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Scientific articles

***Programa de Educación Ambiental No Formal y Sustentable sobre
Residuos Sólidos Urbanos (PEANFSRSU) para habitantes de la
Comunidad, Las Vigas, Gro., México***

***Non-Formal and Sustainable Environmental Education Program on Urban
Solid Waste (PEANFSRSU) for the residents of the community, Las Vigas,
Gro., México***

***Programa de Educação Ambiental Não Formal e Sustentável sobre Resíduos
Sólidos Urbanos (PEANFSRSU) para os habitantes da comunidade, Las
Vigas, Gro., México***

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Resumen

Los residuos, emanados de las actividades humanas, se manifiestan en diversos entornos y generan un impacto adverso sobre el medio ambiente. Por ende, el propósito de esta investigación consistió en presentar un programa de educación ambiental no formal y con un enfoque sustentable dirigido al manejo de los residuos sólidos urbanos (PEANFSRSU) en la comunidad de Las Vigas, Guerrero (México). El sustento de esta indagación se encuentra en la problemática latente y los desafíos asociados con la gestión inadecuada de los RSU en la mencionada comunidad, sumado a la insuficiencia de prácticas y comportamientos idóneos por parte de sus habitantes. Para ello, se adoptó una metodología mixta, que incluyó la observación directa en localidades específicas, la aplicación de encuestas a 56 personas, así como entrevistas con 42 informantes clave. Los resultados del diagnóstico revelaron carencias significativas de índole socioeconómica y ambiental. En concreto, el 63 % de los encuestados identificó la problemática asociada con los RSU, mientras que el 68 % percibió las consecuencias de la contaminación generada por estos residuos en distintos ámbitos sociales. Asimismo, en términos económico-políticos, el 46 % consideró que el problema de los RSU constituía una preocupación de gran envergadura. Finalmente, las entrevistas arrojaron luz sobre la magnitud del problema que representan los RSU en la comunidad, pues se evidenció la falta de implementación de conocimientos existentes y la deficiencia en la conciencia ambiental. Con base en estos hallazgos, se concibió el PEANFSRSU, el cual se estructuró en cuatro fases: contexto, estructuración, programación y evaluación. En conclusión, la problemática de los RSU en Las Vigas exige una respuesta concertada entre la comunidad y las autoridades.

Palabras clave: deterioro ambiental, contaminación, educación, medio ambiente.

Abstract

Waste, resulting from human activities, manifests in various environments and generates adverse impacts on the environment. Therefore, the purpose of this research was to present a non-formal environmental education program with a sustainable approach aimed at managing urban solid waste (NEEPSMUSW) in Las Vigas community, Guerrero (Mexico). The basis of this investigation lies in the underlying problem and challenges associated with the inadequate management of USW in the mentioned community, coupled with the insufficient appropriate practices and behaviors by its inhabitants. To achieve this, a mixed methodology was adopted, which included direct observation in specific locations, surveys conducted with 56 individuals, as well as interviews with 42 key informants. The diagnostic results revealed significant deficiencies of socioeconomic and environmental nature. Specifically, 63% of the respondents identified issues associated with USW, while 68% perceived the consequences of pollution generated by these wastes in different social spheres. Additionally, in economic-political terms, 46% considered the USW problem to be of great concern. Finally, the interviews shed light on the magnitude of the USW problem in the community, as it was evidenced by the lack of implementation of existing knowledge and the deficiency in environmental awareness. Based on these findings, the NEEPSMUSW was conceived, which was structured into four phases: context, structuring, programming, and evaluation. In conclusion, the USW issue in Las Vigas demands a concerted response from the community and authorities.

Key words: environmental deterioration, pollution, education, environment

Resumo

Os resíduos surgem das atividades humanas, tornam-se presentes em diversos ambientes e impactam adversamente o meio ambiente. O objetivo do estudo foi apresentar uma proposta de Programa de Educação Ambiental Não Formal e Sustentável sobre Resíduos Sólidos Urbanos (PEANFSRSU) na comunidade de Las Vigas, Guerrero, México. Os resíduos sólidos são analisados em várias áreas da ciência e disciplinas, incluindo ciências sociais, ambientais e educação. Esta pesquisa é justificada pelas problemáticas e desafios relacionados ao manejo inadequado dos resíduos sólidos urbanos na referida comunidade, bem como pela escassez de práticas e comportamentos adequados por parte dos habitantes.



Foi um estudo misto, envolvendo observação no local, uma pesquisa com 56 pessoas e entrevistas com 42 informantes-chave.

Os resultados do diagnóstico revelaram deficiências socioeconômicas e ambientais significativas. Sessenta e três por cento dos entrevistados reconheceram os problemas associados aos resíduos sólidos, enquanto 68% perceberam que a poluição causada por esses resíduos tem consequências em diversos aspectos sociais. Em termos econômico-políticos, 46% consideraram que o problema dos resíduos sólidos urbanos é de grande preocupação. A entrevista revelou que os resíduos sólidos representam um problema sério na comunidade, com falta de aplicação prática dos conhecimentos existentes e deficiências na conscientização ambiental. Com base nesses achados, o PEANFSRSU foi elaborado, estruturado em quatro fases: contexto, estruturação, programação e avaliação. Em conclusão, a problemática dos resíduos sólidos em Las Vigas exige uma resposta coordenada entre a comunidade e as autoridades.

Palavras-chave: deterioração ambiental, poluição, educação, meio ambiente.

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Introduction

This article addresses the issue of waste, which is defined—according to the General Law for the Prevention and Control of Solid Waste (LGPGIR) in the Official Gazette of the Federation (DOF) of 2015—as “material or product whose owner or possessor discards and which is in a solid or semi-solid state, or is a liquid or gas contained in containers or tanks, and which may be susceptible to recovery or requires subjecting itself to treatment or final disposal” (p. 52). This conceptualization encompasses any product in a solid or gaseous state, coming from extraction, transformation or use processes, that is decided to be abandoned or discarded due to its lack of value or usefulness (Ministry of Health, National Presidency of Buenos Aires, 2014).

Although the term “garbage” is commonly used to refer to waste, it is extremely general, since it includes all mixed and discarded elements that are considered not useful. In fact, in the domestic context, most people simply deliver this waste to those in charge of its disposal without delving into the process of transportation, separation, treatment or use. In other words, awareness about the impact of garbage on pollution and the environment is

usually low, unless it is reminded through government guidelines and regulations (Magaña, 2011).

The Report on the Situation of the Environment in Mexico (2015), issued by the Ministry of the Environment and Natural Resources (SEMARNAT), formally establishes that waste is materials or products discarded in solid, semi-solid, liquid or gaseous state, contained in containers or deposits, which require treatment or final disposal according to the provisions of the General Law for the Prevention and Comprehensive Management of Waste (LGPGIR) (2003). This regulation classifies them into three groups according to their characteristics and origin: urban solid waste (MSW), special management waste (RME) and hazardous waste (RP).

In the specific area of MSW, they are defined as those generated in homes as a result of the elimination of materials used in domestic activities, such as consumer products and their containers, packaging or organic waste. In addition, they include those coming from other tasks carried out in establishments or public spaces, as long as they are not considered waste from another category. In this regard, it is important to note that with the publication of the LGPGIR in 2003, municipal solid waste (MSW) changed its name to urban solid waste (MSW), as mentioned in the 2015 SEMARNAT report.

Now, in this research reference is made to urban solid waste (MSW) in a general and comprehensive manner, that is, without focusing on any particular category. For this reason, it is postulated that the way in which people manage this waste is similar, regardless of whether it is common waste, special management waste or hazardous waste. In line with this premise, Torre *et al* . (2019) establish that, within the framework of sustainable development, the primary objective of any waste management strategy must be the maximization of the use of resources and the prevention or reduction of adverse impacts on the environment that may arise from said waste management strategy. management.

Having explained the above, it can be indicated that the purpose of this study was to design a non-formal environmental education program with a sustainable approach for the management of urban solid waste (PEANFSRSU) aimed at the inhabitants of the Las Vigas Community, located in the Costa Chica of the state of Guerrero (Mexico). To this end, a diagnosis related to MSW management was carried out and the methodology proposed by Nieto *et al was adopted* . (2008) for the program design. In addition, the flow diagram for the development of programs and the characteristics outlined by the Ministry of

Environment and Natural Resources (SEMARNAT) (2009) were taken into consideration for the design of non-formal environmental education programs.

Theoretical foundation

A comprehensive waste management system must possess the ability to address all types of waste, regardless of its origin. In fact, added to the environmental problems mentioned are urban concerns about the shortage of housing, the poor condition of the streets, the proliferation of garbage dumps and the presence of annoying noises, which has caused the deterioration of environmental conditions in both environments. rural as well as urban (Santiago, 2008).

The management of urban solid waste, therefore, constitutes a problem that requires a prompt solution at a global level, since disorderly population growth has become a factor that will aggravate this reality. In line with this idea, the World Bank report projects a 70% increase in waste generation by 2050, hence the need to implement emergency measures to stop this trend.

At a global level, and despite the fact that developed countries represent only 16% of the world's population, it can be said that they generate 34% of waste, while Asia and the Pacific contribute 23%, and it is estimated that In Africa this figure will triple by 2050 (Bartra and Delgado, 2020).

Due to these projections, it is essential to identify aspects related to the evaluation and decision-making by municipal public managers (Duque and Silva, 2022), since municipalities play a crucial role in the management of urban solid waste, since They are responsible for guaranteeing this service to the entire population. Unfortunately, deficiencies in this area affect global health and contribute to global climate change.

Therefore, currently, environmental education for sustainability and environmental education programs aimed at managing urban solid waste play a crucial role in reducing environmental problems, which, to a large extent, derive from the lack of knowledge. objective and real about the functioning of the natural and artificial world (Bartra and Delgado, 2020). In other words, environmental education must focus on transmitting scientific knowledge that allows building an accurate understanding of the environment so that the population can perceive and understand it as it is and, consequently, act responsibly.

The insistence on converting environmental education into an essentially scientific discipline reflects the need to approach these projects from a deconstructionist perspective (Meira, 2013). In this sense, this area covers the educational process that explores the relationship between human beings and their environment, whether natural or artificial, as well as the repercussions of this interaction.

To achieve this objective, it is essential to establish an educational process that examines the relationship of any topic or human activity within an analysis of its importance or impact on social and environmental life, considering both pedagogical and political aspects (Roger, 2010). This means that environmental education must adhere to the principle of sustainability to contribute to the construction of fair, equitable, democratic societies committed to the preservation of the environment and the well-being of future generations (Maldonado, 2009).

In other words, environmental education for sustainability must address various aspects of the environment, which implies transcending the ecological dimension to incorporate political, social, pedagogical and economic dimensions with the aim of providing responses to the exacerbation of environmental problems (Simões *et al .*, 2019). To do this, continuous formal and informal training, training and research processes are required in the field of public policies to raise the level of environmental awareness in the population (Ministry of the Environment of Ecuador, 2018), which has been taken into account for the development of the Non-Formal Environmental Education Program with a Sustainable Approach for the Management of Urban Solid Waste (PEANFSRSU).

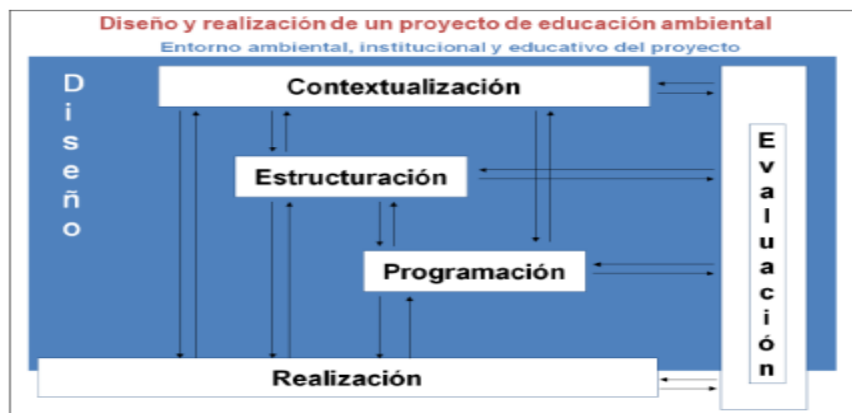
Now, the design of projects like the one mentioned requires a complex process that requires detailed planning and a deep understanding of the objectives and contexts involved. According to Ruiz (sf), the first crucial step in this process is planning, which involves organizing the ideas that arise and that approach the proposed goal. This phase is essential to guarantee the effectiveness of the project and not to forget elements necessary for its success.

Nieto and Buendía (2008) add that the design of educational projects is not simply technical, but involves assuming the complexity inherent in the processes of social construction where education affects. This is especially relevant when seeking to transform paradigms, cultures, structures, discourses and practices in the environmental, economic, political and social spheres that seek to promote peace, equity, quality of life, justice, governance and the protection of the environment. environment.

Regarding the design and execution of an environmental education project, Nieto *et al.* (2008) point out that several phases must be taken into account, such as contextualization, structuring, programming and evaluation. Contextualization consists of characterizing the most significant relationships between the project environment and the basic elements of the educational project, such as objectives, contents, activities and materials. Structuring and programming, on the other hand, are interrelated processes that are based on contextualization and provide feedback, hence their modification is allowed, since it is common for new factors to arise to be considered, which can limit or expand the original ideas. .

Now, although the structuring of a project is intrinsically linked to the progress achieved in contextualization, as the latter is deepened it is feasible to advance simultaneously in the definition of the structure and programming. In other words, it is during this process that the evaluation is designed, which implies that both the context and the programming may be subject to modifications. In order to illustrate this premise more clearly, it is presented in Figure 1 below.

Figure 1. Outline of the design of an environmental education project



Source: Nieto and Buendía (2008)

As established by the Secretariat of the Environment and Natural Resources (SEMARNAT) (2009), non-formal environmental education programs aim to address previously identified environmental, educational and community needs with the purpose of generating benefits that are met in a responsible manner. these needs. In addition, SEMARNAT defines a series of characteristics that must be considered in these programs:

1. **Diagnosis:** The environmental condition or issue must be considered, an inventory of programs and materials must be carried out, and the needs of the social actors to whom the program is directed should be understood.
2. **Policies and organizational capacity:** It is essential that the program be consistent with the organization's priorities, that the organization's needs for the program are identified, and that an inventory of available resources be made.
3. **Scope and structure of the program:** The goals and objectives of the program must be clearly established to ensure its coherence with the objectives of environmental education, as well as define the format and instrumentation of the program.
4. **Alliances and collaboration:** It is recommended to establish collaborations and alliances to strengthen the implementation of the program.
5. **Resources for program implementation:** Refers to the evaluation of necessary resources, including quality educational personnel, facility management, provision of support materials, and emergency planning.
6. **Quality and relevance of the program:** The quality of the program must be guaranteed through the use of appropriate educational materials and techniques, the conduct of field tests, adequate promotion and dissemination, and its duration.
7. **Evaluation:** Evaluation strategies must be determined, effective evaluation techniques and criteria must be used, and the results must be used to continually improve the program.

Method

This study was based on a mixed research methodology, as theoretical and epistemological perspectives, points of view, as well as qualitative and quantitative methods were combined. Specifically, participant observation was used, which consisted of designing an observation format with indicators to record the urban solid waste (MSW) present in the community of Las Vigas, as well as citizen practices and attitudes regarding its management. The objective of this participant observation was to record MSW in four specific places in the community and also to document the attitudes and behaviors of the inhabitants in relation to the management of this waste.

Likewise, a survey was applied that covered socioeconomic, environmental, social and economic-political indicators in order to understand the socio-environmental

perception of MSW. The survey was administered to 56 residents of Las Vigas, selected through convenience sampling, which allows the number of participants to be arbitrarily chosen (Hernández, 2021). Each survey indicator included ten questions related to its objective, and was applied both in person and online, through a link posted on a community member's Facebook profile.

The data was processed using Microsoft Forms , which made it easy to obtain percentages. Additionally, interviews were conducted with 42 key informants from the community to understand their socio-environmental perception on MSW in relation to socio-political and socio-environmental aspects.

Regarding the design of the PEANFSRSU, it was based on the methodology proposed by Nieto *et al* . (2008) for the development of environmental education and sustainability projects or programs, which included phases of contextualization, structuring, programming and evaluation (see figure 1).

Results

Participant observation for the registration of MSW with household and other characteristics

During July 3 and 4, 2023, the MSW observation and registration activity was carried out in the community of Las Vigas, specifically in four previously selected areas: the community garbage dump, the El Aterrizaje neighborhood, the Centro and the Santa Cruz neighborhood. The methodology used was participant observation, since it sought to document both MSW with household characteristics and those of other types present in said areas.

The tour began in the town known as San José la Pala and Las Vigas because the garbage dump is located between these communities. During this phase, the organic waste deposited in the garbage dump was recorded, including animal carcasses such as cattle, cats and dogs, as well as decomposing food remains, such as spoiled fruits, mango and coconut shells, as well as grass and leaf litter. , among others.

Regarding inorganic waste, plastic bags and containers, metal objects and containers, paper, cardboard, disposable diapers, waste from personal cleaning products, sanitary napkins, clothing and footwear were evident. Regarding special handling waste,

tires, appliance waste, light bulbs, technological waste and construction waste, such as debris, were identified.

Likewise, dangerous waste was detected, including batteries, expired medications, syringes, energy-saving and fluorescent lamps. This same dynamic was repeated in the three remaining areas of the community, where similar cases were found regarding the generation of MSW.

In the case of organic waste, remains of various foods were evident, such as coconut, tamarind and mango shells, animal feces, grass and leaf litter. Regarding inorganic waste, the presence of plastic bags and containers, metal containers, paper and cardboard was observed. Regarding special handling waste, the generation of tires, debris, light bulbs and waste from household appliances was confirmed. Finally, in relation to hazardous waste, the presence of batteries, medication waste, syringes and mercury lamps and energy-saving light bulbs was recorded.

Participant observation related to the practices and attitudes of community inhabitants that they carry out with waste

During July 5 and 6, the absence of the waste collection cart was noted, which led to the observation that residents chose to deposit their MSW in peripheral areas of the community or, failing that, incinerate it. In relation to the practices or behaviors of the inhabitants regarding MSW, a worrying reality was evident, since the population contributes significantly to the generation of MSW by consuming a variety of products, some of which can be considered expendable. It was also found that some people have a tendency to throw away garbage anywhere, for example, after opening containers of juice or cookies.

Likewise, the culture of MSW reduction was revealed to be deficient, as some people purchase products without taking into account the impact on waste generation. Likewise, there was a lack of culture regarding reuse, replacement, recycling and reduction of MSW. In this sense, it was realized that most of the waste that was discarded could have had a use, but for the population any discarded object was considered useless.

In addition, the absence of a culture of substitution for more sustainable products was confirmed, since the predominant use of Styrofoam or polystyrene plates, glasses and spoons, as well as plastic containers in the local market, was found, despite the availability

of alternatives. more respectful of the environment or made of durable and less polluting materials.

Likewise , a deficiency in the recycling culture was identified, although it was observed that a small number of people collected aluminum containers for profit. Even so, the lack of a culture of MSW separation was highlighted, which underlines the need to implement environmental actions and programs that promote a more deeply rooted environmental awareness in the population.

Based on these observations, it is recommended to promote environmental education aimed at the management, control and proper disposal of waste, as well as carry out activities aimed at the separation, recycling, reuse, among others, of discarded objects with the objective of reduce waste generation.

Socio-environmental perception of the inhabitants of the Las Vigas community in relation to MSW through the survey

A survey was applied in the community of Las Vigas, located on the Costa Chica of the state of Guerrero (Mexico), with the purpose of evaluating the socio-environmental perception of MSW. The survey consisted of 40 items that covered socioeconomic, environmental, social and economic-political indicators. Each indicator included ten questions related to the research objective.

A total of 56 people participated, of which 98% showed knowledge about the purpose of the research and agreed to participate, while the remaining 2% chose not to do so. Regarding the socioeconomic data of the respondents, it was observed that the population is mainly composed of women (63%), with a marital status that is mostly married (48%) and a predominant educational level at the upper secondary level. In addition, the majority own their own home and have access to communication and health services.

The population of Las Vigas is diverse in terms of age (between 16 and 71 years old). Although the majority of respondents are employed (66%), the majority earn a minimum wage. Furthermore, the majority (89%) indicated that the home they occupy is their property—with partition walls as the most used material for its construction (77%)—while only a small percentage mentioned wooden homes (2%). Regarding access to the media, there is a high proportion of people who own a telephone (49%) and read

newspapers (20%), and a smaller percentage who access other media (30 %). Regarding health services, a high percentage of the surveyed population (80%) reported having access to these services.

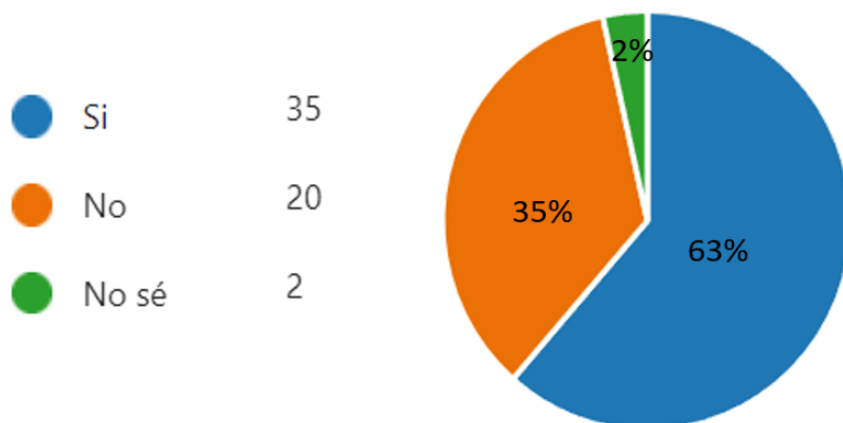
Regarding the environment indicator, of the 56 people surveyed, 63% stated that they had knowledge about MSW, while 34% admitted not knowing about this topic and 3% stated that they did not know about it. Furthermore, most people (63%) tend to throw away garbage without separating it, which could lead to environmental problems. Likewise, 80% of those surveyed perceive that the liquids emitted by garbage contaminate the soil and bodies of water, and 70% believe that garbage contributes to the pollution of the atmosphere and the ozone layer.

In this regard, 57% of respondents burn garbage in the open, which poses the risk of air pollution. Furthermore, 48% generate more than 1 kg of garbage per day, a significant amount in terms of MSW. In addition to this, 23% of those surveyed admit to throwing garbage in the street, sewers or bodies of water, which also causes pollution. According to 77% of the participants, MSW pollutes the air, soil and water. The majority (84%) observe soil and water contamination, as well as the proliferation of mosquitoes due to improper garbage management.

On the other hand, 46% of people know of the existence of special places to deposit containers of fertilizers or agrochemicals used in the field, while 29% are unaware of this information and 25% have no knowledge about it. These results reveal that although the majority of the population in the community has a basic knowledge about environmental problems related to garbage or MSW, there is still room for improvement around this issue, hence it is crucial that the community in as a whole, together with the relevant authorities, focus on finding solutions to these problems.

Figure 2 shows that there is a culture of garbage separation in the Las Vigas community.

Figure 2. Garbage separation



Source: self made

In relation to the social indicator, the knowledge and attitudes of the respondents regarding MSW were evaluated. The most significant results revealed that 77% of the participants believe that MSW pollution has detrimental effects on health. In addition, 71% stated that they separate garbage between inorganic and organic, and 68% stated that they knew the 4 R technique (reduce, reuse, replace and recycle).

Regarding garbage disposal practices, 80% of those surveyed indicated that they deposit garbage in its proper place. Only 16% stated that they had knowledge about the existence of an environmental culture in the community and about the proper management of waste. On the other hand, 63% expressed concern about garbage management in the community.

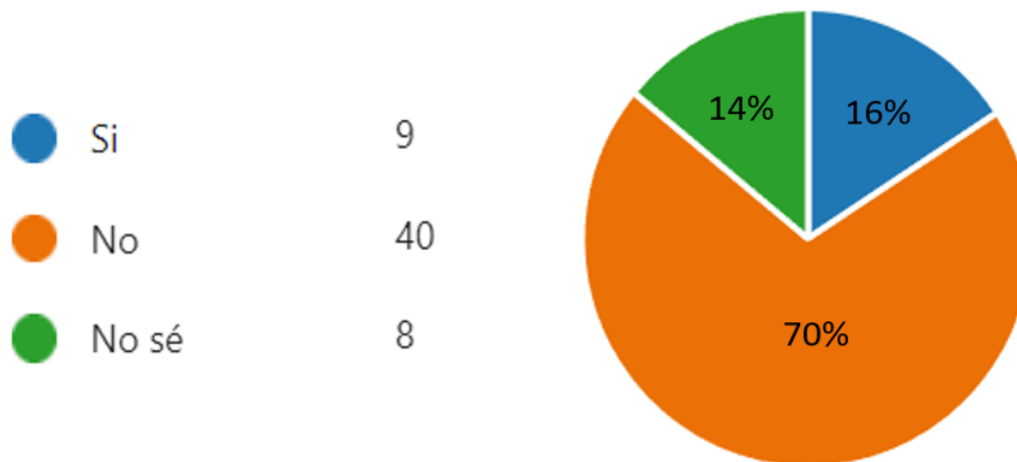
It is worth noting that only 11% of respondents had heard of MSW before the survey, although 79% believe that environmental authorities should require businesses to use reusable bags or containers.

Likewise, 45% of those surveyed express a positive opinion about scavengers, which indicates a favorable perception of their work, without being seen in a derogatory or discriminatory manner for the work they do. Additionally, 52% believe and perceive that an environmental education program focused on MSW would be beneficial to the community.

Broadly, these findings reflect a concern on the part of the inhabitants of Las Vigas regarding the pollution caused by urban solid waste, as well as a willingness to take measures to address this problem. Therefore, the need arises to implement environmental actions aimed at managing MSW, as seen in Figure 3, as well as to promote more

environmental education. Furthermore, stronger government policies and business practices are required to improve municipal solid waste management in the community.

Figure 3. Environmental culture, management, control and disposal of MSW



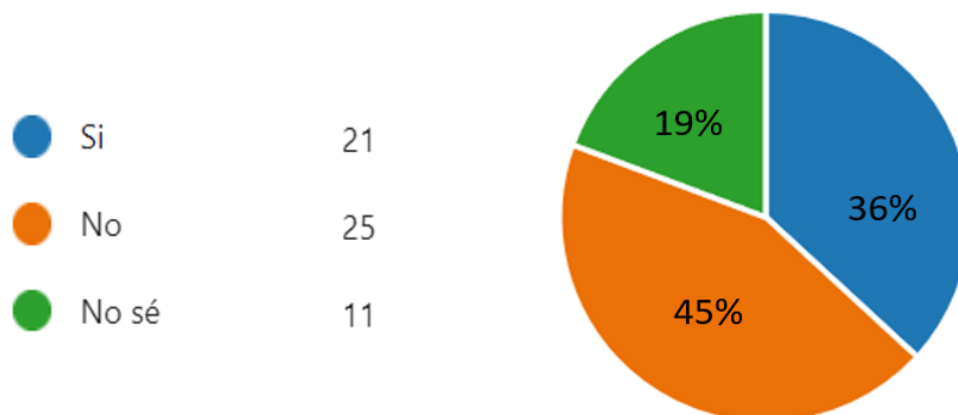
Source: self made

In the economic-political indicator, 82% of those surveyed identified that garbage is one of the most significant problems in the community. Likewise, 59% consider that the consumption of products in daily life contributes to the generation of garbage, although 50% believe that by changing habits and purchasing only necessary products, the amount of waste could be reduced. In addition to this, 55% mention the possibility of reusing products or packaging to avoid throwing them away, while 70% believe that replacing shelf-life products could reduce environmental impact, such as opting for durable and environmentally friendly products instead of disposable.

In this context, 61% consider recycling used products important. However, only 36% of respondents are aware of programs that use garbage for economic gain, and 55% mention that garbage is marketed in the community. On the other hand, 71% affirm that the authorities collect garbage for disposal in the garbage dump, although 27% perceive conflicts between the authority and the population in relation to garbage management.

In general, these data reflect widespread community concern about the garbage problem, although there is still uncertainty about how to address it and what actions authorities are taking to solve it. Therefore, it is essential to implement programs that take advantage of urban solid waste, which will not only promote environmental care, but could also generate additional economic resources (figure 4).

Figure 4. Existence of programs for the use of MSW to generate economic income



Source: self made

Study of socio-environmental perception of MSW through interviews with key informants from the Las Vigas community

An interview was applied to 42 key informants from the Las Vigas community with the purpose of delving into the socio-environmental perception of MSW. The indicators considered addressed socio-environmental and socio-political aspects, with the participation of individuals residing in Las Vigas, some of whom held positions in the government as officials or public servants. In addition, other key informants who were involved in the effort to convert Las Vigas into a municipality, as well as local commissioners, were interviewed.

In the socio-environmental sphere, several participants admitted that they were initially unaware of the term “urban solid waste”, but later defined it as objects discarded by people, such as plastic, paper and disposable containers, among others. The majority expressed concern about the garbage situation and the pollution it generates, as they recognize its negative environmental impacts in various areas. In fact, the damage caused to agricultural activities due to the contamination of soil and crops was highlighted, and it was mentioned that the containers of agrochemicals, fertilizers and other substances, both used in the field and in homes, generate contamination in the bodies of water.

Likewise, they stated that the pollution generated by MSW affects various aspects, such as health, air and soil, and highlighted that the amount of MSW produced by the inhabitants of Las Vigas is excessive, which includes both organic and inorganic products.

as well as special handling and hazardous waste. In addition, the lack of an environmental culture in the population that facilitates its proper management was noted, which leads, in some cases, to these wastes being deposited in inappropriate places. Separation, reuse, replacement or recycling practices were noted as scarce, although it was evident that some people collect plastic and aluminum containers for sale.

Regarding the MSW collection system in the community, it was described as irregular and lacking adequate management by the authorities, and it was mentioned that the rules or laws related to MSW do not apply in this context. In this sense, one of the main problems that Las Vigas faces is the situation of the garbage dump, which already presents contamination problems, which is why the implementation of a sanitary landfill located in a place that does not affect or contaminate the environment is suggested. In addition, concern was highlighted over the oxidation lagoon near the landfill, for which it is considered necessary to find a solution.

The urgency of having an instituting president in the municipality of Las Vigas to manage these environmental demands was emphasized. Although a municipal commissioner was recently elected, he or she is expected to pay attention to community issues and seek effective solutions to identified environmental challenges.

Most of the key informants concluded the interview by highlighting the existence of other problems of various kinds. However, in the environmental field, they pointed out the problems of drinking water and biodiversity as relevant issues. Likewise, they emphasized the importance of promoting environmental education as a fundamental strategy to address the challenges related to MSW. Consequently, they suggested the implementation of environmental education programs focused on the proper management of MSW, as well as the invitation of specialists on the subject. In addition, they proposed promoting recycling, separation and reuse programs for discarded objects, as well as managing collection centers for MSW and linking these activities with programs promoted by the federal government, such as the Sembrando Vida program, among others.

Regarding the sociopolitical indicator, the results revealed that the community of Las Vigas is located on the Costa Chica of the state of Guerrero. Previously, this place belonged to the municipality of San Marcos, Guerrero; However, a few years ago, it became independent and was established as an independent municipality that integrated other surrounding communities. According to the president of the Management Committee

of the municipality of Las Vigas, this municipality has 19 communities, of which Las Vigas is the municipal seat.

However, some key informants highlighted that, since the decree was issued by the state government for the consolidation of Las Vigas as an independent municipality, an instituting authority has not yet been established. Therefore, certain administrative procedures are still carried out in the municipality of San Marcos. In addition, they stated that public services in the municipal seat and the communities that comprise it are neglected, which represents a problem and a social need that requires urgent attention.

Among the problems mentioned are safety, health, the environment, among others. In particular, in relation to environmental problems, the accumulation of garbage (MSW), deficiencies related to water supply, air and soil pollution and the deterioration of biodiversity were identified.

Design of a Non-Formal Environmental Education Program with a Sustainable Approach for the Management of Urban Solid Waste (PEANFSRSU)

According to the methodology proposed by Nieto *et al.* (2008) for the design of environmental education projects, which includes the elements of context, structuring, programming and evaluation, and considering the flow chart to develop programs, which covers the diagnosis of needs, congruence with policies and the capacity of the organization, the definition of the scope and structure of the program, the resources for the implementation of the program, its quality and relevance, as well as the evaluation; and taking into account the characteristics suggested by SEMARNAT (2009) for the design of non-formal environmental education programs, which include the diagnosis, policies and capacity of the organization, the scope and structure of the program, the resources for its implementation, quality and relevance of the program and evaluation; The Non-Formal Environmental Education Program for the Management of Urban Solid Waste (PEANFSRSU) has been structured for the community of Las Vigas. The details of this structure are presented in tables 1, 2, 3 and 4.

Table 1. Contextualization phase of the PEANFSRSU design for inhabitants of the Las Vigas community

Context problems	Educational field	Knowledge field	Target population
In this section, the result of the diagnosis in this study is considered, that is, what was recorded in the participant observation, the results of the survey applied to inhabitants of Las Vigas, Guerrero, and what was revealed by the interview of the key informants. In this case, the environmental problems presented in the community of Las Vigas stand out, the inadequate management of MSW, the lack of culture of recycling separation, among others.	In this section of the design, the pedagogical dimension of the program must be considered. A program of this type, even if it is designed for formal or non-formal environments, must be supported by pedagogical and didactic approaches to learning. This proposal is based on social constructivism and the competency approach.	The fields of knowledge of this program are based on environmental education for sustainability. Sustainable or sustainable development (according to Agenda 21, as cited in Madroñero-Palacios and Guzmán-Hernández, 2018) establishes that sustainable development is defined as “the process capable of satisfying the needs of the present generations without compromising the ability of future generations to satisfy theirs.”	The inhabitants of a community on the Costa Chica in the state of Guerrero (Las Vigas, Guerrero); In addition, local authorities were informed of the importance of the program.

Source: self made

The learning process has been studied from various epistemological perspectives, among which constructivism stands out , and more specifically social constructivism, rooted in the historical-cultural legacy of Lev Vygotsky. This approach postulates that knowledge is a social construction that arises through interaction and participation in culturally regulated activities.

In the case of environmental education, it has been formally associated with constructivism, since the importance of social and cultural interaction in the process of knowledge construction has been recognized (Romero and Moncada, 2007).

On the other hand, the concept of *competencies* has gained prominence in contemporary education. Although its definition may vary, it is generally understood as a complex combination of skills, knowledge, attitudes and values, which are evaluated in specific contexts (Government of the Republic of Costa Rica, 2017, cited by Ramírez-Díaz, 2020).

Within the framework of competency-based curricular design, educational programs must be organized around the development of specific skills to set comprehensive goals instead of simply focusing on the accumulation of knowledge. This is because competencies are intrinsically linked to the context and must be described based on the expected learning in a concrete and contextualized way (Frade, 2009, cited by García, 2011).

Table 2. Structuring phase of the PEANFSRSU design for inhabitants of a community in Las Vigas

Foundation	Intentions	Organization of topics	Characteristics of the participants Facilitator	Characteristics of the participants Student (attendees or inhabitants of the Las Vigas community).
<p>The foundation is educational and was chosen in the previous phase. These refer to the competency approach and constructivism.</p>	<p>The intentions in this case are to state the purpose and purposes of the program. In this section you must have a general competence of the PEANFSRSU and its elements of competence.</p> <p>General -Promote competencies (knowledge, skills, attitudes and values) on the proper management of MSW in the community of Las Vigas, Guerrero, Mexico.</p> <p>Elements of competition - Know the environmental problems of your environment and the environmental impact of MSW. - Identifies ways for the proper management of MSW, and methodologies to reduce MSW using separation and recycling practices.</p>	<p>Topic 1: Adverse impact of MSW in the community of Las Vigas, Guerrero, Mexico.</p> <p>Topic 2. Proper management of MSW and knowledge of practices to reduce this waste (classification, separation, recycling and reuse).</p>	<p>This section refers to identifying the participants or facilitators in the program. For this reason, for this PEANFSRSU a professional with skills in this field of knowledge is required. Use educational strategies so that the student learns. Other specialists in topics of this educational program will be invited.</p>	<p>Proactive in his learning and uses strategy to learn about MSW.</p> <p>Participation, interest and motivation to contribute to their environment.</p>

Source: self made.

Table 3. Programming phase of the PEANFSRSU design for inhabitants of the Community of Las Vigas, Guerrero

Specific objectives	Themes	Time	Methodology	Materials and supplies	Achievement evaluation
State specific objectives	Proposals for each specific objective.	Proposed for each specific objective.	Proposals for each specific objective.	Proposals for each specific objective.	Proposals for each specific objective.
The elements of PEANFSRSU's competence had already been described in the intentions. These elements refer to: - Know the environmental problems of your environment and the environmental impact of MSW. - Identifies ways for the proper management of MSW, and methodologies to reduce MSW using separation and recycling practices.	Topic 1 (objective 1): Adverse impact of MSW in the community of Las Vigas, Guerrero, Mexico. Topic 2 (objective 2): Adequate management of MSW and knowledge of practices to reduce this waste (classification, separation, recycling, and reuse).	4 sessions of 2 hours with the facilitator. 6 sessions of 2 hours with the facilitator.	Tour of the community to identify the MSW generated by the inhabitants of the community of Las Vigas. Strategy to reduce MSW (separate, classify, recycle).	With objective 1 and 2, it is intended to have MSW as teaching materials, regardless of their type. Some resources such as garbage containers and recyclable bags are suggested. Didactic materials, pens, colors, white sheets, among others.	Diagnostic, continuous and summative evaluation to evaluate the learning and competencies of people who participate in the PEANFSRSU.

Source: self made

Table 4. Evaluation phase of the PEANFSRSU design for inhabitants of the community of Las Vigas, Guerrero

<p>Evaluation of the PEANFSRSU for inhabitants of the community of Las Vigas, Guerrero</p> <p>Phase 4 of the evaluation of an environmental education program, and specifically of the PEANFSRSU, consists of evaluating its different phases during the design. In addition, when the program is launched, evaluations must be carried out to identify the results.</p> <p>Before carrying out a session, a diagnostic evaluation must be carried out, or during the implementation of the program, continuous evaluation must be implemented, and at the end of a session or topic a summative evaluation must be carried out. It is also suggested that self-assessment, co-assessment and hetero-assessment be implemented. Likewise, it is also suggested to carry out an evaluation with the target population of everything that the program was to know its efficiency.</p>

Source: self made

Discussion

The analysis carried out through the observation and registration of urban solid waste, both household and other types in the community, reveals similarities with previous research, such as that carried out by Rosario (2016), who studied the generation and composition of MSW through household and municipal level in Cuernavaca. By applying a by-product generation format, it was established that the estimated MSW generation in the state reached 1842 tons per day. In this sense, it was determined that the byproducts found in Cuernavaca were similar to those estimated for the Cuernavaca-Jiutepec-Temixco metropolitan area, where it is estimated that Cuernavaca contributes 30% of this waste (Center for Social Studies and Public Opinion. CESOP Report, cited by Rosario, 2016).

Given this scenario, Rosario (2016) designed a waste management intervention with the application of the 5 Rs. In a specific part of the work, he evaluated the population's attitude towards solving the garbage problem in the municipality. The results indicated that half of the population considers that training the community in MSW management is the solution to the problem, followed by a third who proposes a MSW management plan. Furthermore, a quarter of the population considers that community organization would be a viable solution, while others believe that placing more garbage deposits could be an appropriate solution. These findings highlight the importance of implementing a waste management plan supported by waste management and separation campaigns at the household level with the aim of promoting active community participation in the proper management of MSW (Rosario, 2016).

On the other hand, it can be noted that the results of this work obtained in relation to the management of MSW coincide with those reported by Villanueva (2023). In his study,

this author analyzed the perception of students in the preparatory section of the Montes de Oca Educational Center, Tzompantle campus , Morelos (Mexico), about the MSW generated in said educational center. Using participant observation and initial diagnosis, it was concluded that the high school lacked adequate management of MSW, hence the need to implement strategies to address this problem. These results suggest the need to develop environmental education strategies in the prevention and separation stages to achieve minimization and adequate management of MSW (Villanueva, 2023).

Now, the results of the survey of this research, focused on the socio-environmental perception of MSW, coincide with the findings of Navarro (2017) in the population of Nauta, Peru. In this work, personal interviews were used through surveys to collect data, and the results revealed that the majority of the population of the city of Nauta perceived a lack of environmental responsibility on the part of local authorities. This idea was based on the observation of serious problems in the management of solid waste both in the city and in the provincial districts, which generated negative impacts on the environment and the health of the population, by contaminating bodies of water and floors. Despite this, a significant willingness on the part of the population (85.2%) to get involved in environmental projects was evident.

In relation to the data from the interview with key informants from the community of Las Vigas, these agree with a study by Gran and Bernache (2016), who carried out an investigation on the management of urban solid waste, capacities of the municipal government and environmental rights . Their methodology included interviews with key actors and field visits, and they concluded that the municipal government's capacities were insufficient to address waste-related needs, leading to violations of collective and transgenerational environmental rights.

Regarding the design of the non-formal Environmental Education Program for the management of Urban Solid Waste aimed at the inhabitants of the Las Vigas Community, this coincides with a study carried out by Saucedo (2015), who investigated the composition of urban solid waste and designed environmental education programs for the municipality of Bustamante, Nuevo León. Its objectives included the identification of solid waste with recycling potential and the development of educational programs to raise community awareness about local environmental conditions and their adverse social, economic and environmental impacts. The results of this research indicate that waste generation is closely related to the socioeconomic level of individuals, since this is

influenced by the consumption of products and goods. However, the proper disposal of this waste is linked to aspects of education and culture, which are promoted both in the family environment and in specific spaces dedicated to this purpose, such as educational establishments and workshops. Therefore, it is crucial to immerse communities in environmental education programs that allow them to understand the interdependence between culture, the environment and society.

Conclusions

It can be concluded that the challenges faced by the community of Las Vigas in the proper management of urban solid waste are similar to those found in other investigations carried out in different locations. Specifically, a lack of environmental awareness and education is observed among the inhabitants of Las Vigas, resulting in inadequate waste management, as well as environmental problems and risks to public health.

On the other hand, the design approach of the proposed non-formal environmental education program is based on the understanding that waste production is linked to the socioeconomic level and the consumption of products and goods; Furthermore, it is highlighted that the proper disposal of these wastes is related to the cultural and educational levels promoted at home and in educational spaces.

To address this problem, the proposed environmental education program has taken into account the results found in the study, as well as the diversity of existing resources in the community. Therefore, it is expected to plan activities and teaching strategies in closed and outdoor spaces to raise awareness among the population about the importance of proper management of MSW.

In conclusion, this article highlights the need to implement the non-formal environmental education program for the community of Las Vigas Guerrero, since this educational approach is vital to promote positive changes in the management of MSW. Through awareness and education, we seek to actively involve the population in sustainable practices, reducing waste generation, proper separation and recycling, which will contribute to improving the quality of life of the inhabitants and protecting the environment. environmental environment for future generations.

Future lines of research

This study provides a relevant starting point for future research within the field of environmental sciences, especially in the field of environmental education for sustainability, with a specific focus on MSW from a socio-environmental perspective. Therefore, the following investigations should comprehensively address the problem of MSW, considering not only technical and environmental aspects, but also socioeconomic and cultural aspects that influence its generation, management and final disposal of waste.

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