IJMSOR Vol. 3, Issue. 1
January - December, 2018

Using Shrimp Exoskeleton in the Student Community for Academic Development[1]

Aprovechamiento del Exoesqueleto de Camarón en la Comunidad Estudiantil para el Desarrollo Académico

DOI: https://doi.org/10.17981/ijmsor.03.01.09

Research Article - Reception Date: May 6, 2018- Acceptance Date: August 17, 2018

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To reference this paper:
J. Robles, L.A. Mejía, S. Perea & R. Hernández "Using Shrimp Exoskeleton in the Student Community for Academic Development", *IJMSOR*, vol. 3, no. 1, pp. 51-55, 2018. https://doi.org/10.17981/ijmsor.03.01.09

Abstract-- In the municipality of Pueblo Viejo, Magdalena, some fishermen, traders and families involved in shrimp sales and consumption generate large amounts of waste, which becomes an environmental problem. One of these wastes is the shrimp's exoskeleton. A qualitative study was performed following the guidelines of the Research as a Pedagogical Strategy model (IEP, by its acronym in Spanish), with the objective of raising awareness in the student community on the importance of research in order to make use of the shrimp exoskeleton and their academic development, using techniques such as participant observation and field journals. The unit of analysis is forty (40) students in the 11th grade at the San José School in Pueblo Viejo, Department of Magdalena. The results show that the students were able to raise awareness in the community on the possibility of using the exoskeleton's proteins to make fish feed concentrate, thereby creating job opportunities for the community, while at the same time helping to reduce the pollution caused by these wastes.

Keywords--shrimp exoskeleton, animal feed processing, fish.

Resumen-- En el municipio de Pueblo Viejo (Magdalena) algunos pescadores, comerciantes y familias dedicadas a la venta y consumo de camarón, generan gran cantidad de residuos convirtiendo esto en un problema medioambiental. Uno de esos residuos es el exoesqueleto del camarón. Se realizó una investigación cualitativa, bajo los lineamientos de la IEP Investigación como Estrategia Pedagógica, teniendo como objetivo concienciar a la comunidad estudiantil sobre la importancia de la investigación para el aprovechamiento del exoesqueleto de camarón y su desarrollo académico, donde se utilizaron técnicas como diario de campo y observación participante. La unidad de análisis estuvo conformada por cuarenta (40) estudiantes de 11° de la IED San José de Pueblo Viejo, ubicada en el Departamento del Magdalena. Los resultados evidenciaron que los estudiantes lograron sensibilizar a la comunidad, frente al aprovechamiento de las proteínas presentes en el exoesqueleto para la elaboración de alimentos concentrados para peces, generando actividades productivas para la comunidad, donde a su vez se aportó a disminuir la contaminación generada por estos residuos.

Palabras clave-- exoesqueleto de camarón, elaboración de alimentos, peces.

1 This study is derived from the Program to Strengthen Citizenship and Democratic Culture CT+I through the IEP supported by ICT in the Department of Magdalena (CICLON)

I. Introduction

This study was undertaken as a result of the concern of the residents of the Municipality of Pueblo Viejo about the excessive waste of shrimp exoskeleton, which is dumped every day outdoors by fishermen and traders in the region. The San José School (*Institución Educativa Departamental San José*), whose curriculum includes an assignment on environmental education, is well aware of this issue, because its surroundings are affected by the pollution caused by dumping of these wastes on the Troncal del Caribe highway.

Some local governments have included this environmental issue in their campaign themes, and some have even launched campaigns such as "don't be dirty with Pueblo Viejo". However, the scope of such plans and programs is limited to prohibiting dumping wastes outdoors, to address visual pollution, but none of these programs or plans has proposed an option of alternative that is attractive for the people who produce these wastes.

Environmental education at schools is conceived as a tool to raise the awareness of the student community, which should produce new attitudes, knowledge and activities, as students focus not only on analyzing a problem in detail, but also on finding ways to stop or prevent the deterioration of the environment. In this sense, the objective of environmental education is to promote behaviors that are more responsible towards the environment, as well as information that promotes learning of aspects related to the environment and ways for caring for it [1], by promoting the usefulness of research as a pedagogical strategy (IEP) that associates the academic knowledge provided by the school with the problems and knowledge of the community, in order to promote activities that promote more knowledge or answers on the problem. Based on the above, it is important to develop a research project in the classroom under the IEP methodology involving the school's surrounding community and the existing issue of shrimp waste products, to raise the awareness of the student community on the importance of research to make use of the shrimp exoskeleton.

Research performed on the properties of the shrimp exoskeleton [2] show that glucosamine can be extracted by means of acid hydrolysis from shrimp exoskeleton. Other studies have shown that waste from shrimp heads can be used to produce feed for fish farming, thanks to its high content of proteins, unsaturated fatty acids and other equally important compounds. The shrimp exoskeleton can be used and recycled to produce more attractive and safe end products [3]. Shrimp by-products are widely used in industry because they feature high content of chitin, which is processed using chitinolytic microorganisms for subsequent industrial use [4]. Consequently, a viable alternative is to study the possibility of manufacturing fish feed concentrate from shrimp exoskeleton, taking into consideration the empirical knowledge of the fishermen and the academic and research knowledge of the students guided by the lead professor, provided through the research project on shrimp exoskeletons, aimed at feeding fish in fish farms.

The wastes produced from selling shrimp are dumped every day on the sides of the highway, of the ocean and of the swamp Ciénaga Grande de Santa Marta. This has been a problem for a long time, and given that water is a source of life for the entire community, the pollution caused by the disposal of these solid wastes has produced changes in the make-up of aquatic ecosystems and on human health. The water is polluted by waste water, solid wastes, spills and direct and indirect deposits of various types of materials that change its physical and chemical characteristics [5].

Some of the consequences include bad smells and landscape pollution, due to the community's lack of awareness of environmental issues. The progress made by society in recent years has improved people's quality of living, resulting in a more consumer-oriented society, which gives rise to an increase in the amount of waste produced every day, leading to the current need to eliminate, or otherwise recycle, these "wastes" [6].

This study is not only an attractive alternative for the students and teachers involved in the research project, who increase their research skills, enhance learning methods and gain new knowledge on the different factors involved in making using of shrimp exoskeletons, but also for shrimp fishermen and traders, by adding value to the product, which is very important for the region by providing greater opportunities and income, as well as reducing environmental deterioration [7]. Consequently, it creates greater awareness of students in the classroom on how to carry out research that takes into consideration the knowledge and issues of the student community and society [8].

A. Characterization of the species

The shrimp is a small decapods marine crustacean, with a laterally compressed body and very long antennas. It has an articulated shell of chitin, a thick shell that protects its bronchia and a resistant and hard exoskeleton that protects its soft meat [9].

Shrimp live in both fresh and salt water in places such as coasts, lakes and rivers, though one-fourth of known species live in fresh water. They can be found in several oceans worldwide, in equatorial and polar regions. [10] They feed on small particles of organic matter from various types of decomposing vegetation [11].

A key feature of shrimp is that they are capable of reproducing very quickly, which enables the exis-

tence of abundant quantities of the species. During the reproductive stage they migrate from waters of greater to lower salinity and depth [12].

Processing of crustaceans produces large quantities of waste (10,000 m tons per year), which may be recycled to benefit mankind by transforming the raw material through various industrial processes. 45% of shrimp waste is considered a potential source for reduction of potential impact due to its easy degradation [2]. Shrimp waste contains chemical components such as proteins, carbohydrates, fats, minerals and chitin, among others [2].

A study by López [13] used exoskeleton wastes to make biodegradable polymers for use in various areas, through the extraction of chitin, which demonstrates the versatility of the waste, by contributing to the environment while at the same time taking advantage of its benefits. Chitin is obtained through enzyme deacetilation of chitin, which is the second most abundant polysaccharide in nature after cellulose [14].

The growth of the shrimp industry has generated a large amount of "wastes", ill-considered as such, because as we have mentioned, there is wide room to recycle parts such as the head and shell, and which if not recycled pose a serious pollution problem [15].

B. Process for extracting proteins from shrimp exoskeleton

According to Ozuna, Lozano, Méndez &Vásquez [16], the following is the procedure to extract the shrimp exoskeleton: wash, dry, grind and submit the exoskeletons to acid and alkaline hydrolysis to free the proteins, which should precipitate and be characterized, in order to use them for production of feed concentrates, obtaining from the shell the de-mineralized exoskeletons, and from these extract the chitin and proteins, divided into digestible and non-soluble proteins such as scleroproteins, as well as amino acids such as Leucine.

III.Methodology

A. Design

The implemented methodology is based on research as a pedagogical strategy (IEP), which seeks to discover and obtain knowledge through the analysis of collective knowledge from the academic, social and cultural scenarios. This methodological proposal is carried out in a theoretical-practical manner, integrating ICT into the design of strategies to consolidate and develop research competencies [17]. Regarding the shrimp exoskeleton, its components and use and society's knowledge enable complementing what was found in the various areas involved in the research. The IEP enables carrying out the chosen path under the guidance of the teacher and cultural negotiation.

B. Participants

The unit of analysis consisted of forty (40) students in the 11th grade at the San José School in Pueblo Viejo, in the Department of Magdalena.

C. Techniques and instruments

Data collection instruments were selected taking into consideration the type of environment and approaching the culture to enrich the procedure. These included participative observation and field journal, in which teachers through the process of advising and assisting, take on an active role in the research, recording in the field journal the performance of each stage and the information gathered by the task groups that were created.

D. Procedure

The study was carried out based on the six steps established in the methodological route of IEP:

- *Stage* 1: create the collaborative learning groups
- *Stage* 2: a general meeting was held during which students made questions and created discussion groups to start localized learning.
- *Stage* 3: the group formulated the problem, identified the causes and effects at the theoretical level, using tablets as didactic media.
- *Stage* 4: the research paths were defined, in which the students selected the methodology and epistemology to direct their research and learning processes, with guidance from the teacher.
- *Stage* 5: Gathering of information based on theoretical analysis and sharing knowledge with the community.
- *Stage* 6: Summary of the results, reflection on the research practice and social appropriation of the knowledge by sharing their experiences at an institutional fair.

V. Results

Through the collaborative learning groups created at the school, research was made on the questions posed in the discussions and the various observed causes in the San Jose school's neighboring area in Pueblo Viejo, including theoretical searches through ICT media to learn the need, innovation and importance for the community.

Through the research performed by implementing the IEP methodology, the group obtained academic knowledge and sources of information that enabled identification of the most polluted locations due to concentration of shrimp exoskeleton, which

is the solid waste to be recycled. Also, measures for prevention and improved environmental management were found.

It was proposed to recycle this organic waste to produce feed for fish. Various strategies were discussed through research of the natural sciences using tablets as ICT tools, to learn about the recovery of the proteins present in the shrimp exoskeleton. As a result, the following actions were implemented:

a. The areas of greatest accumulation of shrimp exoskeleton were determined, to later intervene and analyze the situation.
b. The characteristics of the various substances considered to be "waste" in shrimp were established, in order to then explore ways to make use of it and reduce pollution.
c. The entire educational community at the San José School was involved in the process of developing a citizen culture that is protective of the environment, impacting the community and raising awareness on sustainable development.
d. Additionally, a reduction of pollution was achieved at the identified sites through recycling of the shrimp exoskeleton.

These actions were possible thanks to implementation of the research as pedagogical strategy model (IEP), which links academic knowledge from various disciplines such as natural sciences, geography, mathematics and others, which knowledge available in the community such as fishing for shrimp, the hours and search areas, and the amounts fished.

This demonstrates the importance and naturalness of the study through the acquisition of new knowledge to create research habits and skills in the student community and awareness in the community, in order to instead of treating this as solid waste, consider the possibility of recycling it to improve fish food and preserving a healthy food for the future of the community and as a new source of income reducing costs by recycling a waste whose value was unknown until then.

V. Discussion

Some substances that are considered wastes and cause substantial pollution may be used and recycled. Currently, such wastes can help improve the environment through education and research, specifically by using the IEP method, which links academic knowledge with community knowledge [17]. As a result, having students working together with the community in a single task group could have a positive impact for society in terms of environmental and research practices.

The results of this study coincide with those of Navarro and Garrido, [1] who say that environmental education is a tool used in school to raise awareness among the educational community. It should integrate knowledge, attitudes and actions, along with the IEP methodology, which not only informs about the issue, but also enables the development of concepts, responses and solutions for the surrounding environment [17] to act in favor of caring for the environment.

This study offers an excellent alternative because pollution in this municipality is quite severe. Recycling these solid wastes not only reduces pollution but creates other benefits, such as producing feed for fish, and the school community is empowered by the acquired knowledge and research skills.

Consequently, we can say that by implementing the IEP, the San José School of Pueblo Viejo began the process by posing an environmental problem for the students and the community, with all the difficulties faced by the student community such as the low probability of achieving a higher education and employment once the students graduate from school, and pollution of the environment. This creates the need to involve the various actors and start localized learning and end problem-based learning [17]. Proceeding to the design and the path of inquiry respecting the organization including in this stage the socio-cultural knowledge to make contrasts and links, creating a space for community involvement to recover polluted areas. Also to make use of the exoskeletons as a source of food for fish, empowering the students with the knowledge acquired from the various academic disciplines and the product generated to demonstrates to the students and the community the results of the activity, involving the community in general, creating networks for jobs and income generation for the fishermen and other actors as set forth by Camargo [18], which says that the IEP enables creating spaces that respect and live diversity, showing the creative contributions of the teacher in the conversion of questions of the learning groups and the capacity of the children and youth to actively transform their realities through the analysis of social issues and proposals for intervention that includes all their innovative capacity.

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