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ENVIRONMENTAL EDUCATION, RESPONSIBLE CONSUMPTION AND THE THREE RS: A REVIEW TO PROMOTE SUSTAINABLE URBAN WASTE MANAGEMENT PRACTICES

Educación ambiental, consumo responsable y tres R: revisión para fomentar prácticas sostenibles del manejo de residuos urbanos

Diana Patricia Mora Méndez
Universidad Europea del Atlántico, Spain (dmoram100@hotmail.com) (https://orcid.org/0009-0002-9258-2003)

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ABSTRACT

Climate change is a priority issue today, not only because of its constant presence on political and economic agendas, but also because of the impacts it generates on life on the planet. What is at stake is the sustainability of human life, making it urgent to adopt measures to mitigate its effects. Among these, the proper management of municipal solid waste is of particular importance, as it contributes to approximately 5% of greenhouse gas emissions.

This article presents a review of the state of the art of the following relevant aspects for the promotion of sustainable urban waste management practices: environmental education, responsible consumption and the three R's strategy (reduce, reuse and recycle). This research is developed under a qualitative approach and a documentary methodology, prioritizing official sources such as international organizations, environmental authorities, universities and educational institutions, in order to offer a broad and reliable vision of the subject.

An overview of the generation of urban solid waste and its repercussions is presented, as well as the evolution of environmental education as a tool for transformation. Responsible consumption is discussed as an ethical basis for sustainable decision-making, while the three Rs are presented as a concrete, accessible and effective strategy. The current challenge is to strengthen the dissemination and practice of these actions, promoting an aware and committed citizenship with the care of our common home: the Earth.

Palabras clave:
Educación ambiental, consumo responsable, tres R.

RESUMEN

El cambio climático es un tema prioritario en la actualidad, no solo por su presencia constante en las agendas políticas y económicas, sino por los impactos que genera sobre la vida en el planeta. Lo que está en juego es la sostenibilidad de la vida humana, por lo que se hace urgente adoptar medidas que permitan mitigar sus efectos. Entre ellas, la gestión adecuada de los residuos sólidos urbanos cobra especial importancia, ya que estos contribuyen aproximadamente al 5 % de las emisiones de gases de efecto invernadero.

Este artículo presenta la revisión del estado del arte de los siguientes aspectos relevantes para el fomento de prácticas sostenibles del manejo

de residuos urbanos: la educación ambiental, el consumo responsable y la estrategia de las tres R (reducir, reutilizar y reciclar). La presente investigación se desarrolla bajo un enfoque cualitativo y una metodología documental, priorizando fuentes oficiales como organismos internacionales, autoridades ambientales, universidades e instituciones educativas, con el fin de ofrecer una visión amplia y confiable del tema.
Se presenta una visión general sobre la generación de residuos sólidos urbanos y sus repercusiones, así como la evolución de la educación ambiental como herramienta de transformación. El consumo responsable se analiza como base ética para la toma de decisiones sostenibles, mientras que las tres R se presentan como una estrategia concreta, accesible y efectiva. El reto actual es fortalecer la divulgación y práctica de estas acciones, promoviendo una ciudadanía consciente y comprometida con el cuidado de la casa común: la Tierra.

Introduction

We cannot remain indifferent to the current environmental crisis, marked by the consequences of climate change, a phenomenon accelerated by a model of civilizational development centered on excessive consumerism. The dominant economic system is based on anthropocentrism, linear production and accelerated consumption that continues to consider natural resources as unlimited. This logic promotes the continuous production of goods and services whose usefulness is ephemeral, but whose environmental impact is long-lasting.

The principle of "the more you sell, the more you earn" has guided economic growth, without considering with equal rigor the waste generated: both those derived from the production process and those arising from discarding, disuse or planned obsolescence. This problem transcends the economic sphere; it is also an ethical issue that directly calls into question the responsibility of human beings towards the environment they inhabit.

The excessive generation of municipal solid waste represents one of today's most pressing challenges. Tons of materials are discarded daily in homes, businesses, stores and educational institutions, which if properly managed could represent an opportunity to reduce the consumption of resources, promote circular economies and contribute to a truly sustainable development. To this end, it is necessary to promote conscious decisions that integrate ethical values, technical knowledge and individual and collective commitments.

In response to this problem, many efforts have been made to find practical solutions that allow citizens to actively contribute to the mitigation of environmental impact. Within this framework, environmental education, responsible consumption and the application of the so-called three Rs (reduce, reuse, recycle) are key pillars for promoting a cultural transformation towards sustainability. As stated by UNESCO (2021), environmental education should be promoted as an essential driver to achieve sustainability, highlighting the importance of practices such as responsible consumption and proper waste management, including the three Rs.

This context raises the need for a review of the state of the art that gathers and systematizes relevant information on these issues, offering teachers, researchers and community leaders conceptual and methodological tools for the design of pedagogical strategies. The main objective of this review is to provide an updated overview of the problems associated with the increase in urban solid waste, to analyze the role of environmental education in the formation of committed citizens, to explore responsible consumption as a starting point for change, and to highlight the transformative potential of R's in everyday life. Finally, significant experiences are presented that integrate these elements and that can guide new proposals to reduce environmental impact from the local to the global level.

Method

The methodology used for the elaboration of this article is framed within the framework of documentary research with a qualitative approach, in correspondence with the proposed objective. According to Arias (2012), documentary research with a qualitative approach makes it possible to analyze, interpret and understand phenomena based on the systematic study of bibliographic and documentary sources, which is especially useful when seeking to build solid theoretical or conceptual frameworks. For this purpose, searches and reviews were conducted and organized around the main related subtopics: solid waste production and its environmental impact; current solid waste management in developed and developing countries; environmental education; responsible consumption; the three R's (reduce, reuse, recycle); and the strategies that integrate these elements in terms of solid waste reduction.

The documents selected come mainly from official sources, such as international environmental agencies, sector ministries, universities and educational institutions. The selection of sources responded to their thematic relevance, institutional reliability and timeliness, in order to guarantee the validity of the inputs analyzed. The purpose of this review is to build a solid frame of reference to support pedagogical proposals aimed at promoting environmental responsibility from a critical and transforming perspective.

Results

Solid Waste Production and Its Impact on the Environment.

It is necessary to begin this section with the definition of solid waste. Solid waste is defined as materials or products that are discarded in solid, semi-solid, liquid or gaseous state, contained in containers or deposits, and can be classified according to their characteristics and origins into three different groups: municipal solid waste (MSW), special management waste (SMW) and hazardous waste (HW) [Secretaría de Medio Ambiente y Recursos Naturales. (2019)]. Solid urban waste will be taken into account for this review.

The final disposal of solid waste continues to be a major problem today. According to Franklin, O. [Franklin, O. (2025)] "5% of all greenhouse gas emissions are attributed to solid waste and another 8%, to food waste. Together, they account for more than shipping and air transport combined."

For the UN Environment Program (2024), the overview of solid waste production will be as follows:

> Municipal solid waste generation is expected to increase from 2.1 billion tons in 2023 to 3.8 billion tons in 2050. In 2020, the global direct cost of waste management was estimated at $252 billion. When the hidden costs of pollution, ill health and climate change from poor waste disposal practices are taken into account, the cost rises to $361 billion. If urgent action is not taken on waste management, by 2050 this annual global cost could almost double to a staggering $640.3 billion.

It is not only the production of large volumes of municipal solid waste, but also the management of such waste and the effects it has on the integrity of the planet (something is missing here). For the World Bank (2019, March 6), the solid waste issue also includes:

> Floods, diseases, polluted oceans, which are some of the many consequences of not treating what we waste. Garbage not only ends up in large, foul-smelling landfills but also has a devastating impact on the planet and could be even worse in the future.
>
> According to the study, the world generates 2.01 billion tons of municipal solid waste per year, and at least 33% of this waste is not treated. Rapid urbanization, population growth and economic development are projected to increase the amount of waste globally by 70% in the next 30 years if urgent action is not taken. A future where living with garbage could be the new normal.
>
> But it is not only the large North American, European or Asian cities that could be affected by this development. Latin American cities are not exempt from this problem: each of their inhabitants generates almost one kilogram of garbage per day, but only 4.5% of waste is recycled at the regional level.

In his interview to Climática (n.d.), journalist Oliver Franklin-Wallis, writer of the book "Wasteland" states:

> That we don't think about the future until it's too late. Take a plastic soft drink bottle: it could take up to 450 years to degrade in the environment. In the process, it will release microplastics and nanoplastics that could have serious effects on the health of humans and the rest of life on this planet. We produce about 500 billion plastic bottles a year,

and that's just one type of waste! Litter is the physical equivalent of global warming: it is something we all see and touch every day.

From another perspective, as López (n.d.) says, when "garbage is put in its place", a series of processes originate that involve diverse and complex problems that are difficult to solve, ranging from the forms of governmental organization to provide this service, to corruption in its management at different levels, to the exploitation and manipulation of a group of the community dedicated to these tasks, to the environmental problems caused by the accumulation of this waste.

In addition to the real waste aspect of abandoning materials that could be reused, which results in a greater and more irrational exploitation of natural resources, both renewable and non-renewable.

Solid Waste Management in Developed and Developing Countries

The European Parliament (2024, March 25) states that

> each European generated an average of 5 tons of waste in 2022, amounting to a total of more than 2.2 billion tons. In Europe, the aim is to recover waste or, in other words, to use it in different ways. The residues can be recycled, used as backfill (e.g., to replace soil for slope reclamation or for safety purposes in geotechnical applications? or landscaping engineering) or can be incinerated and the energy produced from this process can be used. In less than two decades, from 2004 to 2022, the amount of waste recovered increased by 40.6%, from 870 to 1,223 million tons. Recovered waste accounted for more than half of total waste (61.4%) in 2022. The remaining waste was landfilled (30.2%), incinerated without energy recovery (0.4%) or disposed of in some other way (8.0%). Solid waste going to landfills is partially exported from the EU to other countries.
>
> In 2022, waste exports to non-EU countries reached 32.1 million tons, a slight decrease of 3% compared to 2021. Most of the waste exported out of the EU (55%) consists of ferrous metal waste (iron and steel), which mainly goes to Turkey. The EU also exported a large amount of waste paper (15%), with India being the main destination. In 2022, 39% of EU waste went to Turkey (12.4 million tons), followed by India (3.5 million tons), the United Kingdom (2.0 million tons), Switzerland (1.6 million tons) and Norway (1.6 million tons).
>
> Municipal waste is waste generated by households, businesses, offices and public institutions. They represent only about 10% of the total waste and are managed by municipal authorities. In 2022, the volume of municipal waste generated varied greatly among EU countries, from 301 kg per capita in Romania to 803 kg per capita in Austria. The percentage of municipal waste recycled increased from 19% in 1995 to 48% in 2022, while in the same period the percentage of waste deposited in landfills decreased from 61% to 23%.

In Latin America, the production of solid waste has been increasing due to industrial development, the growth of population centers and consumption [Instituto de Estudios Urbanos. (2021)]. According to the Inter-American Development Bank (IDB). (2023),

> it is estimated that the average annual generation of municipal solid waste (MSW) in Latin America and the Caribbean for 2018 was 224 million tons (a figure equivalent to 1.02 kg/inhabitant per day). In 2020 the COVID-19 pandemic caused an estimated 6% reduction in MSW generation (211 million tons), linked to a drop in gross domestic product (GDP) per capita. By 2030, it is estimated that MSW generation will reach 259 million tons, which will bring an associated increase in the demand for services, infrastructure and business and institutional capacity. Argentina, Brazil, Colombia and Mexico account for about 74% of total solid waste generation in the region.

The management of the final disposal of MSW is done as shown in figure one, within which it is highlighted that of the total MSW generated in 2018 in the region, 4%, on average,

was subjected to valorization process, 57% was deposited in landfills and 39% was taken to inadequate disposal sites (12.5% of the inadequate disposal sites correspond to controlled landfills and 26.5% to open dumps)

Figure 1

Destination of collected waste.

Source. Adapted from Inter-American Development Bank. (2023).

Environmental Education

Environmental education was first mentioned in an international context at the Stockholm Conference on the Human Environment in 1972, where the Declaration on the Human Environment was adopted. The following is a quote from the UN (2023) in the Environmental Education Toolkit for Latin America and the Caribbean,

> environmental education, aimed at both the younger generations and adults, and paying due attention to the less privileged sector of the population, is essential in order to lay the foundations for a well-informed public opinion and for individuals, companies and communities to act responsibly in protecting and improving the environment in all its human dimensions. It is also essential that the mass media avoid contributing to the deterioration of the human environment and disseminate educational information on the need to protect and improve it, so that people can develop in all aspects. (p. 6)

It is essential to promote environmental education, aimed at both young people and adults, paying special attention to underprivileged sectors. This will strengthen well-informed public opinion and encourage responsible behavior on the part of individuals, companies and communities, aimed at protecting and improving the environment in all its human aspects.

> Another relevant international document, adopted in 1975, is the so-called Belgrade Charter, which is considered a general framework for environmental education. The goal of environmental education is established there: "To reach a world population that is environmentally aware and interested in the environment and its related problems, and that has the knowledge, skills, attitudes, motivation and desire to work individually and collectively to find solutions to current problems and to prevent those that may arise in the future."
>
> Later, at the Intergovernmental Conference on Environmental Education organized by UNESCO and UNEP and held in Tbilisi in 1977, several aspects were clarified and defined, which constituted the theoretical foundation of environmental education. This is based on an understanding of the environment as a totality that encompasses both natural aspects and those derived from human activities. (p. 7)

These three historical moments shared a vision of the environment as an interconnected system, influenced by human activities. However, concrete strategies for delivering environmental education or integrating it into school curricula have not yet been developed.

Starting in the 1980s, international texts on the environment began to incorporate concepts related to school scenarios, as well as the impacts of human actions on the environment. These impacts not only affect present generations, but also compromise future generations.

The Colombian environmental policy (2012) includes an international vision on environmental education, which highlights the following:

> At the Moscow meeting (1987), UNEP and UNESCO proposed some curricular strategies based on interdisciplinarity and integration to promote environmental education in the world. There, a consensus was reached regarding the concept of environmental education as a process in which individuals and communities become aware of their environment, based on knowledge, values, competencies, experiences and will, so that they can act individually and collectively to solve present and future environmental problems.
>
> The discussion and evaluation of these curricular strategies, their development and achievements in some regions of the world were the subject of the International Training Seminar for the Incorporation of Environmental Education in the Primary School Curriculum (Malta) and the Seminar for the Incorporation of Environmental Education in the Secondary School Curriculum (Cairo), both held in 1991. These seminars resulted in recommendations such as the participation of teachers in the design of a curriculum that incorporates the environmental dimension in all school plans and processes, and research into evaluation methods for these processes. (p. 11)

In the 1990s, environmental education acquired a more political connotation, seeking to influence academic, business and social spaces in order to reach the entire world population. This perspective allowed for greater awareness of environmental impact and the need for its mitigation, as mentioned in Colombia's Environmental Education Policy (2012, p. 11):

> In 1992, the European Economic Community, through its Policy and Action Program for the Environment and Sustainable Development, Action 21, proposed that, without prejudice to the prerogatives of the Member States, all those aspects related to the environment, included in both natural science and human and social science courses, that prepare for practical life, should be incorporated into all school curricula at different levels. The Action 21 proposal was unanimously accepted at the Rio Conference in 1992. Specifically, this program focuses on the development of environmental awareness, training and education. Later, in October of the same year, an environmental education meeting was held in Toronto, Canada, which underscored the aforementioned approach, confirming the need to promote intersectoral and inter-institutional work strategies to strengthen environmental education.

Responsible Consumption

At the beginning of the 21st century, the international community is concerned about the serious impact of pollution on the environment and the negative consequences it generates, and in response to this situation, the Sustainable Development Goals (SDGs) were adopted at the international level, where environmental education was specifically linked to Goal 4: Quality Education. In particular, target 4.7 states that:

> To ensure that all students acquire the knowledge and skills necessary to promote sustainable development, including through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and

non-violence, global citizenship and appreciation of cultural diversity and the contribution of culture to sustainable development. (UN, 2015).

Along the same lines is sustainable development goal number twelve, known as responsible production and consumption. This objective has its origin in the concern for the depletion of the planet's resources, in a context of constant population growth. If by 2050 the population is 9800 million, it would take almost three planets to provide the natural resources needed to maintain current lifestyles. (UN, 2015). In view of this, there is an urgent need to take action. The UN indicates that there may be two paths: 1. Reduce waste generated and 2. Think carefully about what you buy and choose a sustainable option whenever possible. Two actions within the reach of any person, hence the importance of education in responsible consumption.

For its part, the Earth Charter published in 2000, promoted by the United Nations World Commission on Environment and Development since 1987 and jointly drafted by thousands of people around the world, has become a benchmark for sustainable development issues. Based on sixteen principles, in which common values are recognized. Principle four reads "To ensure that the fruits and beauty of the Earth are preserved for present and future generations." As well as in principle fifteen "Eradicate poverty as an ethical, social and environmental imperative." This principle is based on the idea of "Enabling all human beings with the education and resources required to achieve a sustainable way of life. In addition, provide the social security and support networks required for those who are unable to support themselves." These are examples of shared responsibility and its relation to education.

For Mejía, M. (2022), responsible consumption "can be defined as that decision made by a consumer who is concerned about the consequences generated by a purchase and its subsequent effect on the environment and society, as well as the waste generated in this process" When consumers become aware that their purchasing decisions can reduce the impact on the environment and adopt practices to materialize this ethic of care for the environment, they become responsible consumers.

In the words of CONPES 3874 of 2016, which refers to the Colombian Comprehensive Policy for Integrated Solid Waste Management, the premise is that companies extract materials, apply energy to them to manufacture a product and sell that product to the end consumer, who then discards it when it no longer serves the user's purpose.

The logic of discarding has generated problems on different fronts, such as pressure on resources, pollution associated with production, and the effects on final disposal, which includes inefficient recovery, reuse and reduction processes. In addition, there is little economic interest in integrated waste management, as it implies investments that often do not generate the desired profitability. It must be remembered that, in the capitalist system, economic utility is the main purpose and hence the economistic convenience or not of any productive effort is evaluated. As stated by the Ellen MacArthur Foundation (2013) the linear production model incurs resource losses in several ways:

Waste in the production chain. In the production of goods, significant quantities of materials are normally lost between extraction and final manufacture.

Waste along the value chain in food markets. Material losses are recorded at different steps in food production: harvesting, transportation, storage and consumption. Across the entire food supply chain, these global losses are estimated at one-third of the food produced for human consumption each year.

Waste at the end of its life cycle. For most materials, utilization rates are quite low compared to primary manufacturing rates.

The Three R's (reduce, reuse, recycle)

Moving from the theory of responsible consumption to daily practice is possible through the application of the three R's. We speak in the plural, as there are several visions of these R's:

- During the G8 Summit in June 2004, Japan's Prime Minister Koizumi Junichiro Junichiro presented the three Rs initiative: reduce, recycle, reuse. This initiative seeks to build a recycling-oriented society. According to this strategy, it can be an excellent guiding thread for environmental education in any community in which it is intended to influence environmental culture.
- Suarez (2013) describes the three Rs (reduce, reuse, recycle) as: an old philosophy that began as an environmentalist thought and became for many a way of life. It is based on the reduction of consumption in general, the reuse of the elements that can from the use of the same and recycling, which has to do with the rescue of elements discarded in different scenarios of everyday life of man, to process them and make them new elements or part of them. Recycling consists of choosing a material that after one or more processes can be converted into raw material or part of a new product. In recent years, recycling has gained importance as one of the most practical ways of renewing domestic and industrial waste, etc., materials that people throw away every day without taking advantage of them (p. 5).
- In their review of 114 definitions of circular economy Kirchherr et al. (2017), evidenced that there are at least nine concepts involved in the practical exercise of circular economy, employing the R's:

Figure 2

Codification of actions within the framework of the circular economy.

Source. Adapted from The 9R Framework Source, Kirchherr et al. (2017).

- Mejía, M. (2022) proposes seven R's: recycle (separate at source), reduce, reuse, reject, reclaim, redistribute and reflect.
-

In times of climate change, a comprehensive understanding of the processes that generate the planet's environmental imbalances is urgently needed. In addition to the great influence of greenhouse gases on global warming of the atmosphere, it is important to value, within the polluting contributions, the irresponsible use of natural resources to satisfy fatuous consumption needs, far beyond the essential needs of human beings.

Reversing the current state of threat to the biosphere requires an urgent and profound transformation of the global energy model and of the voracious patterns of consumption of resources and environmental services.

Education for sustainability emerges as a relevant approach for the transformation of the mental models of the population based on values, awareness, social and generational responsibility and, above all, on the survival of homo sapiens on earth. Arias, B. (2016)

On the front line (of greenhouse effect reduction, or global warming? Here something is missing) are the states, understood as nations, departments, municipalities, provinces, states, or any other form of political-administrative organization. In addition to this transformation, there is the commitment derived from international agreements, especially the Sustainable Development Goals. The following are some of the exercises that have been undertaken in relation to the combination of environmental education, responsible consumption and the three Rs.

Alberto Sileoni, Minister of Education of the Republic of Argentina in 2007, indicated in the presentation of the guide for primary school teachers on environmental education, "this process involves and makes society, but especially the State, responsible. Who has the legitimacy to promote and demand the care of the environment. Likewise, to generate conditions, through public education, to establish a new relationship: community life, development and environment." The same text states that environmental education

> is characterized by its heterogeneity of practices, i.e., there are many different educational practices that are identified as EA (environmental education), as explained in the section on experiences. However, if we investigate and look for a common component or characteristic, we will see that they all promote some type of change, beyond the approach and the didactic strategy used, whose common characteristic is that of action, that is, it is an education for action. Prioritizing changes at the individual level (changes in attitudes) or, at the other extreme of possibilities, oriented towards changes in the social order and, why not, in civilization. (p.18)

For Simancas, R. et al (2019), environmental education is strengthened through responsible consumption and the application of practices such as the R's, which translates into education for sustainable development:

> It is therefore essential that educational institutions begin to develop within their academic and extracurricular programs, educational courses that critically and analytically provide students with a point of view of the real situation of the planet and the immediate and long-term solutions to these environmental problems. In this way, having trained the students environmentally, the educational community will begin to transform itself into a more sustainable environment, more environmentally friendly, and certainly much more responsible; thus achieving that in the future these people will have a positive impact on the society outside the educational entity and in this way, the longed-for environmental education will be multiplied.

As stated by Nay-Valero, M., & Febres Cordero-Briceño, M. E. (2019). Environmental education adapts to the conditions of each context in which it is conceived,

> The diversity and progression of international documents together with the contributions of various researchers show that American educational processes are under reflection and transformation in order to adapt and respond to the demands of society. In the case at hand, environmental issues in their social, economic,

> environmental, political, cultural and natural dimensions have been considered in curricular reforms at the country level. Four central paradigms can be identified in the international guidelines that have been developed over (the last?) four decades: the environmentalist paradigm, characterized by knowledge of ecosystems in their natural conditions, as a provider of resources and opportunities for exploitation, with an anthropocentric vision; the globalization paradigm characterized by incorporating the New World Economic Order; the paradigm of globalization, characterized by understanding and assuming the integration of complexity based on the multidimensionality of environmental problems; and the paradigm for sustainability, characterized by a biocentric vision of complex and systemic interrelationships, determined by the interwoven network of interrelationships between political, economic, social, cultural, environmental, technological and ethical dimensions.

For Martínez, R. (2012), reaching people in particular has to be the objective of environmental education, therein lies the transformation influencing the apprehension of new consumption habits, a new civilization,

> Learning strategies should generate epistemic curiosity, task control, confidence and challenge, generating healthy lifestyles towards the care of the environment and oneself. Questioning, for example, the forms of energy generation, consumption and transportation habits, identifying the distribution of differentiated responsibilities in the problem of air pollution and environmental polycrisis.
>
> Participation, in its deepest and most complete sense, can be conceived as a process in which an individual or group investigates and analyzes a specific situation, seeks alternatives and possible positive contributions to help solve the problem; prepares a plan of action and evaluates its possible effects; takes action, putting into practice what has been agreed upon and evaluates the results obtained as a group.
>
> Solid waste management is conceived as a process of actions ranging from awareness to waste treatment and disposal, including the values and norms that determine product consumption. These are integral and participatory actions and those that take place between society and its natural environment. Such as the need to recycle because of its implications on the environment and your health.

Progress in the implementation of the R's with respect to solid waste reduction.

Cruz et al. (2024) conducted a literature review of practical applications of the three R's technique in educational institutions, especially in secondary schools at the national level in Peru and internationally. The study aimed to promote the development of values of responsibility towards the environment in secondary schools, in addition to identifying knowledge gaps that need to be explored in new studies in the context of secondary education.

> After analyzing the thematic content, three categories of representative issues for the 3Rs strategies (Reduce, Reuse, Recycle) in the environmental attitude towards solid waste in high school students were evidenced: the use of pedagogical strategies for the proper management of solid waste with the application of the 3R's technique, the management of solid waste from educational institutions; and the ethical-environmental teaching from the value of responsibility in the proper management of solid waste with the application of the 3R's technique.

Table 1

Categories of representation of the 3 R's strategies in the secondary educational context

Category 1. The use of educational strategies for the proper management of solid waste with the application of the 3R's technique.

Pedagogical strategies for the adequate management of solid waste with the application of the 3R's technique, importance of relating education with environmental pedagogy, adequate management of solid waste.
Category 2. Solid waste management in educational institutions
Solid waste; classification; solid waste management in the educational institution.
Category 3. Ethical-environmental education based on the value of responsibility for the proper management of solid waste with the application of the 3R's technique
Environmental pedagogical strategies; conceptual and attitudinal change in high school students as part of the ethical-environmental teaching from the value of responsibility

Source. adapted from Cruz, Williams & Arroyo-Ñahui, Madeleyne & Condor-Salvatierra, Edwin. (2024).

In the discussion, the authors of the same study obtained the following results for the three aforementioned categories:

In the first category, it is discussed from demonstrating that through a pedagogical strategy it was possible to obtain a change in the perception that students have regarding recycling, solid waste management and the protection that should be had with the environment, for this reason it is necessary to continue implementing strategies to be reminding students of the mission that everyone has to safeguard nature.

In the second category, solid waste can be classified into usable and non-usable. Respondents did not identify this clearly and therefore it is necessary to start with a precise explanation of these terms. Similarly, according to the regulations and the solid waste control procedure, solid waste can be classified into domestic and industrial waste, the former including usable waste (paper, cardboard, glass, tin, plastic). If this standard is taken into account and compared with the students' responses, it can be affirmed that the respondents lack the knowledge base that would allow them to argue how to classify solid waste.

The findings refer to the precept of preservation and conservation based on a culture or ecological conduct with the practice of the value of responsibility and norms that seek to appreciate the interrelationships between the student and the environment, his culture, his habits, his conduct and his biophysical environment, generating a real conscience for the maintenance of the different ecosystems in which living beings interact, promoting their sustainable development.

Discussion and Conclusions

Facing climate change requires not only adaptation measures, but also an active participation in the reduction of solid waste from an individual and daily basis. The growing generation of waste, widely documented as one of the main causes of environmental pollution, represents a priority challenge in all social contexts. This challenge must be addressed not only by public policies, but also from educational spaces, homes and communities.

In this sense, environmental education, responsible consumption and especially the three R's are consolidated as practical, accessible and meaningful tools. These practices allow people of different ages, socioeconomic levels and cultural backgrounds to effectively contribute to the reduction of environmental impact and more efficient use of resources.

Since its origins, environmental education has promoted an ethical vision that recognizes nature as a living being that deserves care, respect and protection. This approach has given rise to reflections on responsibility, freedom, peace and solidarity in relation to

modes of production and consumption. Indeed, progress has been made towards an ethic of environmental care that must be strengthened and deepened.

Currently, environmental education is projected in multiple areas of human life: in companies, through corporate social responsibility; in communities, through public policies; and in educational institutions, through pedagogical projects and strategies. These actions are aligned with the Sustainable Development Goals (SDGs). However, there is still a need to translate environmental values into real, daily and sustained practices.

Techniques such as the three R's provide a concrete basis for responsible decision making, enabling people to understand the impact of their consumption habits and generate new opportunities for more sustainable forms of economy. The circular economy, based on the reuse of materials and respect for resources, is one of the most promising alternatives on this path.

We are, therefore, facing a scenario of opportunity that demands greater research production aimed at developing methodologies, strategies, technologies and processes capable of reducing the environmental impact of urban solid waste. This challenge requires a renewed ethic, useful and applicable knowledge, and a closer approach to the realities of citizenship in order to build sustainable solutions with local and global impact.

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