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Enfoques innovadores de educación ambiental con el aprovechamiento de residuos orgánicos urbanos

Innovative approaches of the environmental education with the use of urban organic residues

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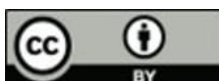
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Resumen

El presente documento nace de la necesidad de fortalecer la educación ambiental en el ámbito educativo a través del aprovechamiento de residuos orgánicos, que son vistos como desechos y generadores de problemas ambientales, económicos y sociales. Se determina la importancia de la educación ambiental como herramienta esencial para concientizar y sensibilizar, sobre todo para lograr el empoderamiento de los estudiantes y fomentar una cultura ecológica. El presente artículo tiene como propósito analizar las oportunidades de educación ambiental enfocadas en el aprovechamiento de residuos orgánicos generados a nivel urbano. Evaluar la educación ambiental formal en diferentes grupos objetivo y la relación de su aprendizaje con las TIC (Tecnologías de Información y Comunicación) y redes sociales. Su principal aporte es una presentación de la realidad de la educación ambiental



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en el país y en diferentes contextos culturales. La metodología utilizada en el estudio se apoya en la investigación bibliográfica, de tipo expositiva; en donde además se recopila información sobre las falencias y proyectos educativos en el Ecuador en temas ambientales.

Palabras clave

Ambiente, aprovechamiento, educación, residuos orgánicos, TIC.

Abstract

This document arises from the need to strengthen environmental education in the educational field through the use of organic waste, seen as waste and generators of environmental, economic and social problems. The importance of environmental education is an essential tool to raise awareness and sensitize, especially to achieve the empowerment of students and promote an ecological culture. The purpose of this article is to analyze the opportunities for environmental education focused on the use of organic waste generated at the urban level. Evaluate formal environmental education in different target groups and the relationship of their learning with ICT (Information and Communication Technologies) and social networks. Its main contribution is a presentation of the reality of environmental education in the country and in different cultural contexts. The methodology used in the study is based on bibliographical research, of an expository nature; in addition, information is collected on the shortcomings and educational projects in Ecuador on environmental issues.

Keywords

Environment, use, education, organic waste, ICT

1. Introduction

The generation of waste is one of the most important problems in the society, since it is related to its growth and its activities. Waste is directly proportional to an increase in the economic level of a country. The culture of the waste lies in the environment and is presented through the following figures obtained from the INEC (National Institute of Statistics and Censuses, 2016) that express: “according to the waste characterization conducted in 2016, 58% correspond to organic waste and 42% to inorganic waste (cardboard, paper, plastic, glass, wood, metal, scrap, rubber, textile, spotlights, batteries and non-hazardous sanitary waste, among others)” (p. 15).

In the aforementioned, it can be observed that the data of the organic component are high. This could cause contamination to the soil, water and air, as well as an impact on the human health. Therefore, it is essential to link society to have as a result decision, action, awareness and improvement of the life cycle dynamics of waste. This can avoid focusing on solutions or alternatives that only cover up pollution or the transfer of it to another place; i.e., these are reactive and waste storing measures, in which its used it not yet seen.

As regards to the classification of waste, it has suffered a reduction in Ecuadorian homes, so according to the INEC (2017a):

In relation to the proportion of homes that did not classify their waste among the represented cities, a reduction is verified, the largest of which is recorded in Quito with a reduction of 9.71%, followed by Machala 7.31% and Guayaquil 3.24%. (p. 6).



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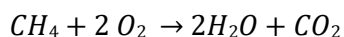
With this background, it can be said that there is a decrease in environmental awareness in the main cities of the country. This may be due to the absence of information on how and where to place the waste, in addition to the lack of interest in households in terms of environmental issues.

The waste scenario in the country is mainly based on generation, collection and disposition. The use of waste and its reuse are in a second scenario. There is no proper classification of trash from its origin in many places making it difficult to obtain materials of interest, because they are mixed with the rest of garbage, and since it is difficult to separate, it can lose its value and characteristics.

Organic waste can be seen as a resource, being used in different applications. Composting is one of them, consisting of an organic fertilizer based on plant waste that improves soil properties and nutrition. It is a viable and economical option, which can be used in crops destined for food or ornamentation (Vargas *et al.*, 2011, pp. 39-40). Another type of fertilizer is vermicompost, which is produced through the action of the Californian red worm in organic waste (EMGIRS EP, 2017).

Incineration is another alternative for urban organic solid waste (RSOU), a process by which electrical energy can be obtained. Calvachi and Navarro (2013) conducted a study about the calorific value of RSOU in Ecuador, whose results show an interval between 15.86 KJ/g to 17.08 kJ/g (p. 98). This proves its viability for incineration, as according to the ISWA (International Solid Waste Association, 2013) The calorific value of the waste must be at least 7KJ/g for being efficient (p. 5).

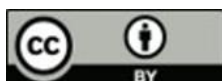
From this, it is also possible to obtain biogas, which is the result of anaerobic degradation of organic matter; this can be used for heating, transportation, electricity generation, etc. The production of biogas in a controlled way allows the reduction of greenhouse gases (GHG). Because, in combustion, methane is transformed into two products: CO₂ and water, avoiding its direct diffusion into the atmosphere, as shown in Equation 1. This is an advantage, since the uncontrolled methane produces more pollution than CO₂ (Romero, 2010, p. 344).



Equation 1

In this context, biodiesel and bioethanol are biofuels, whose raw material can also come directly from crops or from residues. Its application focuses mainly on transportation, and have different advantages: GHG emissions are reduced, mainly CO₂ up to 50%. According to Jaramillo and Zapata (2008) "Biofuels are biodegradable, 85% degrade in approximately 28 days" (p. 45). With this appreciation, the importance of the use of biofuels is highlighted, since their decomposition is generated in natural conditions causing less impact to the environment.

When analyzing the production cycle of biofuels, it is possible to compare how to obtain them, since if it is done through food crops such as maize or sugar cane, it could violate the nutritional and environmental safety. There is also an impact and greater use of natural resources. On the other hand, if the production is from materials without any value such as waste, organic waste, this would mean less pollution, reduced waste and reduced costs that are generated at its disposal.



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In the educational field, Ecuador has a national environmental education strategy for the year 2017-2030. Its objective is to link public institutions, private (at initial levels, basic and higher education) and citizenship in sustainability, i.e., it is an extensive process that links other systems such as economic, political and social.

As a result, according to the website of the MAE (Ministry of Environment, 2017), this plan showed that it has not achieved a high optimization level of resources and research. There are deficiencies in the classification of waste and teacher training in environmental issues. Another of the identified problems is found in the institutions of higher education (IES), where more than 50% of them have environmental policy. However, based on the percentage mentioned only 44% apply it properly.

Another recent educational program is the so-called "Land of Children and Youth" (TINI), undertaken by the Ministry of Education of Ecuador since 2017 whose purpose is to create culture and environmental awareness in educational institutions. It provides a physical space for both young people and children, in which they will be main actors in the care and development of life and biodiversity.

Youth and children interact with the environment through activities such as care, planting of plants and trees, construction of bird shelters, etc. Among the main components used for the implementation of the program are the management of natural resources, environmental health, socialization, expression, organization and management. It should be noted that within the environmental health component, its activities focus on the segregation of solid waste, in addition to its use for the elaboration of organic fertilizers (Ministry of Education, 2016, pp. 11-19). Despite government efforts, environmental culture has not achieved the expected results. Therefore, dynamic programs are needed according to specific groups. The following information will show environmental education, its characteristics, approaches and relevant traits.

Environmental education (EA) must be integral, related to socio-cultural, economic, technological, political and environmental systems. In other words, the perspective of man and nature is changed, as Novo (2009) states in a new ideological vision in which "It contemplates the human being not as a ruler or owner of nature but as a part of it, as a species that, with its undoubted singularities, is challenged to understand and develop in harmony with the rest of the biosphere" (p. 202). This emphasizes the influence that nature has on us and that the study of what surrounds us represents our own knowledge. We are part of a system, formed of relationships and elements that make up a whole, therefore any decision will affect that whole.

According to Castillo (2010) in the article on the importance of EA as a current problem, it is established that learning is based on the creation of experiences, knowledge and values that transcend over the time. It does not seek memorization, on the contrary, it seeks the active participation to ensure the permanence of awareness and that it becomes a habit. An ethical orientation makes possible the nexus for sustainability, through the change of attitudes and considerations towards others. All this results in the possibility of achieving a critical thought and better problem solving (Castillo, 2010, pp. 105-108).

All of the above makes environmental education a key factor in the development of new methodologies in the use of waste, this being an opportunity for new generations to know and take action against problems as the accumulation of waste, that were previously considered mere waste, without commercial value, and which are currently seen as raw material for future use.



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This article will address four main sections: environmental education by target groups; the influence of ICTs and social networks on environmental education and environmental education opportunities in the use of organic waste.

2. Environmental education by target groups

2.1 The environment and the age

In the study of Pol and Castrechini (2013) in Cataluña, an evaluation was carried out for children, young people and adults from 9 to 35 years old to determine their ecological behavior. It is concluded that the EA has greater effectiveness in the age groups between 8 and 13 years, since they present higher scores that mean greater knowledge, awareness and environmental values. On the other hand, the environmental awareness in adolescence suffers a decrease that reintegrates again in the adulthood.

With the time, the environmental awareness acquired at an early age is lost. The absence of environmental programs is often not the cause; it has to do with the psychological processes and changes that adolescents experience. The rebellion towards established norms and the lack of concordance between verbal communication and actions in authorities, encourage a deficiency of commitment to environmental issues, information observed in Figure 1.

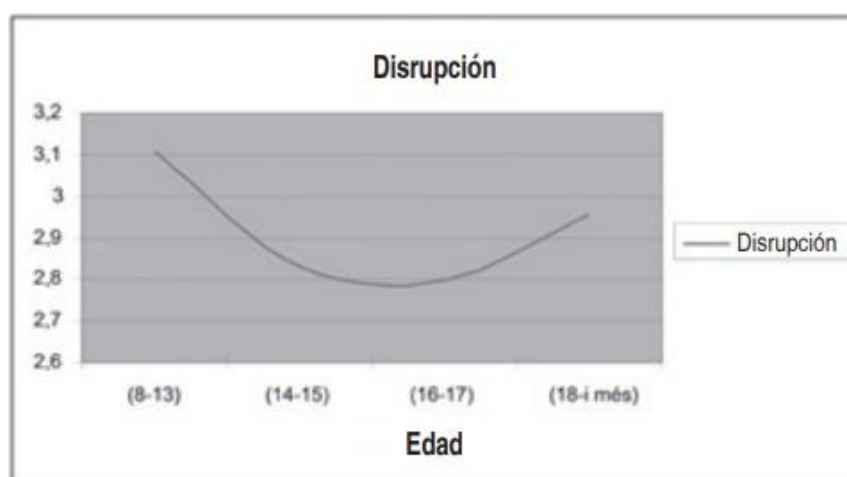
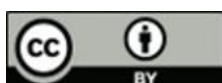


Figure 1. Disruptions in EA. Source: (Pol and Castrechini, 2013, p. 341).

As shown in Figure 1, in the ages corresponding to childhood, from 8 to 13 years, there are high scores in terms of knowledge and environmental values. From 14 to 17 years, there is a notable reduction, a very marked disruption. However, in adulthood this environmental awareness increases again, but does not manage to match the scores of initial periods.

Children are in a formative stage both in education and in values. They are more perceptive in terms of new knowledge. They are conditioned to follow the parameters that are established. That is, there is talk of greater control towards them and can generate greater influence in their habits.

The decrease in environmental awareness in adolescents is reflected in another study conducted by Boeve *et al.*, (2015), where students from 12 to 19 years old participate in 51 schools in Sweden. It is reaffirmed that in "ages up to 13 years, there is a rapid incorporation of environmental concepts and attitudes. Meanwhile, at higher ages, motivation and interest



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suffer a significant decrease” (pp. 15708-15711). The same is true in another study conducted by Olsson and Gericke (2015), in students between 12 and 19 years in schools in Sweden. Where it is established that there is a “reduction in the efficiency of EA in adolescence. It is also noted that there is no total reduction in the EA, since in the adulthood it ascends again” (pp. 41-42).

This can be explained by the problems of this transition phase, characterized by the constant inner struggle, key to the definition of personality and values. Interpersonal and intrapersonal relationships are built; there are constant conflicts of power between adults due to the difference of thoughts and the search for their identity. The social group has more influence than adult people, and the thinking focuses on their individuality and in the present, their main concern is their sentimental and social life (Garza, 2003, pp.36-38).

The university phase underlines the lack of involvement in environmental problems. People do not feel part of the solution, suppressing their responsibility and accepting the consequences that bring about the destruction of the environment. The social influence determines the environmental behavior of the people, usually these actions serve as parameter of behavior (Pol and Castrechini, 2013, pp. 345-346).

In addition, in the EA it is recommended to apply different strategies according to the level of maturity and ages, as stated by Corraliza (2016), professor of environmental psychology; in his study he says that there are 4 phases for EA. The first phase is to develop positive feelings through a physical and visual approximation of the environment. The second phase emphasizes prevention and the beginning of practice for the creation of customs and experiences. The third phase is dedicated to children over 12 years old with a proactive and conscious vision, locating personal reasons to work in favor of the environment. The fourth phase aims to establish a systemic panorama in relation to different social and intrapersonal contexts.

According to Díaz *et al.* (2014) reference is made to the EA, in early childhood from 3 to 5 years old in Bajo Cauca, Department of Antioquia, Colombia. Cognitive processes in this phase are influenced by the bond that can be established with them and the nature.

As for the environmental understanding of children, they distinguish their components through their senses, in a physical and visual way. They have ideas about the care of the environment, but they have a naturalistic conception, where the human being is not part of it, i.e., they feel alien to nature.

The formation of children includes a perception of extensive systems not immediate to the human being, such as jungles, parks, aquatic ecosystems, terrestrial, etc. The meaning of the environmental word also includes systems in which we inhabit as our home, school, work, streets, our city. With the understanding of these aspects, it is possible to encourage the direct action of ecological behaviors, visible in the environment in which the children coexist.

In the study of Vázquez and Manassero (2005), the action towards the environment is examined in 774 students from 14 and 16 years old who are coursing the last year of secondary education at international level, from which 57% are women. In general, they present a moderate attitude, driven mainly by the idea of sustainability, responsibility and defense of the animals (pp. 315-316).



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Students express their commitment to environmental care, but they develop negative criteria of externality toward environmental problems in them. There is an underestimation of the risks that may occur. Specialized participation to repair environmental damage as the only resource to resolve conflicts is discussed. In a way, scientific and technological advice is necessary, but everyone's participation is also necessary.

It is observed that there is a concept of change and conservation, but there is a passive attitude. The problem is known, but this environmental awareness is not materialized. The pollution is blamed or attributed to the great powers, like its solution.

On the other hand, in another study conducted in Chile in students between 14 and 16 years old, it is concluded that they are intended to help the planet in large measure, hence Gädicke *et al.* (2017) say "Students between 14 and 16 years have done activities as energy and water savings (70%), reduction of car use (30.8%), waste classification (24%) (p. 114). However, the constancy is not estimated in their actions, they could have taken it into practice for short periods of time, again to return to the consumerist practices.

The EA should start at an early age, in the stages of childhood and adolescence, because there can be achieved the construction of a link with the environment. In the first instance through sensory perceptions and exploratory recognition of what surrounds them; later to foster a critical and reflective thought in a space of trust and communication. The aim is to strengthen the first thoughts and experiences obtained, carried by the personal growth.

In the EA, there is no correct age for initiation, Corraliza (2016) expresses that the EA is not old, because since we are born we are already in contact with nature, which is our home, source of life and feelings. Therefore, knowledge and preservation of the environment becomes a necessity because of the role it plays in our development to be able to take advantage of it responsibly and is also a source of enjoyment.

2.2 A matter of gender

Perceptions differ in gender, women have more environmental qualities. The men have an impersonal attitude of the environment, a minimization of effects and total confidence in the scientific branch and in the developed countries, and they have more conviction in the great powers as alternatives for preservation. Instead, women see as a measure the linkage of all the elements involved in the problem. This analysis is seen in the international study of Vázquez and Manassero (2005) with students from 14 to 16 years old (pp. 319-320).

Gädicke *et al.* (2017) conducted an investigation focused on gender differences in environmental perception, in which participated 452 students from 14 to 16 years old, who were evaluated through a weighting, taking into account their perceptions of environmental problems. As a result, women showed greater interest, concerns at the local or regional level; as for environmental problems, mainly on climate change (pp. 115, 118, 119).

One of the reasons for the role in the environmental perception of women is their level of maturity, which is associated with the characteristics imposed by the society, such as care, problem solving, concern for others, etc. At a neuronal level, in women a process of improvement at an earlier age is performed. Mental processes are optimized through the recognition of the most important neuronal connections. But this does not want to discredit the maturity of men, because this factor relates to living conditions and experiences (Castillero, 2017).



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In the study of Palavecinos *et al.* (2016), 237 students from Spain and Chile were examined, who were from 18 to 26 years old in Chile and from 18 to 53 years old in Spain. By contrasting the study on different continents, it is observed that students have very similar environmental behaviors. This statement is interesting because there are great differences in dissemination, implementation and availability of information and projects between countries. On the other hand, Chilean students showed a higher environmental emotional link, while the Spaniards showed some indifference, and one more time the role of women in the environmental struggle is strengthened, they are recognized as pro-environmentalists, and have greater connection and empathy (pp. 146-148).

There is greater concern in the fact that the economic development increases the purpose of contributing to the environment, as in the case of Spain; but despite having access to a large amount of information, this does not guarantee that these intentions will be put into practice. The cognitive approach is important, but emotional training as well, because these are factors that influence the behavior. The construction of an affective connection reinforces the interest, motivation and entrepreneurship of favorable actions, and emotional stimuli are capable of creating stronger behaviors.

3. ICT and social networks in environmental education

ICTs are instant knowledge portals available to all and are strategic when it comes to disseminating information and promoting better interaction with students. These tools have a great influence on the way people think, so their management carries great responsibility.

According to Carvajal (2014), their importance in the environmental area is that "ICT are interdisciplinary technologies that can promote the profound transformation necessary in global efforts to fight for sustainability and sustainability of the planet" (p. 67). Science is expressed through the media, in experiences, research, models, programs in different branches, and can be adapted and improved for the benefit of a society. Sharing these experiences enables the strengthening of global cooperation towards change-generating practices.

The digital age is very marked in children, who are born learning how to manage technological tools. They have easy access to it and can explore different scenarios that change the look of the planet. But to do so, there must have a formed criterion, capable of discerning the best information and assimilating it properly. These tools are also a problem, because they go according to social tendencies and have a programmed obsolescence that forces it to consume more and more. This is the case of cell phones that are common tools for the search of information, connection and communication, but it has been seen that the digital connection weakens the emotional connection.

The management of libraries and online information reinforces the knowledge taught in the classroom. It is switched from closed systems to open systems, where students develop the subjects they have received. Curiosity causes questions and response that can be found in these media in both colloquial and technical language. The teacher will serve as a guide, trainer of criteria and support to distinguish information lacking of support. It is not possible to eliminate the role of the teacher who acts as mediator between the students and the technological tools. In addition, it creates a space for discussion and tutoring to strengthen knowledge (Zúñiga, 2004, pp. 3941).



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Technology has potential for proactivity and action in the face of natural disasters; it communicates immediately and decentralizes help. It is a source of contribution, participation and geographic information to enhance prevention. Real-time monitoring of the physical environment gives a perspective of what is happening around, and it adapts society and creates resistance to environmental problems (Johnson and Valdiviezo, 2011, p. 9).

According to figures from the Spanish Foundation for Science and Technology (FECYT), in the survey of Social Perception of Science and Technology of 2018, in Spain

television is the most used source to obtain information in 75%; 40% of the population uses the Internet as a first option to be informed; social networks are the most used in people under 35 years, followed by visual platforms like YouTube. On the other hand, according to the INEC (2017b), 58% of the population in Ecuador over 5 years old uses the Internet, out of which 74% do it at least once a day. The use of social networks is massive with 91% (pp. 14-15; 22.41).

As can be seen, the most important means for the dissemination of information are the visual ones like the television, besides the Internet that generates influence through the social networks. Due to their high use, they are tools with potential to educate the environmental awareness.

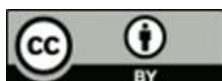
The media has more capacity for influencing. The problem lies in the type of information shown, i.e., if it is a tabloid it seeks to draw the attention of users through shocking news. The commitment of the media is to transmit objective information based on research and in an understandable language for the population. Therefore, it is necessary to prepare journalistic environmental issues to achieve a proper interpretation.

An investigation was carried out by Cervantes (2015) in Monterrey in the year 2013, in which the amount of environmental information was estimated in television, radio and press channels. The results showed that there is no great interest in showing this type of information, instead, entertainment, show biz and scandals are preferred. There are ecological-type sections, but they are not enlarged because of their lack of interest. The author determined that:

Out of the 266 times environmental issues were addressed, 208 were in the news providing information of a non-pedagogical fact. Only 15 times a didactic approach was given with pedagogical objectives. The observed media oriented 66 times the information they provided on the environment towards reflection and awareness (p. 19).

These figures show that there are reports of environmental problems, but they do not go deeper into the action against them. The news does not focus on creating culture in the population, only in showing facts of high impact. Many times, there is a space for reflection, but it is focused on negative aspects and on a global level. They do not focus on the problem, but on their actors. The global reality is presented with greater emphasis, without contemplating the local reality, which is part of the problem.

On the other hand, social networks are the most used by the world in a wide range of ages. The most used social network is Facebook, hence Ruiz (2016) states that:



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Facebook reached 1.49 billion of active users in July 2015, and in August got the milestone of 1 billion of users connected on the same day (1 in 7 inhabitants of the planet). Twitter and LinkedIn continue to grow every year, and the use of photo and video platforms such as Youtube, Instagram or Pinterest has increased exponentially.

Facebook is the most attractive social network with the greatest number of users. This can be a tool for transmitting truthful, creative and visual information. It is a mixture of other platforms, as it includes videos, photos, opinion forums, groups with different interests, etc. The information published is seen as part of the leisure, it informs and at the same time it entertains. The disadvantage of managing this social network is that any individual can report messages that are not verified or are not in context. This can mean negative positions without any foundation. Other aspects are seasonal trends, actions that are not necessarily positive.

An example of the use of Facebook in education is manifested in the research presented by Acosta (2013), where a pilot plan was conducted for environmental engineering students from 16 to 21 years old, taking the advice of teachers.

The main objective of the research was to create a Facebook group to disseminate general news, events, forums and congregations for research and describe the reaction of the students. Teachers are vital elements in the administration of the Facebook group, as they are a representation of credibility and security in the information.

The reactions against the publication of news were not positive, with few comments and participation, the students preferred and showed better response to the calls to form research groups. Posting YouTube videos on this platform resulted in a lot of feedback from both students and teachers.

It highlights the use of Facebook for its worldwide recognition, easy use, privacy and security conditions, potential for spreading information to more especially young users. Facebook is characterized as a platform dedicated to entertainment; this can hinder the seriousness of the teaching process. Young people see this space as theirs, where they find relaxation and conviviality with their friends. More serious social networks can be used, dedicated to the opinion as Twitter (pp. 62-64)

ICT makes instruction efficient in children, as in the research of Salinas *et al.* (2016), learning was assessed in fourth-year primary school children in Campeche, Mexico. For the teaching, 4 resources were used: Prezi platform, interactive videos, blog, elaboration of a comic. The acceptance of these tools in children is shown in Figure 2.



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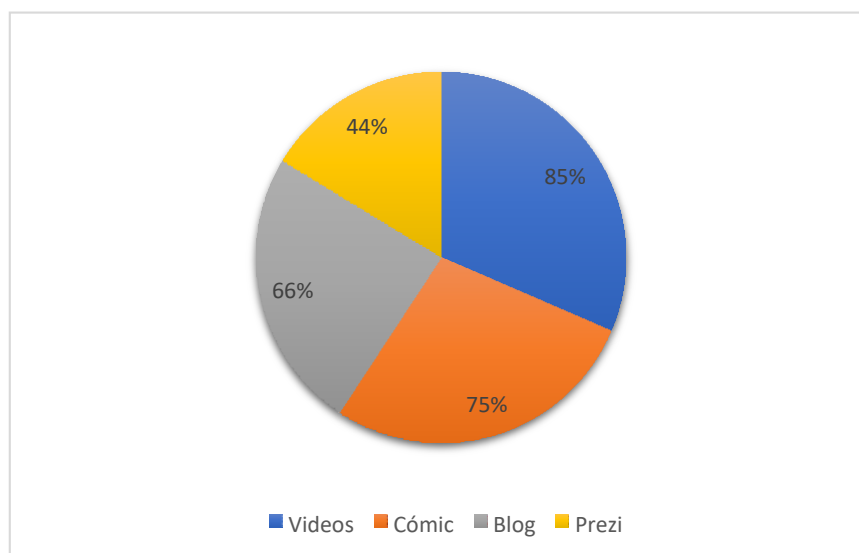


Figure 2. Acceptance of ICT in children. Source (Salinas et al., 2016, p. 3003).

As can be seen, the visual tools are the most prominent, and the videos presented had more impact and attention on the children. In addition, with the use of these tools it was able to increase the environmental interest of students by 91%, according to surveys conducted.

The visual causes greater impact on children, it draws more attention and makes their retention more effective. The percentage that did not agree with these tools may have intelligences related to the kinesthetic part, reason for which methodologies must be directed to various types of intelligence. The diagnosis of children is imperative to undertake with the cognition processes.

Teenagers and university students have different sources and motivations for the search for information. In Hungary, a study was conducted comparing these aspects in university and college students, as shown in Figure 3.

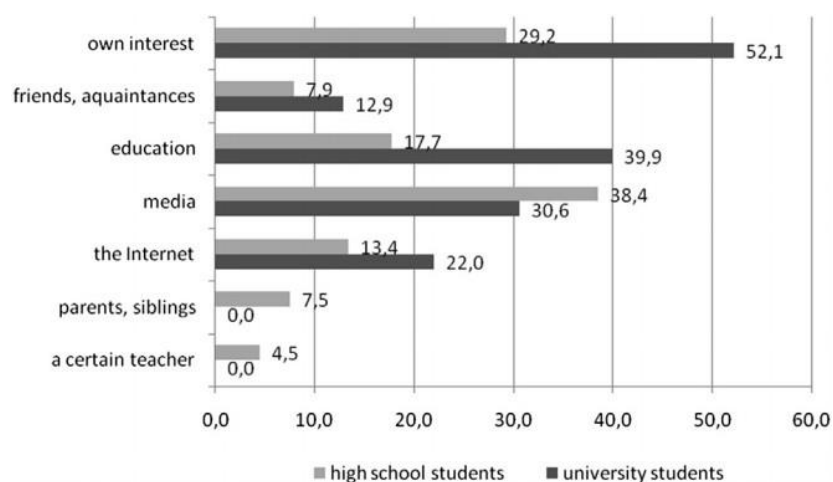
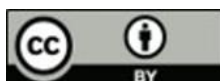


Figure 3. Sources and motivations of EA. Source: (Zsóka et al., 2013, p. 129).



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College students have little personal interest in environmental issues, contrary to university students. The largest information instrument according to both groups is the media, followed by the Internet.

For college students, the motivation to improve their education is low; meanwhile, for college students this is the second reason that motivates them to investigate or deepen the issues. The role of parents, friends and teachers as a source of information is less. This aspect was not considered for the survey in university students (Zsóka et al., 2013, p. 130).

School students do not develop personal interests in environmental issues, this may be because they do not consider it part of their lifestyle. They are taught in schools, but they are taken into account only during the school period. The motivation is important because it impels us to know more, to have greater performance facing the problematic, especially to make better decisions.

To improve the assimilation of EA in adolescents, it is necessary to combine the theoretical and practical part in the methodology, as well as to create environments of trust and horizontal communication with examples, anecdotes, etc. The research proposed by Pedroso and Menéndez (2017) highlights the edu-communication, i.e., videos, drawings, dramatizations, communication skills, made by themselves as a learning tool. All these activities require the integration of authority figures to give more strength and credibility to the projects, being its main achievement the motivation to continue with activities out of class and after completing the project. It is concluded that the best tool is the audiovisual, as it promotes the creativity of the students and allows them to have a better perception and tolerance of their environment (pp. 162-164).

4. Environmental education opportunities in the use of organic waste seen from different countries

In Latin America and the Caribbean, Urban Solid Wastes (RSOU) are the main components of waste, as shown in Figure 4.

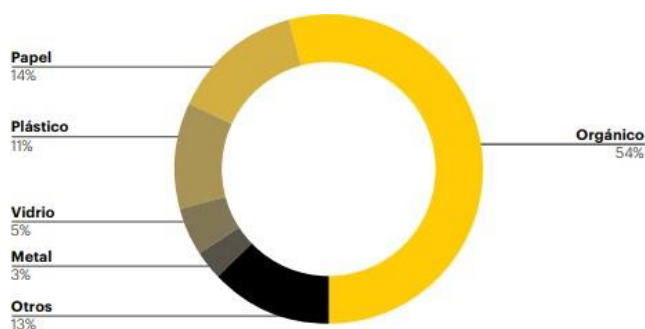


Figure 4. Waste composition in Latin America and the Caribbean. Source: (Graziani, 2018, p. 14).

RSOU exceed inorganic waste by 17.4%. Inorganic materials are also importance due to the use of technologies, more accelerated lifestyle, use of products with reduced lifespan. The RSOU include residues derived from the food and products of ornamentation activities such as leaves, and stems. Figure 5 shows the management of waste in several countries in the year 2017.



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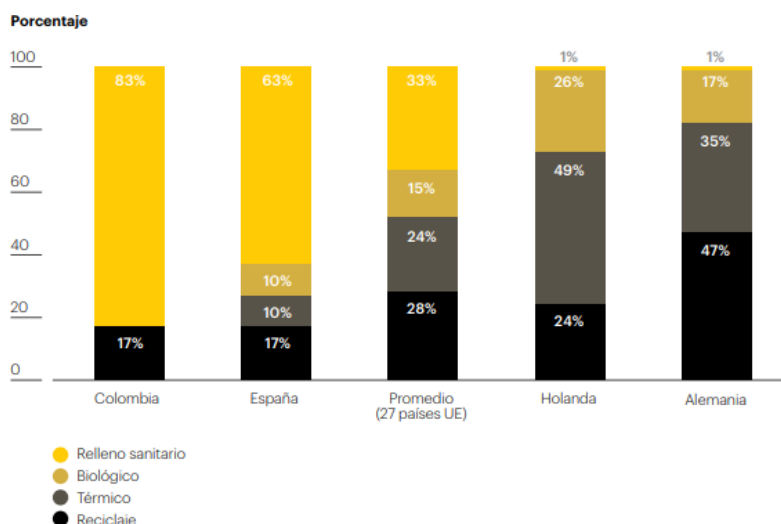


Figure 5. Waste management in the world in 2017. Source: (Graziani, 2018, p. 20).

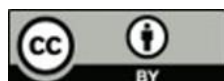
The figure above shows the reality of developing countries compared to the most developed, in which technological, cultural, educational and political problems are evident. If Colombia is used as an example, it can be seen that landfills are of vital importance for waste management, as only 17% is recycled and the biological and thermal treatment is not considered. On the other hand, countries such as Germany and the Netherlands use landfills at a rate of 1%; in other words, 99% of waste is used in recycling and thermal processes.

In Norway domestic waste is used as fuel mainly in heating. This process is developed in the Klemetsrud plant. The energy obtained from these wastes has an equivalent proportion of 4 to 1 with traditional fuels. Transportation costs are compensated with their energy capacity. This plant is intended to produce electricity through turbines driven to homes and public institutions; even some cities in the United Kingdom take their garbage to the city of Oslo, receiving an economic bonus for it.

Another way of using RSOU in Norway is through biogas, which is a means of feeding for transportation as it is used as biofuel. Thus, 2 Kg of RSOU can produce 1 liter of fuel (Price, 2013). Similar practices are carried out in the Netherlands, where the circular economy is primed to avoid the deposit of wastes to a lesser possible percentage. Its principles are the processing, obtaining of energy and recycling used in the construction; being prevention the main tool in waste management. For all of this to take place, strong educational policies and attractive economic incentives are essential (Ossa, 2018).

At school, students perceive garbage as a problem, as it is inevitable to generate organic waste. In schools its characterization allows to know its potentiality in terms of recycling or utilization. This can be a source of savings, obtaining economic benefits, reducing the volume of waste and space and increasing the lifespan of landfills.

About 40% to 50% of waste in schools are organic, about 0.134 Kg/day of food waste is produced. In some schools in Sao Paulo there is a proportion of up to 90% of them. These materials can be used for the benefit of the same institution in gardens and orchards as fertilizer replacement, resulting in improved properties, structure and water retention in the soil. With this practice, the volume of trash can be reduced in 4 tons per month. Composting generates a positive impact on GHG abatement with a reduction of 49.86 Kg. of CO₂ equivalents/tons of waste at the domestic level. Thus, a large number of schools in Sao



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Paulo use composting as a practical tool for education, along with conceptualization, affection and environmental responsibility (Ricci, 2016, p. 13).

In the Research and Advanced Studies Center (CINVESTAV), Mexico, a waste sampling was carried out for 3 years, and it was determined that 48% of it corresponds to organic matter. In the Iberoamerican University of Mexico, a similar figure was obtained: 52% of organic matter feasible for composting (Ruíz, 2012, p. 95).

Once the characterization was carried out, an environmental program was developed through workshops on recycling and separation, techniques for composting, waste disposal and dissemination of results. Organic matter was mainly used in composting. Despite technological deficiencies, infrastructure and personnel, savings of approximately \$5000 were obtained only in the year 2003. Including a decrease in the volume of waste by 67% (Maldonado, 2006, p. 64).

In order for this type of project to take place, it is necessary to increase environmental awareness campaigns for all its members, being the main problem the lack of separation from the source, environmental culture and the diversion of responsibility to the administrators of the institutions. Involving people who generate garbage, in the separation and use of waste increases environmental awareness.

Second-generation biofuels are another alternative for lignocellulosic biomass, which represents a large amount of organic waste consisting of cellulose, hemicellulose and lignin; such as forest and food-type waste (Mueller-Langer et al., 2013, p. 113). Its main representatives are bioethanol and biodiesel, whose world production is shown in Figure 6.

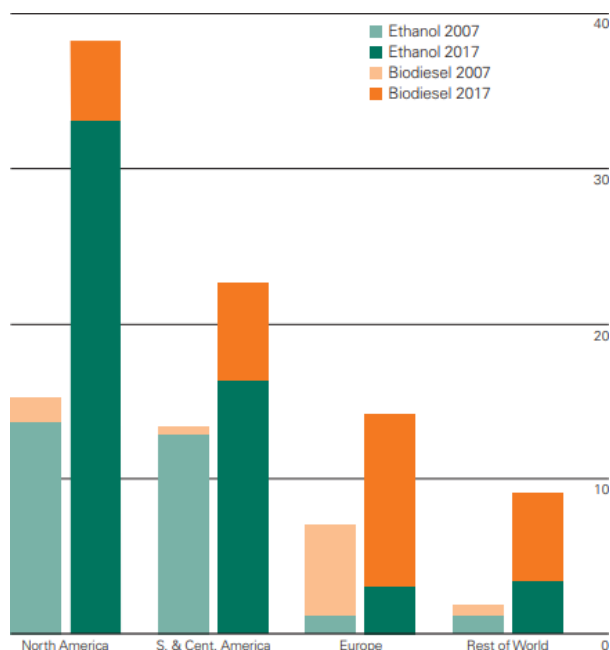


Figure 6. Global production of biofuels (millions of tons of oil equivalent). Source: (BP Global, 2018).

Biofuels have gained worldwide participation since 2007, as a potential replacement for gasoline. Bioethanol in South and Central America has not suffered a significant increase during the years 2007 to 2017, as in Europe and the rest of the world. In North America its



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production in 2007 constituted more than double in 2017. The participation of biodiesel has remained higher than bioethanol during the years of study.

The production of biodiesel is carried out through esterification processes, whose products are ester and water. The hydrocarbon (R') of the alcohol replaces the hydrogen of the carboxylic acid (COOH) as shown in Figure 7.



Figure 7. World production of biodiesel. Source: (Matthey, S.F.).

The esterification technology allows to obtain non-acid esters through a reaction of liquid carboxylic acid with alcohol (Matthey, s.f.).

The production of bioethanol is carried out through the anaerobic fermentation of sugars. Treatments such as enzymatic hydrolysis are usually required for the release of simple sugars present in the raw material. As a result, monosaccharides are obtained easily assimilated by yeasts, microorganisms that through the fermentation process transform simple sugars into ethanol, as shown in Figure 8 (Kanal, s.f.).

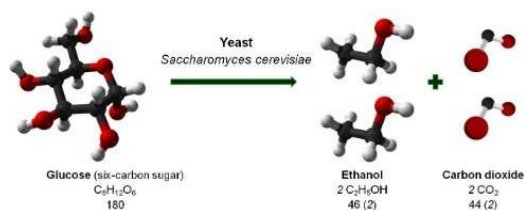
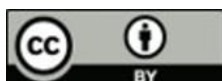


Figure 8. Global production of bioethanol. Source (Kanal, s.f.).

The fruit peels like banana, papaya, mango, pineapple, etc., are a good option to obtain bioethanol, due to its high composition of sugars and carbohydrates. The waste produced corresponds to approximately 50% of its weight (Jahid *et al.*, 2018, p. 2). These wastes are present in the composition of urban waste, as well as vegetable waste, tubers, etc.

Methanol is considered as another biofuel, as it can be generated through organic waste, sewage, feces, etc. It is also a byproduct of the fermentation of alcoholic beverages; and it is also used as an additive to gasoline, as well as bioethanol. It can be obtained from methane, natural gas product. The disadvantages in its production is that it only presents economic feasibility at the industrial level, besides the dangers of toxicity in its manipulation (Leiva, 2011).

The EA is linked to the practicality and the best way to do it is through the waste with which we live daily, due to its easy reach and application. Composting is the best way to strengthen theoretical knowledge and create awareness as consumers. The contact with the problems motivates proposals and ideas of change, allows the inclusion of the children in simple activities that create experiences and knowledge on the reality of the garbage.



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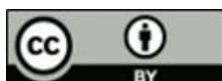
5. Conclusions

Education is a process that is constantly changing due to the dynamism of its nature. Developing the practical aspect through projects that can be carried out in a simple way with the scope in the daily life, consolidates the empowerment towards a new lifestyle, that is conscious, critical and able to see reality and propose solutions to environmental conflicts.

Environmental education should be taught from the initial stage, involving children and making them feel part of the environment, since at this stage, it is more feasible to capture their attention through an interaction, visualization, excursion and execution of projects. Thanks to the perception of their environment and their problems, they acquire autonomy to make decisions and undertake actions, ideas or projects. Children act as promoters of change with influence to adults and directly to their parents. Each person is different with different intelligences and personalities, therefore, the methodology should not be static, it must assume a creative position with several alternatives to ensure the understanding of all.

ICT is a means of sensitizing and transmitting environmental information, complementing the EA. They are instruments that must be in accordance with the needs and characteristics of target groups. They are opportunities to promote dialogue and experience without frontiers and in a faster way. The most important ones correspond to the audiovisual media, such as television and videos, and it is proved that these have been more effective in children. On the other hand, social networks are used by almost every person daily and several times in the day, and these may be an opportunity to disseminate information, but through official entities that have bibliographic support, because they can generate negative or uncertain positions that do not contribute with any benefit to society.

Large amounts of waste are arranged in landfills to remain there for long periods, but these can be used as input for clean technologies, which cause minimal impact to the environment. The useful life of these wastes can be extended through their knowledge and characterization. One of the simplest practices that can be carried out in educational institutions is composting, where the large amount of organic matter is used to improve soil conditions. These activities allow the resolution and approach of everyday problems in children, who are the best information receivers. Thus, they feel part of the solution and are able to replicate it outside their educational environment.



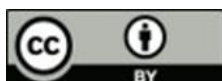
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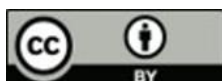
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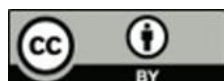
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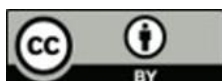
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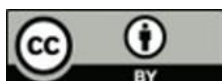
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