significant changes in awareness and citizen participation, but without knowledge of related issues and strategies to address them adequately from the appropriate places, it is useless, and that is where the challenge for HEIs arises, as key actors, they need to propose from their institutional policies, educational models, institutional development plans, study programs, curricula and teaching work through appropriate training programs, proposals for change aligned with this training, not as a panacea, but more as a proposal for the solution of real phenomena that occur in society.

Although teachers show a personal interest or initiative in learning about various topics related to sustainable development, and most say they are prepared to be information managers or promoters, university life is permeated by misinformation, a lack of training and institutional leadership, mainly in aspects of training on topics related to the study variable, such as: sustainability, sustainable development, use of clean and alternative energy, social responsibility, among others, all contemplated within the 2030 Agenda and SDGs.

Finally, the findings presented in this study will serve as a starting point for new research on the subject, as well as for making comparisons between studies from different areas and universities in the region, in order to find similarities and differences in issues of environmental literacy in education, provide solutions, and replicate them as a training model that is aligned with current social needs.

5. References

Abdallah, A. S. H., Makram, A., & Abdel-Azim Nayel, M. (2021). Energy audit and evaluation of indoor environment condition inside Assiut International Airport terminal building, Egypt. *Ain Shams Engineering Journal*, *12*(3), 3241-3253. https://doi.org/10.1016/j.asej.2021.03.003

Adenle, Y. A., Chan, E. H. W., Sun, Y., & Chau, C. K. (2021). Assessing the relative importance of sustainability indicators for smart campuses: A case of higher education institutions in Nigeria. *Environmental and Sustainability Indicators*, *9*, Art. 100092. https://doi.org/10.1016/j.indic.2020.100092

Arias, M. M., & Molina, M. (2017). Lectura crítica en pequeñasdosis ¿Qué significa realmente el valor de p? *Rev Pediatr Aten Primaria*, *19*, 377–381.

Avendaño, M. N. V., & Febres Cordero-Briceño, M. E. (2019). Environmental Education and Education for Sustainability: history, fundamentals and/Educación Ambiental y Educación para la Sostenibilidad: historia, fundamentos y tendencias. *REVISTA ENCUENTROS*, *17*(02). https://doi.org/10.15665/encuent.v17i02.661

Buerkle, A., O'Dell, A., Matharu, H., Buerkle, L., & Ferreira, P. (2023). Recommendations to align higher education teaching with the UN sustainability goals – A scoping survey. *International Journal of Educational Research Open*, *5*, Art. 100280. https://doi.org/10.1016/j.ijedro.2023.100280

Caffaro, F., Roccato, M., De Paolis, G., MichelettiCremasco, M., & Cavallo, E. (2022). Promoting farming sustainability: The effects of age, training, history of accidents and social-psychological variables on the adoption of on-farm safety behaviors. *Journal of Safety Research*, *80*, 371-379. https://doi.org/10.1016/j.jsr.2021.12.018

CazzollaGatti, R., Di Paola, A., Monaco, A., Velichevskaya, A., Amoroso, N., & Bellotti, R. (2023). The spatial association between environmental pollution and long-term cancer mortality in Italy. *Science of The Total Environment*, *855*, Art. 158439. https://doi.org/10.1016/j.scitotenv.2022.158439

Cervantes Rosas, M. de los Á., De Anda Montaño, R. E., Portillo Molina, R., & Rojas Escárrega, D. I. (2024). Las instituciones de educación superior y el desarrollo sostenible: *Revista de Investigación Latinoamericana En Competitividad Organizacional*, *6*(21), 30–43. https://doi.org/10.51896/rilco.v6i21.419

Corbetta, S. A. (2018). Educación y ambiente en la educación superior universitaria: itinerarios en clave de la perspectiva crítica latinoamericana. *Revista Educación*, 534–549. https://doi.org/10.15517/revedu.v43i1.29143

Chen, T., Jiang, H., He, Y., Shen, Y., Huang, Z., Gu, Y., Wei, Q., Zhao, J., & Chen, X. (2024). Nanoplastics and chrysene pollution: Potential new triggers for nonalcoholic fatty liver disease and hepatitis, insights from juvenile Sinipercachuatsi. *Science of The Total Environment*, Art. 171125. https://doi.org/10.1016/j.scitotenv.2024.171125

Chu, L. K., Doğan, B., Dung, H. P., Ghosh, S., & Alnafrah, I. (2023). A step towards ecological sustainability: How do productive capacity, green financial policy, and uncertainty matter? Focusing on different income level countries. *Journal of Cleaner Production*, *426*, Art. 138846. https://doi.org/10.1016/j.jclepro.2023.138846

Colín-Mercado, N. A., Llanes-Sorolla, L., & Iglesias-Piña, D. (2020). El sistema educativo en México, ¿visión sustentable? *Revista CoPaLa. Construyendo Paz Latinoamericana*, (9), 155-170. https://doi.org/10.35600/25008870.2020.9.00157

Cruz, A. H. (2024). Desarrollo sustentable y sus regularizacionesambientales en México. *Universita Ciencia*, *12*, 1145. https://doi.org/10.5281/zenodo.14343952

Dawodu, A., Dai, H., Zou, T., Zhou, H., Lian, W., Oladejo, J., & Osebor, F. (2022). Campus sustainability research: indicators and dimensions to consider for the design and assessment of a sustainable campus. *Heliyon*, *8*(12), e11864. https://doi.org/10.1016/j.heliyon.2022.e11864

Dlouhá, J., & Pospíšilová, M. (2018). Education for Sustainable Development Goals in public debate: The importance of participatory research in reflecting and supporting the consultation process in developing a vision for Czech education. *Journal of Cleaner Production*, *172*, 4314-4327. https://doi.org/10.1016/j.jclepro.2017.06.145

Dowlati, M., Seyedin, H., Behnami, A., Marzban, A., & Gholami, M. (2023). Water resources resilience model in climate changes with community health approach: Qualitative study. *Case Studies in Chemical and Environmental Engineering*, *8*, Art. 100521. https://doi.org/10.1016/j.cscee.2023.100521

Droubi, S., Galamba, A., Fernandes, F. L., De Mendonça, A. A., & Heffron, R. J. (2023). Transforming education for the just transition. *Energy Research & Social Science*, *100*, Art. 103090. https://doi.org/10.1016/j.erss.2023.103090

Du, W., Li, M., Fan, Y., & Liang, S. (2023). Can public environmental concern inhibit the market entry of polluting firms: Micro evidence from China. *Ecological Indicators*, *154*, Art. 110528. https://doi.org/10.1016/j.ecolind.2023.110528

Escario, J.-J., Rodriguez-Sanchez, C., & Casaló, L. V. (2020). The influence of environmental attitudes and perceived effectiveness on recycling, reducing, and reusing packaging materials in Spain. *Waste Management*, *113*, 251-260. https://doi.org/10.1016/j.wasman.2020.05.043

FekihZguir, M., Dubis, S., & Koç, M. (2021). Embedding Education for Sustainable Development (ESD) and SDGs values in curriculum: A comparative review on Qatar, Singapore and New Zealand. *Journal of Cleaner Production*, *319*, Art. 128534. https://doi.org/10.1016/j.jclepro.2021.128534

FekihZguir, M., Dubis, S., & Koç, M. (2022). Integrating sustainability into curricula: Teachers' perceptions, preparation and practice in Qatar. *Journal of Cleaner Production*, *371*, Art. 133167. https://doi.org/10.1016/j.jclepro.2022.133167

Fernándes-Sánchez, F. E., Leite-Campos, M., Eduardo, G.-L., & Marcio, M. B. (2022). Proposal for sustainability action archetypes for higher education institutions. *International Journal of Sustainability in Higher Education*, *23*(4), 915-939. https://doi.org/10.1108/IJSHE-01-2021-0026

Figueroa-García, E.-C. (2023). Factores que determinan el comportamiento sustentable en las instituciones de educación superior. Un modelo para Querétaro, México. *Revista*

Iberoamericana de Educación Superior, *XIV*, 55-76. https://doi.org/10.22201/iisue.20072872e.2023.39.1529

Filho, W. L., Amaro, N., Avila, L. V., Brandli, L., Damke, L. I., Vasconcelos, C. R. P., Hernandez-Diaz, P. M., Frankenberger, F., Fritzen, B., Velazquez, L., & Salvia, A. (2021). Mapping sustainability initiatives in higher education institutions in Latin America. *Journal of Cleaner Production*, *315*, Art. 128093. https://doi.org/10.1016/j.jclepro.2021.128093

Frías-Navarro, D. (2025). *Apuntes de estimación de la fiabilidad de consistencia interna de los ítems de un instrumento de medida.* Universidad de Valencia. https://www.uv.es/friasnav/AlfaCronbach.pdf

Frizon, J. A., & Eugénio, T. (2022). Recent developments on research in sustainability in higher education management and accounting areas. *The International Journal of Management Education*, *20*(3), Art. 100709. https://doi.org/10.1016/j.ijme.2022.100709

Fu, X., Qian, Q. K., Liu, G., Zhuang, T., Visscher, H. J., & Huang, R. (2023). Overcoming inertia for sustainable urban development: Understanding the role of stimuli in shaping residents' participation behaviors in neighborhood regeneration projects in China. *Environmental Impact Assessment Review*, *103*, Art. 107252. https://doi.org/10.1016/j.eiar.2023.107252

García Rangel, F., Vega Cano, R., & Vallaeys, F. (2022). Ética, Desarrollo Sostenible y Responsabilidad Social desde la docencia en instituciones de educación superior latinoamericanas. *Emerging Trends in Education*, *4*(8), 48–61. https://doi.org/10.19136/etie.a4n8A.4729

García Jiménez, M. (2022). El docente y la educación ambiental en México. En T. ChicaizaVillalba, S. García Jiménez, & C. J. Núñez Rodríguez (Coords.), *Cambio climático. Acuerdos y contradicciones* (pp. 175-193). Editorial Abya-Yala. https://doi.org/10.7476/9789978108178.0010

Hermundsdottir, F., & Aspelund, A. (2022). Competitive sustainable manufacturing - Sustainability strategies, environmental and social innovations, and their effects on firm performance. *Journal of Cleaner Production*, *370*, Art. 133474. https://doi.org/10.1016/j.jclepro.2022.133474

Hernández-Barco, M. A., Sánchez-Martín, J., Corbacho-Cuello, I., & Cañada-Cañada, F. (2022). Is sustainability an exhausted concept? Bridging the gap from environmental awareness to emotional proficiency in science education through integral sustainability. *Heliyon*, *8*(12), e12546. https://doi.org/10.1016/j.heliyon.2022.e12546

Huerta-Estévez, A., Severino-Parra, C. A., & Virginia León, F. (2023). Agenda 2030 y educación de calidad en México, avances en el cumplimiento para el 2030. *RIDE Revista Iberoamericana Para La Investigación y El Desarrollo Educativo*, *14*(27), e518. https://doi.org/10.23913/ride.v14i27.1567

Jin, S., Yang, Z., Królczykg, G., Liu, X., Gardoni, P., & Li, Z. (2023). Garbage detection and classification using a new deep learning-based machine vision system as a tool for sustainable waste recycling. *Waste Management*, *162*, 123-130. https://doi.org/10.1016/j.wasman.2023.02.014

Kühnel, K., Schütte, P., Bach, V., Franken, G., & Finkbeiner, M. (2023). Correlation analysis of country governance indicators and the magnitude of environmental and social incidents in mining. *Resources Policy*, *85*, Art. 103762. https://doi.org/10.1016/j.resourpol.2023.103762

Lacruhy Enríquez, C. C. (2024). Agenda 2030 en el contexto de la educación superior y su incidencia en la contribución de la creación de valor compartido. *RIDE Revista Iberoamericana Para La Investigación y El Desarrollo Educativo*, *14*(28), e638. https://doi.org/10.23913/ride.v14i28.1853

Larrondo Montalvo, D. (2025, July 21). *Transición energética en México: retos, oportunidades y el papel clave de la educación superior*. Universidad Panamericana. https://www.up.edu.mx/escuelas-y-facultades/facultad-de-ingenieria/transicion-

energetica-en-mexico-retos-oportunidades-y-el-papel-clave-de-la-educacion-superior/

López Fernández, R., Avello Martínez, R., PalmeroUrquiza, D. E., Sánchez Gálvez, S., Álvarez4, M. Q., & Quintana Álvarez, M. (2019). Validación de instrumentos como garantía de la credibilidad en las investigaciones científicas. *Revista Cubana de Medicina Militar*, *48*(2), 441–450. http://www.revmedmilitar.sld.cu/index.php/mil/article/view/390/331

Liu, Z.-F., Zhao, S.-X., Zhao, S.-L., You, G.-D., Hou, X.-X., Yu, J.-L., Li, L.-L., & Chen, B. (2023). Improving the economic and environmental benefits of the energy system: A novel hybrid economic emission dispatch considering clean energy power uncertainty. *Energy*, *285*, Art. 128668. https://doi.org/10.1016/j.energy.2023.128668

London, S., Rojas, M. L., & Candias, K. (2021). Turismo sostenible: un modelo de crecimiento con recursos naturales. *Ensayos de Economía*, *31*(58), 158-177. https://doi.org/10.15446/ede.v31n58.88712

Lopes, J. M., Suchek, N., & Gomes, S. (2023). The antecedents of sustainability-oriented entrepreneurial intentions: An exploratory study of Angolan higher education students. *Journal of Cleaner Production*, *391*, Art. 136236. https://doi.org/10.1016/j.jclepro.2023.136236

López-Albán, M. E., Rodríguez-Vieira, M. G., & Albán-Moreta, L. A. (2022). Percepciones de los docentes sobre las acciones, gestiones y estrategias en educación ambiental en el nivel básico superior. *Polo Del Conocimiento*, *7*(8), 625-640. https://doi.org/10.23857/pc.v7i8

López-Leyva, S. (2024). La educación de América Latina percibida desde el objetivo 4 de los objetivos del desarrollo sostenible (ODS). *Información Tecnológica*, *35*(2), 23-36. https://doi.org/10.4067/s0718-07642024000200023

MacDougall, J. (2024). *A User's Guide for JASP* (Version 2.0). https://jasp-stats.org/wp-content/uploads/2024/08/MacDougall-Users-Guide-for-JASP-v-2.0.pdf

Martínez-Gallegos, H. (2021). El discurso de la sustentabilidad y la Educación Ambiental. *Educere*, *25*(81), 505-515. https://www.redalyc.org/articulo.oa?id=35666225014%0Ahttps://orcid.org/0000-0002-0722-1362

Memmedova, K., & Ertuna, B. (2024). Development of a fuzzy Likert scales to measure variables in social sciences. *Information Sciences*, *654*, Art. 119792. https://doi.org/10.1016/j.ins.2023.119792

Miśkowiec, M. (2023). Urban courtyards as local points of sustainable urban regeneration challenges to community participation in urban courtyard-related projects in Polish Cities. *City, Culture and Society*, *34*, Art. 100522. https://doi.org/10.1016/j.ccs.2023.100522

Monforte García, G., Hartmann, A. M., & Farías Martínez, G. M. (2017). Declaraciones institucionales y percepciones individuales sobre la sustentabilidad en escuelas de negocios mexicanas. *Contaduría y Administración*, *62*(1), 5-24. https://doi.org/10.1016/j.cya.2016.04.006

Núñez Paula, I. A. (2019). Educación para el desarrollo sostenible: hacia una visión sociopedagógica. *Controversias y ConcurrenciasLatinoamericanas,11*(19), 291-314. https://www.redalyc.org/journal/5886/588661549016/html/

Oinonen, I., & Paloniemi, R. (2023). Understanding and measuring young people's sustainability actions. *Journal of Environmental Psychology*, *91*, Art. 102124. https://doi.org/10.1016/j.jenvp.2023.102124

Organización de las Naciones Unidas para la Educación, la Ciencia y la Cultura. (2025, 4 de abril). *La escasez docente en América Latina y el Caribe: la UNESCO lanza un informemundial y una estrategia para fortalecer la profesión.* https://www.unesco.org/es/articles/la-escasez-docente-en-america-latina-y-el-caribe-la-unesco-lanza-un-informe-mundial-y-una-estrategia

Ortiz Palafox, K. H. (2021). Sustentabilidad y Rendición de Cuentas en México. *Revista de Ciencias Sociales*, *27*(3), 234-248. https://www.redalyc.org/articulo.oa?id=28068276020

Pham, V. C., Bauer, J., Börsig, N., Ho, J., Vu Huu, L., Tran Viet, H., Dörr, F., & Norra, S. (2023). Groundwater Use Habits and Environmental Awareness in Ca Mau Province, Vietnam: Implications for Sustainable Water Resource Management. *Environmental Challenges*, *13*, Art. 100742. https://doi.org/10.1016/j.envc.2023.100742

Rajbahadur, G. K., Wang, S., Oliva, G. A., Kamei, Y., & Hassan, A. E. (2022). The Impact of Feature Importance Methods on the Interpretation of Defect Classifiers. *IEEE Transactions on Software Engineering*, *48*(7), 2245-2261. https://doi.org/10.1109/TSE.2021.3056941

Ramírez López, J. A., Mojica Camarena, N. E., & Lozano Velázquez, D. (2018). La problemática y la carencia de una cultura ambiental para la sustentabilidad del estero de Urías. In Universidad Autónoma de Sinaloa (Ed.), *Ecoeficiencia y educación ambiental : estudio de caso en el CIAD-Mazatlán* (1st ed., Issue September 2021, pp. 32–51). Universidad Autónoma de Sinaloa.

Rexhepi, A., Filiposka, S., & Trajkovik, V. (2018). Youth e-participation as a pillar of sustainable societies. *Journal of Cleaner Production*, *174*, 114-122. https://doi.org/10.1016/j.jclepro.2017.10.327

Samaniego Luna, P. N. (2025). Retos de la educación sustentable en la educación superior. *LATAM Revista Latinoamericana de Ciencias Sociales y Humanidades*, *6*(2). https://doi.org/10.56712/latam.v6i2.3707

Sánchez-Contreras, M. F., & Murga-Menoyo, M. Á. (2019). El profesorado universitarioante el proceso de ambientalización curricular: Sensibilidad ambiental y práctica docente innovadora. *Revista Mexicana de Investigacion Educativa*, *24*(82), 765-787.

Scheiner, S. M. (2023). Greenhouse Effect. In *Encyclopedia of Biodiversity* (Third Edition, pp. 307-323). Academic Press. https://doi.org/10.1016/B978-0-12-822562-2.00132-8

Secretaría de Medio Ambiente y Recursos Naturales. (2021, 26 de marzo). *Producción y ConsumoSustentable.* Gobierno de México. https://www.gob.mx/semarnat/acciones-y-programas/produccion-y-consumo-sustentable

Singh, A. S., & Segatto, A. P. (2020). When relational capabilities walk in education for sustainability scenario. *Journal of Cleaner Production*, *263*, Art. 121478. https://doi.org/10.1016/j.jclepro.2020.121478

Song, M., Latif, M. I., Zhang, J., & Omran, M. (2023). Examining the energy trilemma index and the prospects for clean energy development. *Gondwana Research*, *122*, 11-22. https://doi.org/10.1016/j.gr.2023.06.002

Torres, M., Paz, K., & Salazar, F. (2006). Tamaño de la muestra para una investigacion de mercado. *BoletínEconómico Universidad Rafael Landívar*, *02*, 1–13. http://moodlelandivar.url.edu.gt/url/oa/fi/ProbabilidadEstadistica/URL_02_BAS02 DETERMINACION TAMAÑO MUESTRA.pdf

Thrall, J. H., Brink, J. A., & Zalis, M. E. (2023). The Environmental, Social, Governance Movement and Radiology: Opportunities and Strategy. *Journal of the American College of Radiology, 21*(2), 265-270. https://doi.org/10.1016/j.jacr.2023.02.036

UNESCO. (2025). *La escasez docente en América Latina y el Caribe: la UNESCO lanza un*. La Escasez Docente En América Latina y El Caribe: La UNESCO Lanza Un Informe Mundial y Una Estrategia Para Fortalecer La Profesión. https://www.unesco.org/es/articles/la-escasez-docente-en-america-latina-y-el-caribe-la-unesco-lanza-un-informe-mundial-y-una-estrategia

Yeh, C. S.-H., & Barrington, R. (2023). Sustainable positive psychology interventions enhance primary teachers' wellbeing and beyond – A qualitative case study in England. *Teaching and Teacher Education*, *125*, Art. 104072. https://doi.org/10.1016/j.tate.2023.104072

Yépez González, B. L., Vásquez Ramos, A., & Hernández Martínez, C. E. (2023). La Percepción Social de la Sustentabilidad en Docentes de la Facultad de Pedagogía Veracruz. *Ciencia Latina Revista CientíficaMultidisciplinar*, *7*(5), 10708-10725. https://doi.org/10.37811/cl_rcm.v7i5.8716

Yeung, Y. H., Lin, R., Liu, Y., & Ren, J. (2020). 3R for food waste management: fuzzy multi-criteria decision-making for technology selection. In J. Ren (Ed.), *Waste-to-Energy* (pp. 75-110). Academic Press. https://doi.org/10.1016/B978-0-12-816394-8.00004-5

Zainudin, A. Z., Yunus, N. M., Zakaria, S. R. A., & Mohsin, A. (2021). Design for sustainability integration in education. In S. M. Sapuan, & M. RidzuanMansor (Eds.), *Design for Sustainability* (pp. 139-169). Elsevier. https://doi.org/10.1016/B978-0-12-819482-9.00002-2

Zúñiga Sánchez, O., Marúm Espinosa, E., & Rodríguez Armenta, C. E. (2022). La Educación para el desarrollo sostenible en la educación superior: El efecto de las áreas del conocimiento en las concepciones del profesorado universitario. *Education Policy Analysis Archives*, *30*. https://doi.org/10.14507/epaa.30.7271