Environmental education as a strategy to face climate change

La Educación Ambiental como estrategia para enfrentar el cambio climático

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Abstract

The global environmental crisis that humanity is facing involves the creation of efforts that contribute towards greater socio-ecological resilience, which can face the consequences of these changes that are affecting the planet at a local, regional and global level. These mechanisms seek for society to acquire greater knowledge and skills, to achieve an ecological culture that leads to a sustainable relationship with nature. In this context, this research paper aims to determine the effect that environmental education has had as a strategy that contributes to mitigation and adaptation to climate change. This investigation was carried out through working with students, teachers, and authorities from three educational institutions in the city of Cuenca. It was necessary to apply a study from two approaches, quantitative with the application of surveys to students and their teachers, and qualitative with an in-depth interview to the headmasters and coordinators of each high school. The results were statistically examined in the case of the surveys, and the interviews' contents were properly analyzed. The obtained information was used to establish guidelines that can help to change the traditional way in which environmental education is being undertaken nowadays, this part defines strategies, approaches, and methodologies to be worked in a transversal and holistic way within the curriculum program of the educational centers of this research.

Keywords: Resilience, environmental education, sustainability, climate change, socio-ecology.

Resumen

La crisis ambiental global que enfrenta la humanidad supone la creación de esfuerzos que aporten hacia una mayor resiliencia socioecológica frente a las consecuencias de estos cambios a nivel local, regional y global. Estos mecanismos buscan que la sociedad adquiera mayores conocimientos y habilidades, en miras de una cultura ecológica que logre una relación sustentable con el medio natural. Bajo este contexto, este trabajo tiene como objetivo determinar la validez de la educación ambiental como una estrategia que aporte para la mitigación y adaptación al cambio climático. Para su desarrollo, se trabajó con estudiantes de bachillerato, docentes y autoridades de tres instituciones educativas de la ciudad de Cuenca. Se aplicó un estudio desde dos enfoques, cuantitativo a través de la aplicación de formularios con docentes y estudiantes, y cualitativo con entrevistas a profundidad realizadas con las autoridades de cada institución. Los resultados fueron examinados estadísticamente, en el caso de las encuestas y el análisis de contenido de la totalidad de entrevistas. A partir de este punto, se establecieron lineamientos que aporten para un cambio en las estrategias, enfoques y metodologías con las cuales se trabaja la educación ambiental en la actualidad, con la finalidad de que esta sea trabajada de forma transversal y holística dentro del programa curricular de los centros educativos dentro del estudio.

Descriptores: Resiliencia, educación ambiental, sustentabilidad, cambio climático, currículo, socio-ecología.

1. Introduction

Since its origin, humanity has managed to survive thanks to the use of the resources provided by nature, however, its consumption and predation have been changing and accentuating since the Industrial Revolution, when the use of fossil fuels enabled improved production processes, without considering the high environmental costs they cause (Kothari et al., 2014), generating a developmental wave based on capital accumulation. From the second half of the twentieth century, humanity began to witness the alterations derived from the current development model, thus initiating a trend toward political, technological and scientific efforts to mitigate and adapt to the coming environmental crisis (Castro & Gallego, 2015; United Nations, 1989). The new strategies start from their transversality, without just focusing on the economic, social and/or political aspects, but on establishing tools for society to acquire knowledge and skills in order to create greater environmental awareness toward resource conservation and protection of the natural environment (Severiche et al., 2016), in addition to making population as key actors for greater socio-ecological resilience to the effects of climate change (González et al., 2019). In this context, education is seen as the basis for the fulfillment of the goals set forth at the local, regional and global levels, and it is necessary to include it with an environmental focus in the academic curriculum of all educational levels, as well as the dynamics and performances that are carried out in the classrooms (Dieste et al., 2019).

Environmental Education (EE) emerged under the premise that the population is aware of the impact it has in the ecosystem in order to achieve a better relationship with the natural environment. Environmental education comprises a cross-cutting content, which is based on a multidimensional dialogue that includes scientific and common knowledge (Benitez et al., 2019); thus, the transdisciplinary approach of EE involves the inclusion of indigenous ancestral knowledge with natural sciences, social sciences, mathematics, arts, humanities, geosciences and telecommunications (Garcés, 2012). When the basic elements of environmental education are applied, the teaching-learning process is easily improved, leading to new ways of interrelating with nature, leaving behind traditional pedagogical approaches (Collado, 2019; Sandoval-Díaz et al., 2020), and generating greater social and ecological resilience to global dynamics (Hardy et al., 2019).

At the global level, environmental education has evolved as a key element in achieving the goals set out in the Sustainable Development Agenda 2030 (Timm & Barth, 2020), especially because the overall goal is to keep global warming at 1.5 °C until the next decade (IPCC, 2018), and to do it, it is necessary to establish a workable proposal with all disciplines to achieve a commitment of citizenship (Rodrigo-Cano et al., 2019). In addition, EE is an effective mechanism for teaching the problem of climate change because of its innovative educational approach and its constant search to help the population understand this phenomenon in order to generate attitudinal changes in favor of the environment (González, 2016). Especially because the greatest constraint is intimately linked to ignorance of society. From this, formal and non-formal educational programs have been created to achieve this objective, albeit partially (Jackson, 2016).

National reality is not alien to this trend; in recent years Ecuador has developed various projects such as TiNi (Land of all) (Minduc, 2019) or the National Strategy for Environmental Education (Bravo, 2017) as "Design and promotion of training, education, awareness raising and awareness-raising programs on climate change management" (Ministry of Environment and Water, 2017, p. 27). These programs are carried out by two national ministries, the Ministry of Education and Environment, respectively, applied in different areas, in addition to being directed for the whole population,

from the initial level of compulsory education to the high school. One important aspect is that these environmental education programs have been highly linked to the area of Natural Sciences in the content of the school curriculum, without being cross-cut in all curricular subjects (Falconí, 2018). Knowledge of climate change has focused on working on areas linked to solid waste management and biodiversity care, which are obviously important but do not address basic issues such as energy consumption and natural resource management, which are critical to raising awareness of this highly relevant global, regional and local issue (Cadilhac et al., 2017).

This topic has several axes for its development, especially because of the number of actors involved, the students as critical bodies, content receivers and replicators, who normally do not know and/or have not paid attention to the topic; in addition, they have not been able to reflect adequately on the implications of climate change in society and the world (González et al., 2018). Another important element is the faculty, especially because of their role as agents of change, by inciting changes at the institutional level through interaction with their students. In addition, they motivate students to influence attitudinal changes in their families and in the society (Timm & Barth, 2020). The aim is how to direct attention to the problem, especially because it constitutes the greatest challenge facing humanity today, and the basis for this change is education (Mejía-Cáceres et al., 2020, Ortega and Muñiz, 2019).

Based on the background and problems raised, it is necessary that the formal and non-formal content presented in all educational institutions contribute to generate critical thinking in the population, in order to orient it to an attitudinal change that can contribute toward greater resilience to climate change (Falconí & Hidalgo, 2019; Merino et al., 2017). It is necessary to mention that this study focused on an objective population made up of high school students, thus the importance of establishing guidelines that promote awareness, working from the

method of each educational institution in which climate change is addressed in each subject in a cross-sectional and holistic manner, so students replicate this knowledge in their daily live (Leguía, 2018).

The aim of this research is to determine the validity of environmental education as an effective tool for socio-ecological resilience to climate change in high school institutions in the city of Cuenca, to propose strategies based on the guidelines of Environmental Education with a climate change approach, which can be effectively applied in the centers involved in the study.

2. Methodology

For this research, a non-experimental study was developed, based on a mixed methodological, qualitative and quantitative approach. The type of research was cross-sectional and descriptive, and was based on methodologies applied by authors such as Benitez et al., 2019; Dieste et al., 2019; Gädicke et al. 2017; González et al., 2019; López, 2016; Mwendwa, 2018. Likewise, according to the reality that is being experienced, each instrument included the aspect of virtual education, with the purpose of determining which educational institutions are working with EE.

2.1. Sample selection and área under study

There are three institutions in which the project was conducted, all located in the city of Cuenca: Unidad Educativa Luisa de Jesús Cordero (UELJC), Unidad Educativa Kennedy (UEK) and Unidad Educativa Las Pencas (UELP), all offering High School. The three schools have a total of 412 students enrolled in the academic year 2020-2021, in addition to 31 teachers. A thematic expert, a teacher from the German Sthiele School in Cuenca, was also included in order to learn about the experiences that this institution has had in all ten years during the development of its Environmental Education Program "Small

Scientists in School", in order to have a practical and local basis for the development of the proposal.

2.2. Data collection

Based on a broad literature review, in addition to a previous selection of the sample and areas under study, it has been determined to collect the relevant data for the study, using the following modalities:

- Student perception survey.
- Teacher perception survey.
- Structured-based interviews with key players within the problem.

Two questionnaires were designed for the surveys, one for the students and one for the faculty, all including Lickert scale questions; a pilot test was applied with staff from other institutions to determine the reliability. With these responses, Cronbach Alpha Coefficient was determined through the RStudio software, which was calculated with values of 0.84 and 0.93, respectively, an aspect that indicates the feasibility (Estrada, 2012; Soler-Cárdenas & Soler-Pons, 2012).

Due to the amount of information to be collected, and applying the segments carried out by Estrada (2012) and Borroto et al. (2011), in addition to taking into account the current reality of virtual education, each instrument was divided into six categories, which were the following:

2.2.1. Student Survey

- General information.
- Vision of the environment and environmental problems.
- EE training.
- EE Importance.
- Environmental attitude and willingness to join the change.
- EE in times of pandemic and virtual education.

2.2.2. Teacher survey

- General information.
- Vision of the environment and environmental problems.
- EE training.
- Teaching methodologies and decision to incorporate change.
- Personal and professional motivation.
- EE during pandemic and virtual education.

From this point, forms for its application were defined, which were made using Google Forms platform, with the links: https://forms.gle/1Fb84ua98idwFL7Q7 y https://forms.gle/Epjjqrac2TuDQuM7A. Once answered, statistical tools were applied for their representation through frequency tables, Chi Square test for the student survey by the size of the sample, and Fisher test by the low number of participants. All these calculations were performed using the Stata version16.1 software.

As for the interviews, principal, vice-principal and the academic coordination of each institution were included, incorporating as well a thematic expert from another educational institute. The content analysis was systematized within a methodology called 4L matrix (Ferrer et al., 2019), which determines the limitations, achievements, lines to follow, and lessons learned by each institution during the implementation of EE strategies. Questions were created in such a way that they correspond to the objectives of the research, generating interaction with each participant.

3. Results

3.1. Content analysis of the interviews

At this point, the aim was to determine the status of the situation of each institution in terms of the approaches, methodologies and content applied in Environmental Education, in addition to knowing whether EE was a priority aspect within schools and in the management of curri-

culum subjects. In order to achieve this, authorities from two institutions and a thematic expert were interviewed. The following information was obtained through the systematization of the information and applying the methodology of the 4L matrix:

3.1.1. Achievements

The institutions see as great achievements the wide variety of EE projects that have been implemented during face-to-face classes, and which were focused on better management of resources such as water and energy, in addition to nature-care behaviors and awareness of students and teachers on the subject. They believe that students have improved their behavior and in fact reduced the amount of plastic waste by separating the residues and reducing the high percentage of water waste. This last aspect is corroborated by a decrease in the items corresponding to the water sheets.

3.1.2. Limitations

The main limitations are focused on the reduced training provided to teachers in the institutions, thus feeling demotivated to applying EE strategies with their students. Resistance to new methodologies established by Mineduc or MAE has often been observed, or the fact that activities in this area have not had a focus beyond working with recycled materials manually. Another limitation is linked to the virtual modality, which limited and paralyzed certain activities that were being carried out by these institutions, in order to take their students to other locations to share with nature.

3.1.3. Lessons learned

It is important to mention the following points: work has been done through agreements with institutions such as ETAPA and EMAC, as they are always willing to collaborate on these initiatives. Schools like Kennedy and the German College, within the Student Participation Program, have proposed an interesting initiative for students

to become educators, whether through videos or classes. At UELJC and Kennedy a lot of work is done on the subject of student participation, specially because faculty members with more knowledge in the area belong to this sub-level.

3.1.4. Lines to follow

The three institutions agree on the following: when returning to face-to-face classes, environmental projects must be continuous, even working on how to improve them. New lines of work, beyond waste and water management, should also be incorporated, as well as other topics in which the students are interested to be actively involved. The objective of these projects should not only be to work with the student, but also to involve teachers who also generate environmental awareness, because they are the ones responsible for building this knowledge. Projects must be generated as an initiative of the faculty, using innovative digital tools and motivation, which is the most important thing. Another important aspect is that connectivity is quite large now, thus agreements can be generated not only with state-owned enterprises but with the private sector, working between the same educational institutions to compensate the constraints that each has. The aim is to work in a collaborative environment with the academia and public and private enterprise.

These educational institutions know about how to work on Environmental Education, yet they are aware that there are still several aspects in which they must continue to work to achieve the proposed objectives, starting from a greater inclusion of these topics within curricular planning, but it would require greater control of the authorities to verify that teachers are actually complying with what is proposed, without becoming a limiting agent with excessive control. Everyone wants to continue with the projects already proposed once they are back to face-to-face classes, and so they are also willing to collaborate actively in those that allow them to continue improving

without meaning investment of resources due to the economic situation of each institution.

3.2. Analysis of surveys: Students

The questionnaire was applied to 412 students in the three educational institutions. To start with the analysis, the correlation between the responses of all the variables was determined to know the influence one answer has on the other, and the possibility that the students, due to laziness or lack of time, have answered the whole questionnaire with the same number on the scale is rejected. These correlations, within the same category, are

slightly higher than 0.5, indicating that, as the questions are similar to each other, they are related. However, when compared to questions in different categories, values are less than 0.5, showing that respondents were dedicated to answering carefully and in line with their reality. Below is an analysis of each category within the form.

3.2.1. Category 1: Overview

Figure 1 shows the values determined for this section. It is noteworthy a greater participation of female students, since UELJC is an institution with 100% female students.

Figure 1. Summary of Answers – Category 1 Students
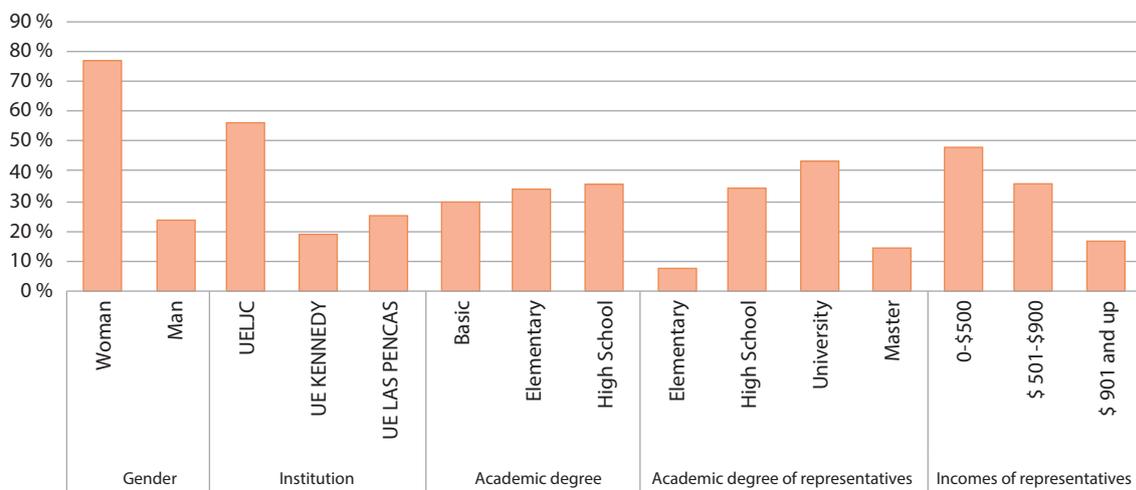
Source: Own elaboration.

Analyzing the interdependence of variables in this category with others using Chi Square test, it is determined that when having a mostly female sample, this aspect does influence the responses obtained. There are many studies that have shown that women are more environmentally friendly than men (Olsson & Gericke, 2017; Vicente et al., 2018). It is important to note that the degree of schooling achieved by parents of students has a large percentage influence on their perception of all the topics addressed in the survey. 43% of parents have

university degrees, so it is inferred that they have greater knowledge of the current reality and may be positively influencing the behavior of the students. Finally, most families have a monthly salary that is equivalent to that of the Ecuadorian basic basket, so they are middle to low economic class, representing 48.1% of the sample analyzed. This aspect may be influencing the behavior of the student, especially the fact that by not having all the necessary resources, there is no culture of waste and/or consumerism as in other social strata.

3.2.2. Category 2: Environmental vision and environmental problems

It is quite clear that students are aware of the importance of the current environmental problems mentioned, especially those related to air and water pollution. These responses may be related to the fact that there are a large number of environmental campaigns in social networks, focused on mentioning the emission of polluting gases by vehicular traffic and industrial activity, as well as those that mention the enormous amount of plastic existing in the bodies of water and that are affecting aquatic biodiversity.

3.2.3. Category 3: EE Training

The student understands that human beings have a fundamental role in socio-ecological resilience to climate change, placing them as beings aware that they are the main actors in the environmental action. It is shown that the perception of contents and the approach worked during classes do not have a strong impact on the group.

3.2.4. Category 4: Importance of Environmental Education

Student emphasize that they understand the importance of EE and how it contributes to a better adaptation and mitigation to climate change. Similarly, as a generation born after the new millennium, the access to the technology has allowed that they see technological innovation as the best way to solve this climate crisis by placing it above EE.

3.2.5. Category 5: Environmental attitude and willingness to join change

It is remarkable that students are willing to make positive changes in favor of the environment from their homes, applying various simple strategies that would easily achieve an attitudinal change in each of them.

3.2.6. Category 6: Environmental education in times of pandemic and virtual education

In this last category, by prioritizing contents due to ministry provisions, the approach, content and methodology regarding EE had to change, without having a significant impact on students, making them to continue being motivated to find new and better alternatives to the problem posed, with the necessary support of their teachers.

3.3. Survey analysis: Teachers

A correlation analysis between variables was done. In applying this test, only the values within Category 2, which is quite similar to that of the study survey, have values greater than 0.5, due to the similarity between the variables; values are lower in the other categories, indicating that the faculty responded in a way that reflects their reality. In the following points, a description of the responses obtained is detailed.

### 3.3.1. Category 1: General information.

The frequencies according to the required variables are presented in Figure 2 as general information. Within this scope, it is emphasized that the majority of the sample was made up of young teachers with few years of experience, which, at the time of applying the Fisher Exact Test, it was observed that the age variable has a high degree of dependence on the responses obtained. This is due to the fact that the methodology used by each teacher will mostly depend on the experience and training he/she has. From the perspective of young teachers, older teachers tend to stay under traditional approaches and resist to change in some way; they find it more complex to adapt to new trends and feel that the methods they use are effective for fulfilling their objectives. On the contrary, younger teachers are highly sensitive to change, as they always find ways to continue learning new strategies, and as the new generations they grew up with greater ecological

awareness, allowing them to be involve in these topics from the subject they teach. In general, aspects such as the area of study in which they work or the career they studied influence the answers obtained, especially because the non-

science teacher has difficulty finding ways to relate the subject to EE. Most of them have information from different branches of knowledge, so the perspectives on the subject are different.

Figure 2. Summary of responses – Category 1 Teachers
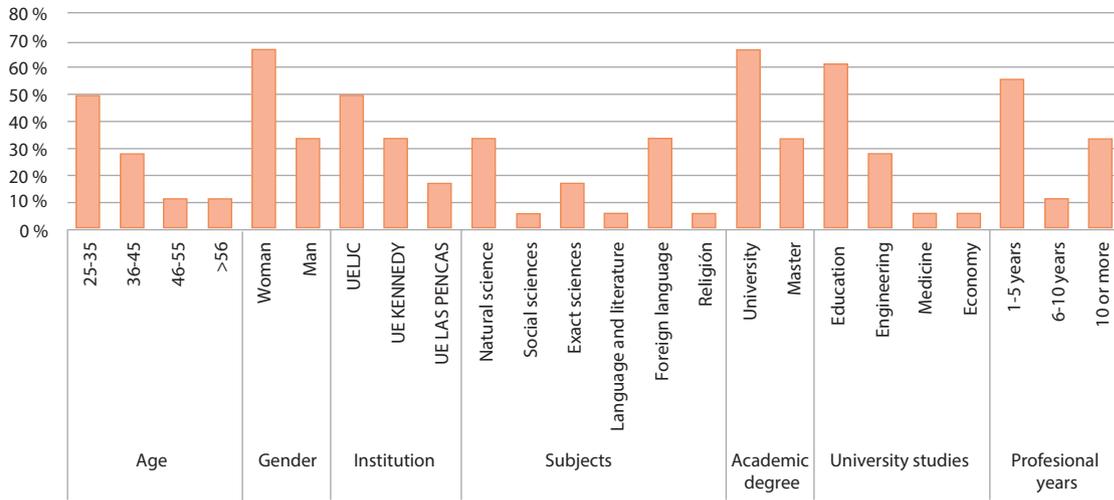
Source: Own elaboration.

3.3.2. Category 2: Vision of the environment and environmental problems

Out of the answers obtained, most of the faculty members surveyed have a clear notion about the impact, the problems mentioned, and the environment; and none selects the 'completely disagree' option in the whole category. Similarly, most recognize that human beings are very important for the environmental crisis.

3.3.3. Category 3: EE Training

The results show that teachers agree and disagree with the variables regarding whether they have studied environmental content, the training received, the knowledge of other projects besides TiNi and the application of this methodology. It corresponds to what was mentioned by the

authorities during the interviews, when saying that many teachers are unaware of how to relate their subjects to EE and that there is a need of trained personnel who can present this information and improve this area. It also shows that respondents understand that the EE must address the relationships between all components of the environment and that the EE must be a common project for the entire educational community.

3.3.4. Category 4: Teaching methodologies and willingness to incorporate change

Within this category, it is quite noticeable that the faculty mostly agree with the points explained, which shows that they are motivated to actively involve students in the teaching-learning process when working with environmental content. However, they do not seem to feel that the

methodologies they are currently working with are effective for students to achieve meaningful learning in this area.

3.3.5. Category 5: Personal and professional motivation

The answers obtained in this category are quite varied and two main aspects are highlighted. There is a clear lack of agreement that only the Natural Sciences area should include EE topics, or that they are reviewing these issues only when curriculum planning requires them, which is favorable since it shows that most teachers feel that this subject should be addressed from all subjects. It is also clearly stated that the EE must be taught from all areas.

3.3.6. Category 6: Pandemic Environmental Education and Virtual Education

Teachers states that EE must be a priority and be included in all subjects, even during virtual classes. Another important aspect is that most have decided to continue reviewing environmental topic during pandemic.

4. Discussion and conclusions

EE for climate change has become a focal point for society's socio-ecological resilience to this global phenomenon (Busch et al., 2019). It is important that educational institutions become the main transmitters, not only of information, but of good habits for their replication by the student, without forgetting that human values are taught at home, and that the role of the faculty is based on serving as a guide for students to form their own understanding of each subject taught in and out of classes (Fazey et al., 2007). Actors are countless since it is a major problem, but the three actors with more direct interaction were selected: students, teachers and authorities.

It is clear that teachers, students and authorities of the three institutions studied emphasize the importance of EE as an axis that contributes toward the creation of environmental awareness, therefore, a behavioral change in favor of the environment in which they live. However, there are great limitations, at the general level these are related to priority content, and at the institutional level these are more derived from economic and infrastructure aspects, which cause the work in this area to be little developed and without clear or measurable results, beyond mentioning that the student is better classifying wastes or having more responsible water management.

The perception of the student in relation to EE is varied, and apparently, it has not had the desired impact. These subjects have not been properly discussed in class, and the projects and research that must be carried out for the subjects, especially in the Area of Natural Sciences, have been projects only done once, causing that only certain students be interested in continue researching and working on their own. According to the answers obtained and certain conversations with students during classes, they feel that the teacher must deepen more on these contents, that the activities done should be more than "using recycled material to assemble a model", they need to be allowed to express themselves and start combining the teacher's expertise with the student's motivation, so that these EE programs are effective.

Based on the results presented, it is necessary to establish clear guidelines that allow educational institutions to address EE from a holistic and cross-sectional perspective, changing the focus of its contents, modifying the traditional methodology and including innovative strategies, without representing an extra effort or investment, but instead constituting a main axis in the teaching-learning process. Organizations such as UNICEF and UNESCO have established guidelines focused on education for sustainable development from eco-pedagogy, which seeks to make the population more resilient toward change, working under the four basic educational foundations which are "learning to know, learning to do, learning to live together, and learning to be" (Fernández, 2003, p. 329). This is

the way the proposed objectives will be achieved, integrating several important aspects to generate an environmental culture that motivates behavioral changes at the individual and collective level (Sarmiento, 2013), becoming the focal point toward greater socio-ecological resilience to climate change.

Regardless the institution studied, the gender or socio-economic situation of these students, the level or specialization of the faculty and/or authorities, it is necessary to work on the motivation and commitment for an ecologically, sustainable and resilient environment. At this point, teachers have a big responsibility at the educational level, thus, the training they possess must be clear and allow them to transmit their knowledge in an innovative way, so that it involves the student in all processes: to learn the theory, apply it and transform it for its replication, and to carry out an active and inclusive education. Authorities should motivate teachers in knowing a lot more about the subject, providing them training for the development of the proposed projects, as well as for the evaluation of results and their continuous improvement.

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