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# Sustainability in Teaching: An Evaluation of University Teachers and Students

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**Abstract:** Since the 1970s, interest in caring for the environment has gained traction and the environmental education movement has gained momentum. The Talloires Declaration was the first document to incorporate sustainable development into higher education. After that, higher education institutions assumed the social responsibility of training human resources with a sustainable vision. This study aimed to contribute to the design of indicators that could be used to evaluate the efficacy of the sustainability taught at the Universidad Autónoma de Guerrero (Autonomous University of Guerrero) in Mexico. We administered a survey to 63 teachers and 511 students from four academic units in high schools, and undergraduate and postgraduate programs. The answers were analyzed using the F-test and the variable descriptions. For the environmental, social and economic indicators, the satisfaction levels of teachers and students were more positive in graduate and undergraduate programs than in the high school. To determine the efficacy of the teaching function in terms of sustainable education, as well as to fulfill the commitments acquired to achieve sustainability, institutional processes need to be strengthened.

**Keywords:** sustainability; teaching; evaluation; higher education

## 1. Introduction

### 1.1. Sustainability

In the words of González et al. [1], sustainability's incorporation into higher education institutions (instituciones de educación superior, IES) in the Iberoamerican region, which includes Latin America, Spain and Portugal, is a relatively new process. Its history can be traced back to the foundation of the Environmental Sciences Formation International Center (Centro Internacional de Formación en Ciencias Ambientales, CIFCA), in 1975. Then in 1985, the University and Environment in Latin America and Caribbean Seminary (Seminario Universidad y Medio Ambiente en América Latina y el Caribe) was founded in Bogotá, Colombia. However, despite progress, sustainable development is not yet a finished concept. In the literature, the definition of sustainable development, proposed in 1987 by the Brundtland Report [2,3], is widely accepted:

> The development that satisfies the needs of the present generation, without compromising the capacity of the future generations to satisfy their own needs . . . It´s a paradigm to think in a future where the environmental, social and economic considerations are balanced in the search of a better life quality.

The sustainable development concept initially had a political connotation. Later, "sustainability" was used in a more critical sense that had been lost over time. Some IES conventionally used either concept, without considering the implications [1,4]. According to Gutiérrez and Martínez [5], the

emphasis was first on the environment, but sustainable development now emphasizes social, economic, political and religious dimensions.

As these polysemic concepts of sustainable development and sustainability developed, environmental education emerged as a strategy to understand and address the growing environmental problems.

### *1.2. Sustainability in the University Curriculum: Student and Teacher Attitudes and Perceptions*

According to UNESCO, education for sustainable development fosters learning to make decisions that secure the economic, environmental and social future. To achieve this, universities are being reformed through teaching and research [6]. The commitment of IES to sustainability is also due to the decisions of university management, the signatures of the declarations and the protests of students and non-governmental organizations (NGOs) [7].

Literature was reviewed on: (a) attitudes and perceptions of students and teachers; (b) and curricular perceptions, about the inclusion of sustainability in education.

For James and Card [8], university students are the key part in diagnosing the perception and participation of practices on environmental sustainability implemented on campus, since they need to be better prepared to face sustainability issues in all aspects of life and participate in activities that have dominion over the future.

Bone and Agombar [9] conducted research in 2010 in the United Kingdom to learn about the development of literacy skills in sustainability; they conducted an online survey of 5763 students in their first year of higher education. Participants felt that the university should better prepare them for future jobs, because sustainability skills will be important to their potential employers. In addition, they indicated that they are willing to accept jobs with a small financial sacrifice, in order to be able to work in a socially and ethically responsible company. Research at Shandong University, China, shows that there is a high level of awareness in the student community about sustainability issues, but a low level of awareness of their significance. However, more than 90% showed a willingness to learn and support sustainable development practices on campus, which should be integrated into the academic activities of the university, as well as the proposal for a general course in the first year with sustainability issues [10].

Pestana and Perreira [11] showed that students at a private university in Portugal have an idea of "consistent" sustainability; they are also "well-informed" about the concept and motivated to encourage companies to adopt sustainable practices in human resources management. A study was carried out at the University of Dammam in Saudi Arabia (Faculty of Architecture and Planning) adapting the Sustainability Assessment Questionnaire (SAQ) to the context. Among the findings, the lack of interest and willingness of respondents to participate in the initiatives [6] stands out.

Based on the previous references, it can be said that students show varied knowledge and attitudes, so it is necessary to strengthen the implementation of sustainability in order to achieve more positive perceptions; since these are formed as thinking, values and attitudes change on the acquired knowledge and result in actions (Dobes, cited by [12]). In this context, universities as trainers must assume greater responsibility [9].

Uitto and Saloranta [13] surveyed 442 teachers from 49 schools in Finland. There were significant differences in their sustainability competence, and the frequency with which they used the ecological, economic, social, welfare and cultural dimensions in their teaching: those who considered three dimensions quite often and used holistic approaches; those who considered two or three dimensions often, but were not active in holistic teaching; and those who used one dimension or considered only a holistic approach.

Sammalisto, Sundström and Holm [12] studied how 312 professors and staff at the University of Gävle, Sweden, perceive sustainability in their roles. The findings indicated that it is difficult to achieve sustainability competence; the participation of senior management is needed; the institutionalization of sustainability needs to be included in management and in all activities; continuous training contributes

to institutionalization and its follow-up; finally, teachers and staff need to know the meaning of sustainability in order to develop their functions.

Watson, Lozano, Noyes and Rodgers [14] evaluated the sustainability content of the Civil and Environmental Engineering curriculum at the Georgia Institute of Technology, United States. The results revealed that in the courses the main focus was on the environmental dimension and cross-curricular themes. The contribution of the curriculum to education for sustainability was characterized as "medium" due to the low coverage of the economic and social dimensions. Nearly half of the students rated the quality of the curriculum as "very good". Concepts of sustainability need to be incorporated broadly into the courses so that students see sustainability in a holistic way.

Aparicio, Rodríguez, Beltrán and Sampedro [15] emphasized the environmental dimension in sustainability to determine the level of linkage of the transverse axis environment with the profile of graduation and twelve courses at the Universidad Autónoma de Guerrero, in Mexico. For 25% of teachers it is "closely linked", for 25% "partially linked", for the remaining 50% it is "little linked". The understanding of the concept of environment varies, for some it refers to environmental problems, for others it refers to biological or ecological situations; therefore, it needs teacher training to deal with it in a comprehensive manner. In a more recent study, students of the Dammam University in Saudi Arabia report that the courses offered have "little" sustainability focus [6].

Colombo and Alves [16] identified whether and how sustainability is taught in the various engineering programs of the Portuguese Public University. They studied the curricula of the 66 programs published on the university's website (15 master's degree, 27 integrated master's degree and 24 doctoral degree programs). According to the scale used, they were 9 "stronger", 17 "medium" and 40 "weaker". The authors conclude that one way to advance the integration of sustainability in education is through teacher training programs, including interdisciplinary pedagogical methodologies.

Teacher awareness is important in encouraging teachers to plan and implement interdisciplinary sustainable education. The specific experience of the sustainable education of subject teachers must be taken into account in teacher training and education [13]. Teacher training therefore needs to be strengthened. Likewise, the university should actively incorporate and promote a contextual rethinking of curricular content, even though sustainability is an unfinished concept [9]. Based on the above, the university curriculum must have a holistic vision (environmental, social, economic and cultural). Active students and staff and community involvement in sustainability initiatives is one of the main keys to change (Tilbury et al. cited by [12]). For Lozano et al. [17], sustainability could not be implemented without the participation of students, teachers, administrative staff, managers and the community [18,19].

The ideas discussed so far highlight the need for more studies on the perception of all actors, mainly students and teachers, as a way to improve practices that lead to real sustainability in the university.

There is a vast literature that reports experiences from European and U.S. universities, but it is significantly reduced in Latin America. Few universities in Mexico are striving to incorporate sustainability into their functions, but more studies are still needed. This paper aims to help fill this knowledge gap about the perceptions of students and teachers.

According to the Mexican Institute of Water Technology [20], after Oaxaca, Guerrero has the highest rate of social vulnerability, with 11 municipalities in the Montaña region, which is one of the seven socioeconomic regions of the state. Guerrero is one of the 32 states of the Mexican Republic, with an area of more than 560 $km^2$. However, Guerrero is facing socio-environmental problems caused by urban growth, land use change and alteration, and the lack of a culture of environmental conscientiousness.

The Autonomous University of Guerrero (Universidad Autónoma de Guerrero) (UAGro) is responsible for contributing to changing this reality by training future professionals, and is committed to strengthening the Sustainable Development (SD) strategies through its teaching, research,

management, and linkage activities. However, UAGro lacks instruments to measure the degree of improvements, even though this is one of the principles of its educational model [21].

### *1.3. Statements and Charters to Promote Sustainability in Universities*

Since the 1970s, these advances promoted international action and resolutions, such as the Conference on the Human Environment, held in Stockholm in 1972, the International Conference on Environmental Education in Belgrade in 1975, the declaration of the Intergovernmental Conference on Environmental Education, organized by UNESCO and the United Nations Environment Programme (UNEP), in Tibilissi in 1977, and the United Nations World Commission on Environment and Development, which unanimously adopted the aforementioned Brundtland Report, also known as "Our Common Future", in 1987 [22,23]. The Talloires Declaration in 1990, created by university presidents, chancellors and rectors from different countries, was the first official document that engaged sustainable development (SD) with higher education.

In 1991, the Halifax Declaration highlighted the importance of Higher Education Institutions (HEIs) breaking the training human resources paradigm and assuming the responsibility of changing the present and the future of society, through policies and actions that led to sustainable and equitable processes to achieve a better society and a safe environment. The UNESCO's Decade of Education for Sustainable Development (2005–2014) aimed to provide equal access to education and learning, rules, and a way of life that would foster a more sustainable future and social justice for current and future generations [24].

In 2009, UNESCO introduced a new dynamic at its World Conference on Higher Education: a higher education model that would not only teach solid competencies for today's and tomorrow's world, but would also contribute to the training of committed citizens on the protection of the environment, the construction of peace, the defense of human rights, and the values of sustainable development. This reinforces the idea that education is part of the social dimension of development [5]; thus, tools are needed to contribute to strengthening education.

In its 2020 vision, Mexico's Asociación Nacional de Universidades e Instituciones de Educación Superior (National Association of Universities and Higher Education Institutions) [25] pointed out that none of the areas of knowledge could be omitted from the environmental problem because they are all linked to social conditions and to the equal distribution of resources. Therefore, knowledge from all areas is needed for the training of critical and creative professionals who will promote respect for the environment and to propose the right actions for efficient natural resources management.

Similarly, the 2001–2006 National Development Plan envisaged that sustainability would be the backbone of the federal government. The following six-year period (2007–2012) was no exception, and for the first time, and in the same document, the importance of environmental education was explicitly mentioned. This allowed governments to obtain national and international recognition, among which the Champions of the Earth (2011), granted by the UNEP and Teddy Roosevelt (2012), stood out for their leadership in environmental matters.

The current National Development Plan (2013–2018) established five development axes; the environmental part is included in the thriving axis that is subordinate to economic policy, even though strategy 4.4.3 aims to "strengthen national climate change policy and care for the environment to move towards a competitive, sustainable, resilient and low-carbon economy". One of its lines of action states that one goal is to "Continue to incorporate sustainability and environmental education criteria into the National Education System and strengthen environmental training in strategic sectors" [26].

Without a consensus, the definition of sustainability and the indicators used to measure it remain open to interpretation. These indicators and definitions are incorporated into university curricula in different ways. A study by Scott [27] presented different explanations of the environmental, social and economic dimensions. Environmental issues include transportation, energy, water, biodiversity, computers, paper, ink and packaging. Social issues include corporate social responsibility, health, safety, ethics, quality of life, democracy and respect. Economic issues include having a viable number

of long-term students. In addition, the author defined a sustainable curriculum as that which provides students with knowledge, skills and understanding for decision-making.

For Taylor and Kraly [28], a higher education institution is sustainable if it meets certain criteria, and their list included: participation in Advancement of Sustainability in Higher Education (AASHE), a campus master plan, a short- and long-term strategic plan, initiatives, study programs, sustainability faculty members, evaluation, student clubs, and scholarships. From this list of indicators, Taylor and Kraly conducted research focusing only on curricula, relying on responses from university presidents and vice-presidents to confirm that the enrichment due to these programs was fundamental to achieving sustainability [28].

According to Agenda 21, " . . . SD indicators need to be designed to provide solid foundations that would help the decision-making at all levels and contribute to the self-regulating of the sustainability of the environment and development systems". Initiatives to create indicators to evaluate the environmental progress have emerged since 1989, like the Organization for Economic Cooperation and Development (OECD). In 1998, the efforts of the Center for Education and Training for Sustainable Development (CECADESU) and the Ministry of Environment and Natural Resources (SEMARNAT) stood out in Mexico.

Within this context, Nieto and Medellín [29] considered indicators as tools to help understand environmental problems, calculate their impact, evaluate performance, and respond. The sustainability indicators were expanded to measure the progress toward SD or demonstrate the lack thereof, with the purpose of serving as an input in the decision-making by generating information, educating and promoting environmental education, and motivating and sensitizing society. These indicators would help facilitate SD analysis and application. Accordingly, for the Mexican Consortium of University Environmental Programs for Sustainable Development (Consorcio Mexicano de Programas Ambientales Universitarios para el Desarrollo Sustentable) (COMPLEXUS) [30], adopting the indicators in Agenda 21 was considered important, enacted at the Earth Summit (Rio de Janeiro, 1992).

What are sustainable teaching indicators? For the purpose of this study, we defined these indicators as tools that measure three dimensions: environmental, social and economic. The environmental dimension is centered on the facilitation of learning that promotes the use of natural resources to ensure its permanence and the provision of environmental services in a developing context. The social dimension implies that awareness and participation lead to the reduction of poverty and inequality. The economic dimension focuses on optimization of the economic resources used, with a greater benefit for all.

The aim of this research was to contribute to the design of indicators that evaluate the sustainability of the substantive teaching function at UAGro.

## 2. Materials and Methods

This research using quantitative and descriptive analysis was developed with the participation of teachers and students from four academic units of the UAGro, located in the city of Acapulco, Guerrero. This study involved three graduate programs, an undergraduate program, and one high school: the Doctorate in Environmental Sciences of the Sciences for Regional Development Center (Centro de Ciencias de Desarrollo Regional) (CCDR), a Master in Epidemiology and a Master in Public Health of The Tropical Disease Research Center (Centro de Investigación de Enfermedades Tropicales) (CIET), a Bachelor in Tourism, and a high school (Preparatoria) No. 2.

The UAGro was chosen because the authors work at the university. It is a public university with 85,758 students and employing 2329 teachers. It includes 45 high schools, 57 undergraduate and 25 graduate degree (22 master's degrees and 3 doctorates) programs. The latter are accredited in the National Quality Graduate Program-Contact [31].

These participating programs were selected (1) to be representative of the three educational levels served by UAGro; (2) because Acapulco is the state city with the largest number of students (23,814)

and teachers (794); and (3) for the convenience of data collection in the same city, due to the insecurity and violence experienced in the area.

### *2.1. Research Steps*

#### 2.1.1. Step One

A recent analysis was completed on the national and international studies on sustainability indicators [4,20,30,32,33]. Adopting the COMPLEXUS proposal was considered feasible as it more accurately reflected the reality in Mexico. The environmental, social and economic dimensions of sustainability were reviewed. A category of indicators was assigned to each substantive function of the UAGro: teaching, research, extension and management. This article only reports on the role of teaching.

#### 2.1.2. Step Two

Once variables that integrate the substantive teaching function were proposed, the proposal was discussed with the evaluation committee, and created by the thesis director, the co-director and three advisors. We used discussion techniques and group analysis. The dialogue was guided by a moderator, within an open and non-directive climate, concluding with the validation of the variables (Table 1).

**Table 1.** Indicators and variables of substantive teaching functions.

| Indicator | Variable | Survey |
| --- | --- | --- |
| Environmental | (1) Curricula's environmental mainstreaming level | - Teachers |
| | (2) * Classroom environment | - Teachers and students |
| | (3) Number of courses and workshops on environmental education or Sustainable Development (SD.) | - Teachers |
| Social | (1) Satisfaction for the furniture | |
| | (2) Satisfaction on audio visual technology and learning material | - Teachers and students<br>- Teachers and students |
| | (3) Teacher's performance, expertise, punctuality, and respectfulness | - Students |
| Economic | (1) Economic support for teaching materials | - Teachers |
| | (2) School fees | - Students |

* In this case, environment refers to the lighting, ventilation and air-conditioning conditions in the classroom, and the use of audiovisual equipment.

Based on the above, six teaching function questions were defined for teachers and four for students (Tables 2 and 3, respectively).

**Table 2.** Teaching function indicators and questions for teachers.

| Indicators | | | Item |
| --- | --- | --- | --- |
| Enviromental | Social | Economic | |
| ✓ | | | 1. How do you feel about the following conditions while teaching your classes?<br>(A) Classroom (lighting, ventilation and air conditioning)<br>(B) Audiovisual equipment (video projector and audio) |
| ✓ | | | 2. Indicate the number of environmental education and/or sustainable development courses you have attended in the past three years. |
| | ✓ | | 3. What level of satisfaction do you have with the furniture, projection equipment, and teaching material you use for the development of your classes? |
| | ✓ | | 4. What level of teacher performance do you think describes you? |
| | ✓ | | 5. How do you see the climate of respect between teachers, students, and managers? |
| | | ✓ | 6. Do you receive financial support for teaching materials? |

**Table 3.** Indicators and questions for students for the teaching function.

| Indicators | | | Items |
|---|---|---|---|
| Enviromental | Social | Economic | |
| ✓ | | | 1. How do you feel about classroom conditions (lighting, ventilation, air conditioning, and furniture) in your classes? |
| | ✓ | | 2. What level of satisfaction do you have with the furniture, projection equipment, and teaching material used for the development of the classes? |
| | ✓ | | 3. What is the level of performance of your teachers with respect to proficiency, punctuality, and respect? |
| | | ✓ | 4. Do you agree with the cost of registration and re-registration fees for your academic unit? |

Environmental Indicator

This indicator contributes to measuring the transversal environmental axis in educational plans, including knowledge, skills, attitudes, and values, by applying the instrument proposed by Aparicio [34] to the academic units. The indicator measures the development of the functions that the teacher performs and the attendance for Environmental Education (EE) and SD courses.

The indicator investigates the teacher's knowledge of the curriculum to determine the degree to which knowledge, skills and attitudes are linked to the teacher's graduation profile and competencies. The Likert scale was used, with values from 0 to 4, where 4 represented the most positive response and 0 represented the most negative response.

Knowledge was determined through the following aspects: (1) builds knowledge about the interrelationship of air, water, soil, and ecosystems; (2) builds knowledge about the natural resources of the state of Guerrero, Mexico and the world; (3) builds knowledge about the use of natural resources; and (4) builds knowledge about the causes and consequences of environmental problems.

Skills were determined based on the following: (1) analyzes situations related to the environment; (2) evaluates environmental impact; (3) develops sustainable development projects; (4) applies methods to mitigate the effects of environmental problems; (5) promotes the use of clean technologies (ecotechnics); and (6) works with creativity and scientific rigor to solve environmental problems.

Attitudes were determined based on the following aspects: (1) natural diversity is valued; (2) respect is demonstrated for conservation and care of the environment; (3) taking responsibility for the search for alternative solutions to environmental problems; and (4) taking initiative in the construction of collective solutions.

Social Indicator

This indicator measured the teacher's satisfaction with the availability of the classroom's audiovisual technology and learning and teaching materials to teach the class. Also measured by this indicator were: the satisfaction with the work climate, among peers and students; the teacher's efficiency in terms of the expertise and development of the subject; and the punctuality and the way in which students were addressed students in the classroom.

Economic Indicator

This indicator measured the amount of support for teaching and learning materials, the economic stimuli to develop projects as perceived by academic and teaching bodies, and other activities related to the roles of teachers and learners.

2.1.3. Step Three

To identify the presence of the environment axis in the curriculum, a questionnaire was used and applied to teachers. Two other sets of questions were built: one for teachers and one for students. The first part included personal identification data, and the second part included six questions for teachers

and four for students (Tables 4 and 5, respectively). The first instrument investigated the environmental indicator; the second and third dealt with environmental, social and economic indicators.

**Table 4.** Teachers' participation in the survey.

| Academic Unit | Total Number of Teachers | Number of Participating Teachers | Participation Percentage |
|---|---|---|---|
| High School No. 2 | 51 | 24 | 45.3 |
| Bachelor in Tourism | 40 | 20 | 50.0 |
| Master in Epidemiology and Master in Public Health (Centro de Investigación de Enfermedades Tropicales)—CIET | 12 | 7 | 58.3 |
| Doctorate in Environmental Sciences (Centro de Ciencias de Desarrollo Regional)—CCDR | 12 | 12 | 100.0 |
| Total | 115 | 63 | |

**Table 5.** Students' participation in the survey.

| Academic Unit | Total Number of Students | Number of Participating Students | Participation Percentage |
|---|---|---|---|
| High School No. 2 | 1348 | 264 | 19.6 |
| Bachelor in Tourism | 936 | 187 | 20.0 |
| Master in Epidemiology and Master in Public Health—CIET | 45 | 24 | 53.3 |
| Doctorate in Environmental Sciences—CCDR | 39 | 35 | 89.7 |
| Total | 2368 | 511 | |

The probabilistic sampling technique was used to determine the participants' selection [35]. Of the 115 teachers and 2368 students from the four academic units, 54.8% and 21.5%, respectively, were sampled. Of the 63 teachers surveyed, 38.1% were female and 61.9% were male. In terms of the academic degree, 36.5% have a doctorate, 38.1% a master's degree, and 25.5% a bachelor's degree, the latter being concentrated at the upper secondary level. In relation to students, 511 were surveyed, of which 62.4% were female and 37.5% male (Tables 4 and 5).

The following formula was used to determine the sample size:

$$n = \frac{N}{1 + N(e^2)} \quad (1)$$

where $n$ is the sample size, $N$ is the population size, and $e$ permissible sampling error.

#### 2.1.4. Stage Four

The information obtained was used to elaborate the databases to perform the statistical analyses. Excel 2011 was used to perform the univariate analysis and the F-test for variance of the two samples.

## 3. Results

The results are presented for the F-test for equality of the variances of the two samples and for each indicator.

### *3.1. F-Test*

The surveys completed by teachers and students from high school, bachelor and doctorate levels were analyzed using the F-Test for variances of the two samples. The results showed an average of

teachers of 2.19 with δ 2 0.09, and an average of students of 2.40 with δ 2 0.17, within a range of zero to four, where zero was no difference and four was excellent. No significant difference was found between the number of surveys completed by UAGro teachers and those completed by students. So, the method of analysis applied to each population could be considered reliable (Table 6).

**Table 6.** F-Test for simple variances in the number of teachers and students surveyed, with the results of the level of significance and reliability of the method.

| | Students | Teachers |
|---|---|---|
| Mean (average) | 2.40 | 2.19 |
| Variance | 0.17 | 0.09 |
| Observations | 12 | 5 |
| Degrees of freedom | 11 | 4 |
| F | 1.79 | |
| P (F ≤ f) one-tail | 0.30 | |
| Critical value for F (one-tail) | 5.94 | |

Calculated F < F tables = 1.79 < 5.94.

### 3.2. Environmental Indicator

The results obtained by the first questionnaire showed that the environment axis, in terms of knowledge, skills, attitudes and values, is closely linked (81% or 42 points) to the curricula of High School No. 2, but not to the curricula of the Bachelor in Tourism (25% or 13 points) or the Master in Public Health (33% or 17 points). The Doctorate in Environmental Sciences and the Master in Epidemiology were partially linked to the environment axis with 67% or 35 points, and 58% or 30 points, respectively (Figure 1).

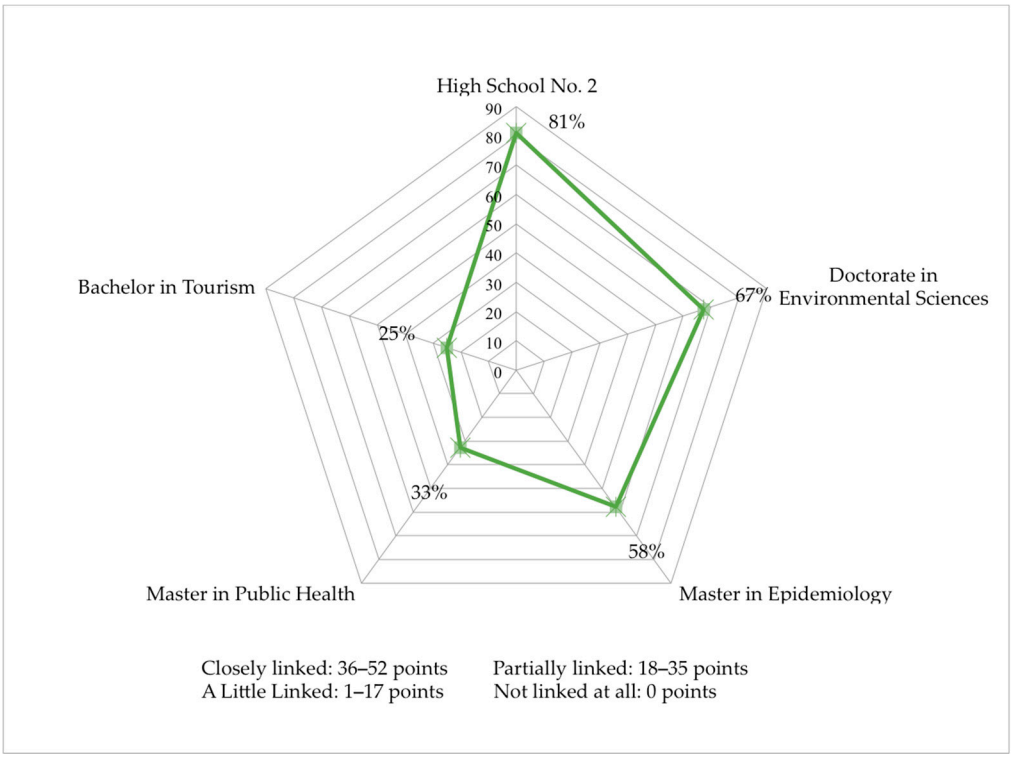


**Figure 1.** Curricula's transversality shown by the level of each component in the environment axis—knowledge, skills, attitudes and values—in the curriculum.

Regarding the classroom conditions, two masters of the CIET and in the Bachelor in Tourism indicated "excellent", whereas the Doctorate in Environmental Sciences showed a satisfactory level and High School No. 2 was somewhat dissatisfied (Table 7).

**Table 7.** Teachers' and students' satisfaction level with the lighting, ventilation and air-conditioning facilities in the classrooms.

| Academic Unit | Satisfaction Level (%) | | | | |
|---|---|---|---|---|---|
| | Excellent | Very Satisfied | Satisfied | Somewhat Dissatisfied | Dissatisfied |
| Doctorate in environmental sciences—CCDR | 8 | 17 | 58 | 17 | 0 |
| Master in Epidemiology and Master in Public Health—CIET | 43 | 29 | 29 | 0 | 0 |
| Bachelor in Tourism | 30 | 20 | 25 | 25 | 0 |
| High School No. 2 | 4 | 8 | 25 | 38 | 25 |

Table 8, referring to audiovisual equipment, shows that the teachers of the Doctorate in Environmental Sciences, the two CIET masters, and the Bachelor in Tourism were satisfied, whereas those in High School No. 2 were not satisfied. Regarding the level of student satisfaction, the results showed excellent satisfaction in both CIET masters, whereas in the Doctorate in Environmental Sciences and the Bachelor in Tourism the students stated that they were satisfied. Finally, in High School No. 2 the teachers responded that they were dissatisfied.

**Table 8.** Level of teacher and student satisfaction with audiovisual equipment in the classroom expressed in terms of the percentage of satisfaction of teachers and students with the equipment in the classroom for the support of academic activities using audiovisual technology.

| Response (%) | CCDR | | CIET | | Bachelor in Tourism | | High School No. 2 | |
|---|---|---|---|---|---|---|---|---|
| | Teachers | Students | Teachers | Students | Teachers | Students | Teachers | Students |
| Excellent | 17 | 23 | 0 | 79 | 25 | 18 | 5 | 5 |
| Very satisfied | 17 | 26 | 33 | 13 | 15 | 24 | 9 | 5 |
| Satisfied | 42 | 46 | 67 | 8 | 30 | 43 | 27 | 22 |
| Little satisfied | 25 | 3 | 0 | 0 | 20 | 13 | 18 | 41 |
| Nothing satisfied | 0 | 3 | 0 | 0 | 10 | 2 | 40 | 26 |

For the attendance at EE and SD courses, the Doctorate in Environmental Sciences teachers attended a greater number of courses (83%), followed by those in the Bachelor in Tourism (74%), the CIET masters' (71%), and High School No. 2 teachers (71%) (Table 9).

**Table 9.** Teachers' assistance with environmental education (EE) and sustainable development (SD courses.

| Academic Unit | Number of Courses (% of Teachers) | | | | |
|---|---|---|---|---|---|
| | 0 | 1–2 | 3–4 | 5–6 | 7 or More |
| Doctorate in Environmental Sciences—CCDR | 17 | 42 | 17 | 17 | 8 |
| Master in Epidemiology and Master in Public Health—CIET | 29 | 71 | 0 | 0 | 0 |
| Bachelor in Tourism | 26 | 26 | 21 | 11 | 16 |
| High School No. 2 | 29 | 42 | 13 | 8 | 8 |

### 3.3. Social Indicator

The teachers' level of satisfaction with the condition of the furniture, equipment, and teaching and learning materials was very satisfactory in the CIET masters, satisfactory in the Doctorate in Environmental Sciences and in the Bachelor in Tourism, and unsatisfactory in High School No. 2. The results of CIET masters' students showed an excellent level of satisfaction, whereas in the Doctorate in Environmental Sciences and in the Bachelor in Tourism, the level was satisfactory, and for the High School No. 2 students, it was somewhat satisfactory (Table 10).

**Table 10.** Teacher and student satisfaction with furniture, equipment, and teaching and learning materials, shown as a percentage of satisfaction of teachers and students, based on the level of education.

| Response | CCDR (%) | | CIET (%) | | Bachelor in Tourism (%) | | High School No. 2 (%) | |
|---|---|---|---|---|---|---|---|---|
| | Teachers | Students | Teachers | Students | Teachers | Students | Teachers | Students |
| Excellent | 8 | 11 | 14 | 63 | 15 | 7 | 13 | 5 |
| Very satisfied | 17 | 34 | 57 | 17 | 30 | 17 | 4 | 8 |
| Satisfied | 58 | 51 | 29 | 17 | 30 | 43 | 29 | 42 |
| Little satisfied | 17 | 3 | 0 | 4 | 25 | 27 | 42 | 36 |
| Nothing satisfied | 0 | 0 | 0 | 0 | 0 | 6 | 13 | 9 |

A greater proportion of the teachers in CIET and the Bachelor in Tourism self-assessed their performance as very good, in the Doctorate in Environmental Sciences the self-evaluation fell between good and very good, and in High School No. 2, the performance was seen as good (Table 11).

**Table 11.** Teacher self-assessment on academic performance.

| Response | CCCR (%) | CIET (%) | Bachelor in Tourism (%) | High School No. 2 (%) |
|---|---|---|---|---|
| Excellent | 17 | 0 | 12 | 13 |
| Very Good | 42 | 71 | 53 | 33 |
| Good | 42 | 29 | 35 | 42 |
| Regular | 0 | 0 | 0 | 13 |
| Bad | 0 | 0 | 0 | 0 |

Regarding the teachers' performance, punctuality and respectfulness, students of the four programs rated it as excellent. However, more negative evaluations were received among the Bachelor of Tourism and High School No. 2 students (Table 12).

Table 13 shows the teachers' satisfaction with the workplace environment. The highest satisfaction level was found amongst the CIET teachers who rated it as excellent. The CCDR, Bachelor of Tourism, and High School No. 2 teachers rated it as satisfactory.

**Table 12.** Students' opinions on their teachers' academic performance, punctuality and respectfulness.

| Response | CCDR (%) | CIET (%) | Bachelor in Tourism (%) | High School No. 2 (%) |
|---|---|---|---|---|
| Excellent | 64 | 66 | 30 | 36 |
| Very Good | 21 | 21 | 26 | 28 |
| Good | 10 | 5 | 22 | 21 |
| Satisfactory | 4 | 5 | 12 | 9 |
| Poor | 1 | 3 | 11 | 5 |

**Table 13.** Satisfaction of teachers, management, and administrative school personnel with the workplace environment.

| Response | CCDR (%) | CIET (%) | Bachelor in Tourism (%) | High School No. 2 (%) |
|---|---|---|---|---|
| Excellent | 8 | 57 | 15 | 8 |
| Very satisfied | 25 | 29 | 25 | 29 |
| Satisfied | 58 | 14 | 45 | 50 |
| Somewhat Dissatisfied | 8 | 0 | 15 | 13 |
| Dissatisfied | 0 | 0 | 0 | 0 |

### *3.4. Economic Indicator*

A greater number of CIET teachers received financial aid for teaching materials. Doctorate in Environmental Sciences, the Preparatory (High School) No. 2, and the Degree in Tourism teachers also received some assistance, although less than what was provided to CIET teachers. However, in all cases, a considerable percentage did not receive any support (Figure 2).

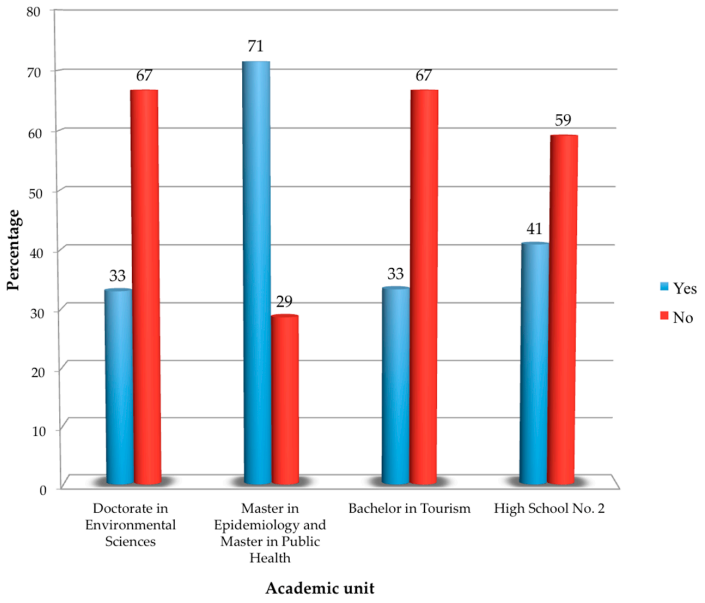


**Figure 2.** The percentage of teachers receiving financial aid for the purchase of teaching and learning materials, by academic unit.

**Table 14.** Students' satisfaction level with the fees for enrollments and re-enrollments.

| Response | CCDR (%) | CIET (%) | Bachelor in Tourism (%) | High School No. 2 (%) |
|---|---|---|---|---|
| Strongly agree | 17 | 0 | 5 | 6 |
| Agree | 37 | 61 | 25 | 24 |
| Neither agree nor disagree | 9 | 13 | 28 | 41 |
| Disagree | 20 | 0 | 15 | 8 |
| Strongly disagree | 17 | 26 | 27 | 21 |

With respect to the students' satisfaction level with fee payments for enrollments and re-enrollments, a greater proportion of CIET and Doctorate in Environmental Sciences students agreed with both the payments and amount of the fees, whereas Bachelor in Tourism and High School No. 2 students neither agreed nor disagreed (Table 14).

## 4. Discussion

Despite the objective of the bachelor and postgraduate educational programs having the society–nature relationship as the focus of their study, the results show that the curriculum is only somewhat linked to the environment. Only the high school demonstrated a strong link, because it is part of a unique baccalaureate governed by a single curriculum that incorporates focus on environmental issues as a cross-disciplinary theme. According to Taylor and Kraly [28], curriculum enrichment is a method that can be used to achieve sustainability. Other authors support this idea; they also consider that the undergraduate and graduate curriculum should have a holistic vision and be analyzed from a multi-disciplinary perspective, both by teachers and students (Tilbury et al., cited by [12,14,16]).

With respect to the greater satisfaction with the use of audiovisual equipment for classroom development, another important result was found in the bachelor and master's degrees. This can be explained by the fact that, to generate a sense of belonging and identity at a higher level of education from which no one is excluded, teachers incorporate learning strategies based on the management of information and communication technologies, since, as established by Remees and Winfield [36], educational spaces must promote social participation, environmental and ethical values, and interaction. Similarly, as Scott [27] stated, the greater use of computers implies a lower consumption of consumables such as paper and ink, which generates attitudes and environmental behaviors aimed at sustainability.

Notably, the level of teacher satisfaction with the conditions of the furniture, equipment and teaching materials was directly related to teaching classes at a higher level of education. The result improved with both the presence of better working conditions and with a smaller population of students served. Similarly, a greater participation in EE and SD courses strengthened the development of competencies aimed at sustainability. Even though there is participation of some teachers in training courses, this is not enough; furthermore, as Colombo and Alves [16] point out, knowledge about the concept of sustainability for planning activities must be strengthened and the classroom approach, and consequently, student learning, must be improved. In relation to the above, the leadership of the university's senior management is necessary to guide and promote sustainability actions in the different functions [7,14], among them teaching.

The economic dimension is indispensable in sustainability, in this work the indicator was approached as resources used by teachers and students in an optimal way, where everyone is benefited, among them the obtaining of stimuli and resources to develop research projects and the payment of registration fees. The findings show that all teachers received economic stimulus for teaching materials; the different perception is explained by the fact that in undergraduate and graduate studies, participating as professors-researchers through the academic bodies (groups of professors from public universities that share one or more areas of expertise), and presenting research projects to obtain funding for the development of activities, are options.

For the level of satisfaction with the payment of registration and re-registration fees, a greater proportion of CIET and Doctorate students in Environmental Sciences considered that their financial contribution is related to the use of the facilities, and that the infrastructure and equipment conditions are appropriate. However, in the upper secondary and bachelor's level, the high density of students provokes an intensive use and degradation of the internal spaces in the classroom as well as bathrooms, cafeterias and external green spaces. For Scott [27], the sustainable curriculum is one that provides students with the knowledge, skills and understanding necessary for decision making, necessary to strengthen learning to achieve better use of school spaces. James and Card [8] refer to this when they

affirm that students are key actors in implementing sustainability practices at the university, and thus will be better prepared to face the problems of the future. In the same way, their active participation on campus is a "key to change" (Tilbury et al., cited by [12]).

Resume Referencing work completed in other universities is all important. All of them, including UAGro, seek to respond to the commitments made by HEIs to focus on environmental, social and economic problems. Evaluations using sustainability indicators were completed to assess progress. Mendoza [37] reported a study of six educational institutions: University of Nottingham, Colorado State University, University of Hokkaido, Autonomous University of Guerrero, University of Monterrey and University of Guanajuato. The authors concluded that each institution must generate its own indicators in accordance with its policies and objectives. This idea agrees with González et al. [1], Taylor and Kraly [28] and Scott [27].

Bieler and McKenzie [38] completed a study in Canadian HEIs. Their result focused on accommodative responses that addressed sustainability in one or two domains connected with the institution's management strategies and core values. In this respect, they had a strong commitment to AASHE considering the autonomy in academia. The results of this study coincide with the proposal of Bieler and McKenzie [38], that to transform sustainability into higher education, the inclusion of variables related to policy, governance, education, campus operations, research and community outreach must include all stakeholders, including non-governmental organizations (NGOs), mentioned by Calder and Clugston [7].

In a study on the publication of sustainability reporting (SR), Ceulemans et al. [39] considered that all HEIs have researched SD, as well as its integration into daily activities. Furthermore, the results indicated that reports are necessary to help state the involvement and commitment of HEIs. Hence, the importance of this work involves the sustainability of teaching, as one of the substantive functions that leads to the development of best practices and the training of socially responsible graduates. As Bone and Agombar [9] mentioned, "literacy in sustainability" should prepare them for employment in companies committed to society.

## 5. Conclusions

To strengthen education as a substantive function, curricula must be updated and integrated into the context of education for sustainability in its environmental, social and economic dimensions. Thus, one of the main challenges for the university is to rethink the curriculum, which in this process requires the participation of managers, teachers, students and the entire university community.

It is pertinent that the university's management institutionalizes sustainability in the substantive functions of teaching, research, extension and management; and in this regard, promotes an updating of teaching skills. For this reason, teachers must be involved in their ongoing formation to appropriate concepts that guide them to better plan their activities, commit themselves to sustainability and contribute to the integral formation of students.

Universities face the challenge of training human resources to critically address environmental, social and economic problems. For the correct development of teaching activities in HEIs, it is necessary to improve infrastructure, furniture and audiovisual equipment, as well as incorporate new technologies to increase the efficiency of processes and good practices; this also contributes to the construction of sustainable academic units. The environment is essential to develop harmonious work, with justice and equality between teachers, administrators and students, for the benefit of all.

Higher education and university professors should strengthen their participation in research projects to obtain financial resources to help improve the development of their professional practice. This article on the teaching function is related to an ongoing doctoral thesis. These results will be contrasted with the overall findings of the other substantive research, management and extension functions.

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## References


1. Gaudiano, E.J.G.; Meira-Cartea, P.Á.; Martínez-Fernández, C.N. Sustentabilidad y Universidad: Retos, ritos y posibles rutas*. *Rev. de l Educción Suior* **2015**, *44*, 69–93. [CrossRef]
2. UNESCO. Conferencia Mundial Sobre la Educación Superior: La Nueva Dinámica de la Educación Superior y la Investigación para el Cambio Social y el Desarrollo. 2009. Available online: http://www.unesco.org/education/WCHE2009/comunicado_es.pdf (accessed on 20 October 2017).
3. UNESCO. Desarrollo Sostenible. 2017. Available online: http://www.unesco.org/new/es/education/themes/leading-the-international-agenda/education-for-sustainable-development/sustainable-development/ (accessed on 20 October 2017).
4. Martínez-Fernández, C.N.; Gaudiano, E.J.G. Las políticas para la sustentabilidad de las instituciones de educación superior en méxico: Entre el debate y la acción. *Rev. de l Educción Suior* **2015**, *44*, 61–74. [CrossRef]
5. Gutiérrez, B.E.; Martínez, M.A. El plan de acción para el desarrollo sustentable en las instituciones de educación superior. Escenarios posibles. *Revista de la Educación Superior* **2010**, *154*, 111–132.
6. Abubakar, I.; Al-Shihri, F.; Ahmed, S. Students' assessment of campus sustainability at the university of dammam, Saudi Arabia. *Sustainability* **2016**, *8*, 59. [CrossRef]
7. Calder, W.; Clugston, R.M. International Efforts to Promote Higher Education for Sustainable Development. *Plan. High. Educ.* **2003**, *31*, 34–48.
8. James, M.; Card, K. Factors contributing to institutions achieving environmental sustainability. *Int. J. Sustain. High. Educ.* **2012**, *13*, 166–176. [CrossRef]
9. Bone, E.; Agombar, J. *First Year Attitudes Towards, and Skills in, Sustainable Development*; The Higher Education Academy: Heslington, UK; University of Bath: Bath, UK, 2011; pp. 8–50.
10. Yuan, X.; Zuo, J. A critical assessment of the higher education for sustainable development from students' perspectives—A Chinese study. *J. Clean. Prod.* **2013**, *48*, 108–115. [CrossRef]
11. Pestana, M.; Parreira, A. Human Resources' student's sensitivity to factors of sustainability. *Ensaio Aval. Pol. Públ. Educ.* **2016**, *24*, 337–358. [CrossRef]
12. Sammalisto, K.; Sundström, A.; Holm, T. Implementation of sustainability in universities as perceived by faculty and staff—A model from a Swedish University. *J. Clean. Prod.* **2015**, *106*, 45–54. [CrossRef]
13. Uitto, A.; Saloranta, S. Subject teachers as educators for sustainability: A survey study. *Educ. Sci.* **2017**, *7*, 8. [CrossRef]
14. Watson, M.K.; Lozano, R.; Noyes, C.; Rodgers, M. Assessing curricula contribution to sustainability more holistically: Experiences from the integration of curricula assessment and students' perceptions at the Georgia Institute of Technology. *J. Clean. Prod.* **2013**, *61*, 106–116. [CrossRef]
15. Aparicio, J.L.; Rodríguez, C.; Beltrán, J.; Sampedro, M.L. Transversalidad del eje medio ambiente en educación superior. *Revista Iberoamericana de Ciencias* **2014**, *1*, 1–10.
16. Colombo, C.R.; Alves, A.C. Sustainability in engineering programs in a Portuguese Public University. *Production* **2017**, *27*. [CrossRef]
17. Lozano, R.; Ceulemans, K.; Alonso-Almeida, M.; Huisingh, D.; Lozano, F.J.; Waas, T.; Lambrechts, W.; Lukman, R.; Hugé, J. A review of commitment and implementation of sustainable development in higher education: Results from a worldwide survey. *J. Clean. Prod.* **2015**, *108*, 1–18. [CrossRef]
18. Jones, P.; Trier, C.J.; Richards, J.P. Embedding education for sustainable development in higher education: A case study examining common challenges and opportunities for undergraduate programmes. *Int. J. Educ. Res.* **2008**, *47*, 341–350. [CrossRef]
19. Cole, L.; Wright, T. *Assessing Sustainability on Canadian University Campuses: Development of a Campus Sustainability Assessment Framework*; Royal Roads University: Victoria, BC, Canada, 2003.
20. Gobierno del Estado de Guerrero. *Capítulo 1. Diagnóstico; Programa Especial: Forestal, Ecología y Medio Ambiente, 2016–2021*; Gobierno del Estado de Guerrero: Chilpancingo, México, 2015.

21. UAGro. *Modelo Educativo. Hacia una Educación de Calidad con Inclusión Social*; Universidad Autónoma de Guerrero: Guerrero, México, 2014.
22. Medellín, M.P.; Nieto, L.M. La producción de conocimiento sobre la sostenibilidad: Tópicos emergentes, en: La educación superior ante los desafíos de la sustentabilidad. *Educación Superior ANUIES–SEMARNAP* **2000**, *3*, 77–78.
23. Covas, O. Educación Ambiental a partir de tres enfoques: Comunitario, sistémico e interdisciplinario. *Revista Iberoamericana de Educación* **2004**, *34*, 1–7.
24. UNESCO. Decenio de las Naciones Unidas de la Educación Para el Desarrollo Sustentable. 2005. Available online: www.unesco.org/education/desd (accessed on 20 October 2017).
25. ANUIES. *La Educación Superior en el Siglo XXI. Líneas Estratégicas de Desarrollo: Una Propuesta de la ANUIES*; ANUIES: México, 2000.
26. Edgar, G.G.; Ángel, A.O.M. *La Investigación en Educación Ambiental Para la Sustentabilidad en México (2002–2011)*; COMIE: Guerrero, México, 2015.
27. Scott, R. Sustainable curriculum, sustainable university. *eCULTURE* **2009**, *2*, 122–129.
28. Taylor, J.; Kraly, E. *The Role of Sustainability Curricula in Higher Education*; Colgate University: New York, NY, USA, 2015; Available online: http://www.colgate.edu/docs/default-source/default-document-library/sustainability-in-higher-education-report-by-jenna-taylor.pdf?sfvrsn=0 (accessed on 27 October 2017).
29. Nieto, L.M.; Medellín, P. Medio ambiente y educación superior: Implicaciones en las políticas públicas. *Revista de la Educación Superior* **2006**, *36*, 31–42.
30. COMPLEXUS. *Indicadores Para Medir la Contribución de las IES a la Sustentabilidad, Universidad de Guanajuato*; COMPLEXUS: Guerrero, México, 2013.
31. UAGro. Anuario Estadístico 2015–2016. 2016. Available online: http://informacionestadistica.uagro.mx/anuarios/Anuario_Estadistico_UAGro_2015-2016.pdf (accessed on 20 October 2017).
32. Gallopín, G.C. Environmental and sustainability indicators and the concept of situational indicators. A systems approach. *Environ. Model. Assess.* **1996**, *1*, 101–117. [CrossRef]
33. González, E.J.; Arias, M.A. La educación ambiental institucionalizada: Actos fallidos y horizontes de posibilidades. *Perf. Educ.* **2009**, *31*, 58–68.
34. Aparicio, J.L.; Rodríguez, C.; Beltrán, J.; Sampedro, L. Metodología para la transversalidad del eje medio ambiente. *Revista Iberoamericana de las Ciencias Sociales y Humanísticas* **2014**, *3*, 163–172.
35. Hernández-Sampieri, R.; Fernández-Collado, C.; Baptista, P. *Metodología de la Investigación*, 4th ed.; Mc Graw-Hill: Guerrero, México, 2006.
36. Remees, M.; Winfield, F. Espacios Educativos y Desarrollo: Alternativas desde la sustentabilidad y la regionalización. *Investigación y Ciencia* **2008**, *42*, 45–50.
37. Mendoza, Y. Sistemas de evaluación de la sustentabilidad en las Instituciones de Educación Superior. *Ciencias Sociales UAT* **2016**, *II*, 65–78.
38. Bieler, A.; McKenzie, M. Strategic Planning for Sustainability in Canadian Higher Education. *Sustinability* **2017**, *9*, 161. [CrossRef]
39. Ceulemans, K.; Lozano, R.; Alonso-Almeida, M. Sustainability reporting in higher education: Interconnecting the reporting process and organisational change management for sustainability. *Sustainability* **2015**, *7*, 8881–8903. [CrossRef]