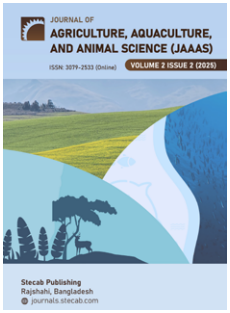

Journal of Agriculture, Aquaculture, and Animal Science (JAAAS)

ISSN: 3079-2533 (Online)

Volume 2 Issue 2, (2025)

https://doi.org/10.69739/jaaas.v2i2.633

https://journals.stecab.com/jaaas

Published by
Stecab Publishing

Research Article

The Entomology Club as a Didactic Strategy to Foster Environmental Awareness Among CETAC No. 22 Students

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About Article

Article History

Submission: May 18, 2025
Acceptance : June 22, 2025
Publication : July 23, 2025

Keywords

Entomology Club, Environmental Education, New Mexican School

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ABSTRACT

This research describes the development and implementation of the teaching strategy called Entomology Club at the Center for Technological Studies in Continental Waters No. 22, located in Ejido Faja de Oro, Cacahoatán, Chiapas, Mexico, since it is inception in 2022 until this year; the methodological processes and the different activities are detailed, as well as the achievements made in these 2 years. The impact for this club had on the curricular and extracurricular processes within the educational institution, and in the community, is highlighted, in terms of the recognition, protection and preservation of the particular environmental surroundings of CETAC No. 22.

Citation Style:

Montejo-López, R., López-Tirado, L., Estrada-Damián, G. B., Montejo-Hernández, N. J., & Mendoza-Cruz, V. (2025). The Entomology Club as a Didactic Strategy to Foster Environmental Awareness Among CETAC No. 22 Students. *Journal of Agriculture, Aquaculture, and Animal Science, 2*(2), 23-29. https://doi.org/10.69739/jaaas.v2i2.633

1. INTRODUCTION

1.1. Context

CETAC 22 is in Ejido Faja de Oro, Cacahoatán, Chiapas, Mexico. It is a secondary school that does not have physical infrastructure, which forces teachers to innovate in pedagogical processes that are of interest to the community, in addition to seeking teaching-learning alternatives that allow the comprehensive training of students.

1.2. School clubs

Science clubs are those that enable the development of scientific skills in students, and it is very important to consolidate them as a pedagogical strategy based on interdisciplinarity and meaningful learning (Cubides & Romero, 2010).

School Environmental Projects (PRAES) allow students to acquire an awareness for the conservation, protection, and improvement of the environment, the rational use of natural resources and the prevention of disasters (Meza *et al*., 2023). PRAES follows the methodological approach of Participatory Action Research with which participation and awareness can be encouraged towards improving the quality of life, through the execution of collective environmental actions (Requena, 2018).

For the above, the creation of the Entomology School Club was proposed, establishing the last Thursday of each month to carry out activities, during the 2022-2023 school year.

This Entomology Club is a group formed by students and teachers of CETAC 22, with the purpose of carrying out teaching activities and disseminating knowledge of the insects that inhabit the campus and it is surroundings. This club seeks to bring young people closer to science and research of small species that inhabit our natural environment, as well as to identify the community of species found in our region.

Environmental education is vital for students to understand the world around them and recognize their deep connections with other living beings. In this sense, it is essential to guide them in a shared reflection on social responsibility in caring for the environment. As teachers we must help them understand that the environment is an inherent part of us, and that it is well-being is, therefore, a task that concerns us all (Sánchez & Reyes, 2021).

Environmental education has a positive impact in the classroom, particularly through the study of entomology, significantly increasing student interest; This suggests that this initiative may expose students to new environmental issues and their interconnectedness, potentially influencing the value they place on the environment for the future (Weeks & Oseto, 2018).

1.3. Objectives

The general objective of this research was "To promote environmental education in students to deepen respect for different forms of life, to commit to the conservation of biological diversity and the sustainable use of natural resources through knowledge of insects, guiding their training as a reflective, responsible and ethical citizen."

The specific objectives were: To create the entomology club to promote the principles of the New Mexican School through the teaching-learning process of insects.

2. LITERATURE REVIEW

2.1. The New Mexican School (NMS)

The New Mexican School aims to promote the integral human development of the student, to promote social transformations within the school and in the community; to forge civic responsibility, based on values such as honesty, participation in the transformation of society by using critical thinking; to promote respect and care for the environment (SEP, 2019).

The NMS promotes environmental awareness, favoring the protection and conservation of the environment, the prevention of climate change and sustainable development (SEP, 2019). It pays attention to the Sustainable Development Goals and the 2030 Agenda (UN, 2017); focusing on developing actions to be able to comply with SDG11 (Sustainable Cities and Communities), SDG13 (Climate Action), SDG14 (Life Below Water), and SDG15 (Life on Land).

The fight against ecological deterioration is promoted, promoting appropriate means and measures (saving and caring for water and electricity, recycling waste, etc.), which represents a contribution to caring for the environment in the daily activities of the entire educational community (SEP, 2019).

2.2. The classroom, school and community program (PAEC)

The Classroom, School and Community (PAEC) program is a strategy focused on the construction of significant and contextualized learning of higher media education students based on the study and labeesity program or problem community school projects (PEC) in which the Coordination of school and community agents participate (September, 2024).

The PAEC consists of four phases, begins with the elaboration of the collective diagnosis, which consists in describing quantitatively and qualitatively the characteristics, interests, needs and resources of the campus and the community that surrounds it; Analyze the information to select, in a base, the main need or community problem from which the PEC will be occupied; The second phase is the design of the community school project, here the activities that will allow the proposed objective to address the problem or need of the town where the educational establishment is located are formulated. The third phase is the implementation of the community school project, where students will participate in activities with the accompaniment of the teachers, who will give academic and training content to the project, promoting that students recognize themselves as social transformation agents . Finally, monitoring and feedback will be carried out to the community school project, which will need moments for the analysis of how work is worked on and identify points to improve or change some aspect to ensure compliance with it is purpose (SEP, 2024).

The Community School Project presents many similarities with the Methodology of Participatory Action Research (IAP), which leads to the learning process based on pedagogical strategies that facilitate learning, activating factors such as motivation, usefulness for life, resolution of basic problems, activation logic and reasoning (Guevara & Rodríguez, 2021).

2.3. School clubs

School clubs are very supportive of students understanding and

embracing the value of activism, developing an awareness and understanding of global issues, the methods used to address issues that concern them, and the role of extracurricular clubs in fostering critical engagement (Bartlett & Yemini, 2025).

Insects are a highly diverse taxonomic group with crucial ecological roles. For their study, learning sequences with observation and drawing activities were designed to enhance students' knowledge and appreciation of insect diversity. To contextualize learning and encourage new personal experiences with live insects, the activities were conducted in school gardens. The results reveal a positive impact on students' knowledge of insect diversity and environmental stewardship (Eugenio-Gozalbo & Ortega-Cubero, 2022).

Iconic insect species are critical for mobilizing public support and resources for nature conservation. Understanding the factors that shape human attitudes toward insects facilitates the selection and establishment of insects as iconic species, especially in local contexts where their role can be critical for specific conservation strategies. To this end, we propose integrating knowledge about local insects into schools. Implementing hands-on, experiential teaching methods allows students to develop an early and meaningful connection with these species, laying the foundation for a greater appreciation and future commitment to their conservation (Schlegel *et al.*, 2015).

2.4. Participatory Action Research Methodology (IAP)

The participatory action research methodology (IAP) comprises four phases: in the first instance, the diagnosis, in which the problems and needs of the community are identified. In the second phase the action plan is structured, which must be designed in coordination with the community. The third stage consists in the implementation of the Action Plan, where planned activities are carried out. Finally, the process evaluation is carried out to determine it is effectiveness and adjustments for posterity are made (Sandín, 2003).

This methodology is considered the first step for social transformation, where teachers, students and social groups that seek as mutual end of new knowledge from their own experience are involved (Martínez, 2006).

3. METHODOLOGY

This research had a qualitative approach, using Participatory Action Research (PAR), Community Social Intervention Methodology with emphasis on the fact that people affected by social problems must be part of the solution to these problems, therefore, the design, execution and evaluation of plans and actions is done from the dialogue between researchers and community members (Montenegro, 2004).

The population was made up of several actors linked to our Educational Institution "Center for Technological Studies in Continental Waters No. 22, located in Ejido Faja de Oro, Cacahoatán, Chiapas, Mexico, which is located in a rural area context with great environmental diversity in it is surroundings. The Club was structured in the following stages:

1. Public call: The announcement was disseminated through posters and school announcements, explaining the club's objective and planned activities. Interested students registered voluntarily.

2. Diagnostic evaluation: All club members were given a diagnostic tool (a drawing of an insect) to determine their initial knowledge of insects, biodiversity, and perceptions of environmental issues.

3. Theoretical-practical workshop: An introductory entomology workshop was held, covering topics such as:

- General insect morphology
- Main taxonomic orders
- Habitats and adaptations
- Ecological importance of insects
- Ethical collection and conservation techniques
- Procedures for assembling and preparing entomological boxes.

4. Campus Tours: Scheduled field trips were made to the school grounds and nearby natural areas for observation, photographing, and collecting specimens, following ethical criteria and respect for local biodiversity.

- Collection: Insect collection tours were conducted around the school (approximately 5 hectares), using an entomological net to capture them.
- Insect Conservation: The collected insects were placed in wide-mouthed glass and plastic jars with 70% alcohol.

5. Making Entomological Boxes: Using the collected insects, the students mounted and labeled the specimens, creating entomological boxes as evidence of learning.

Mounting: Pins and a solid Styrofoam base were used to mount the insects, allowing the morphological parts of each insect to be observed.

They were also named according to their taxonomic order.

6. Final Evaluation: The final evaluation instrument created in Google Forms, "CETAC 22 Entomology Club Final Questionnaire," was administered.

A drawing of an insect with it is parts was again requested (to compare before and after), and an entomological box of the collections was presented as the final product to identify the lessons learned and changes in the participants' environmental awareness.

The insect collection, conservation, and assembly activities were adapted to the school context, following the methods described by Borror and DeLong (2005).

For identification, the insects were given common names (as they are known in the community), and their scientific names were established with the help of the Google Lens application and the iNaturaList.

4. RESULTS AND DISCUSSION

The Entomology Club was made up of 23 students (4 women, corresponding to 17.4% of the population and 19 men, representing 82.6%) and 5 teachers (4 women. 80% of the teachers and 1 man, 20% of the teachers).

The entomology club held face-to-face sessions (Figure 2) with tours of coffee plots owned by the club and those adjacent to the school (Figure 3). A total of 23 students attended during 3 sessions held on September 29, October 27 and November 24. The club's focuses were "respect for nature and care for the environment" (NEM), "Natural Sciences, Experimental Sciences and Technology" (MCCEMS) and "Life on Land" (SDG 20-30).

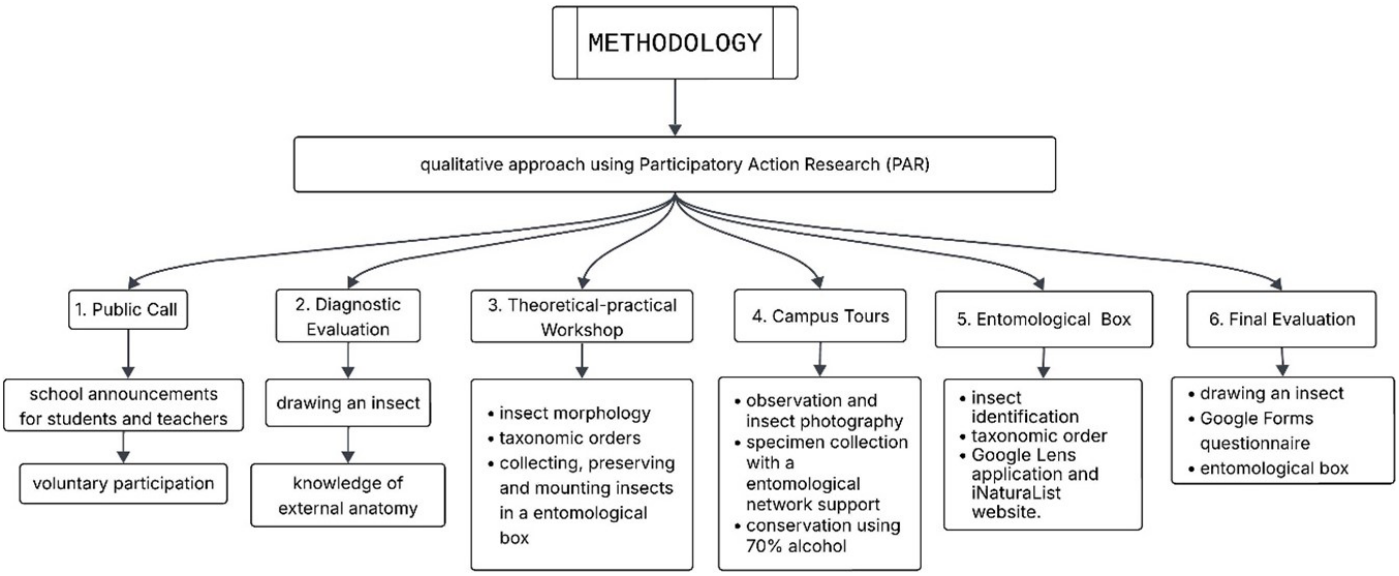

Figure 1. Methodology approach

Figure 2. First conversations with members of the Entomology Club.

Figure 3. Members of the Entomology Club before the start of the entomological collection.

Insects collected included crickets, butterflies, ants, dragonflies and some spiders; all specimens were preserved in 70% alcohol in wide-mouthed plastic and glass jars. Insects were mounted on a Styrofoam plate lined with glossy paper; the insects were attached with round-based pins (Figure 4).

Figure 4. Mounting the insects with round-based pins.

The insects were named based on the taxonomic order to which they belong; the scientific names were obtained with the Google Lens application (2024) and the iNaturalist Mexico website (2024) (Figure 5).

Figure 5. Insect identification.

The activities developed allowed the students to understand not only the world around them, but also their relationships with other living beings. This allows us to reflect on social responsibility in caring for the environment, recognizing that the environment is an extension of the human being itself. This agrees with what was proposed by Sánchez and Reyes (2021) who did a similar project, in which they worked with primary school children to bring them closer to the knowledge of the insects found in their school, with the aim of building an environmental, reflective and contextual education.

There are few similar works, most have been carried out at the basic education level (primary, mainly); Costa-Neto and Pacheco (2004), worked with primary school children in Brazil and observed that contact with insects decreases the level of repulsion that children feel towards these living beings. Cajaiba (2014), in Brazil, observed that the study of insects contributes to the development of scientific skills and improves teachers' confidence.

We agree that teaching about insects brings students closer to environmental care, improving their surroundings and respecting all living beings, but there is a need to adopt a differentiated pedagogical practice in the teaching of Entomology, such as field trips, practical classes, didactic models and educational games among others (Cajaiba, 2014).

It can be highlighted in the diagnostic evaluation, that the drawing of the insect was simple, some did not have the three body segments, others lacked antennae or all legs, some students even drew other organisms such as scorpions, centipedes, spiders, among others; however, when the drawing was asked in the final evaluation, most of the drawings had the basic morphology of an insect, wings, two antennae, 6 legs, compound eyes, a well-defined mouth apparatus, etc. This demonstrated that students improved their knowledge about insects, from being able to differentiate an insect from other arthropods to being able to graphically represent the external anatomy (Figure 6).

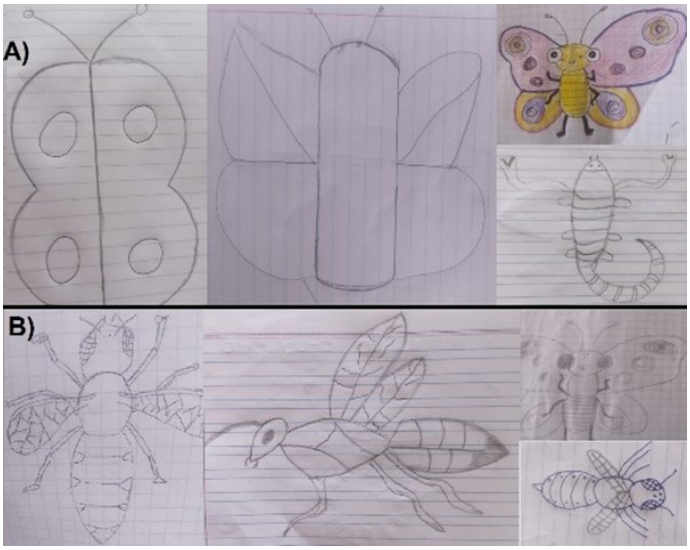

Figure 6. A) Drawings of an insect made during the diagnostic initial. B) Drawings of an insect made during the final evaluation.

The final questionnaire, administered online, was organized into three categories: knowledge acquired, club experience, and opinions and suggestions. In the knowledge acquired category, 11 multiple-choice questions were asked. More than 70% of students answered 9 of the 11 questions correctly, and only fewer than 65% answered 2 questions correctly. It is noteworthy that 100% of students answered correctly in question 7, "What are the benefits of learning about insects?" (Table 1).

Table 1. Students with questions correctly and incorrectly.

Questions	Correctly - n (%)	Incorrectly - n (%)
1	22 (96)	1 (4)
2	16 (70)	7 (30)
3	15 (65)	8 (35)
4	19 (83)	4 (17)
5	21 (91)	2 (9)
6	12 (52)	11 (48)
7	23 (100)	0 (0)
8	21 (91)	2 (9)
9	18 (78)	5 (22)
10	16 (70)	7 (30)
11	18 (78)	5 (22)

In the Club Experience category, the responses highlight the importance of students in capturing insects, taking photographs, field trips, and studying captured specimens. Regarding teamwork and scientific observation, they commented: "If we all do our part, it will be easier for us to better understand insects." "Scientific observation is important for all types of research as it allows us to gather information and obtain reliable results from our research." They also shared that observing the collected insects up close gave them positive emotions such as joy, happiness, fascination, and admiration; they felt curious and amazed. Their opinions were that they wouldn't change anything, and their suggestions included "increasing the frequency of the club," "more materials and equipment for activities," "making more outings to different places related to the club for educational purposes and connecting with people to share other knowledge," expanding the topics by "including other living beings such as plants or animals," suggesting institutional support, such as "providing scholarships," and more entomological materials.

When asked if they would recommend the entomology club to other students and why, they responded yes, because "you learn new things," "you learn more about nature," "because of the types of activities involved," "it's very interesting and you learn a lot, not only talking about insects, but also about preserving their habitat and understanding their importance," and "so as to raise awareness about environmental care."

Based on the analysis of the results, it can be highlighted that the students' participation in the environmental club combined scientific learning with personal and environmental development. Hands-on activities such as observation,

photography, and field trips fostered curiosity, wonder, and emotions like joy, fascination, and admiration, strengthening their knowledge of insects, skills like collaborative work, and a deep connection with nature. Reviews reflect a positive assessment of the entomology club and suggest more tools and materials, including new topics and tours. Most highly recommend the club for it is comprehensive educational and recreational nature, as well as for promoting environmental awareness.

4.1 Achievements

During 2023, the entomology club participated in science and research outreach events, including: The Agrodiversity Fair "Volcán Tacaná" Biosphere Reserve, held in Faja de Oro, Cacahoatán, Chiapas, Mexico, organized by CONANP; The Third CEIDTAM Congress in the Poster modality, held in San Cristóbal de las Casas, Chiapas, Mexico, organized by DGETAyCM Chiapas; Second International Cocoa Festival organized by INIFAP in Tuxtla Chico, Chiapas, Mexico.

In the current year, 2024, we have participated in the following events: Third International Congress of Biology Teachers 2024 (Online exhibition) with the theme "Entomology Club to promote Environmental Education in CETAC 22 Students" organized by CINVESTAV Mexico; School Presentation of the Community School Project (PEC) "if I contaminate, I eliminate myself", the insect exhibition was held to raise awareness about the care of the environment and biodiversity in our educational institution. Presentation at the ExpoCiencias Chiapas (Regional Phase) in Tapachula, Chiapas Mexico.

The most recent achievement is obtaining the Direct Pass to the National ExpoCiencias to be held in Villahermosa, Tabasco, Mexico, where there will be a competition to obtain the pass to the international ExpoCiencias to be held in Abu Dhabi, United Arab Emirates, in 2025.

5. CONCLUSION

The Center for Technological Studies in Continental Waters No. 22 seeks to promote academic development and good practices in students, new strategies to discover the talent of young people, socio-emotional skills, establish new social and communication circles among the entire community.

We recognize that the lack of resources is a challenge in our context, however, we emphasize that the entomology club is a strategy that positively impacts the education and well-being of students, as well as the care of the environment. This educational approach encourages interdisciplinarity, environmental awareness and the well-being of the community, in addition to promoting identity and knowledge of our environment.

Despite limitations in infrastructure, laboratories, and workshops, as well as a lack of specialized materials, the CETAC 22 entomology club has proven to be an effective teaching strategy for fostering environmental awareness among high school students. It successfully integrates scientific knowledge with real-life situations, promoting meaningful learning, and developing skills such as observation, collaborative work, critical thinking, and empathy toward other living beings and nature. The results demonstrate a transformation in knowledge and perceptions of insects, as well as an increase in motivation, scientific curiosity, and socio-environmental commitment. One of the limitations of this research was the lack of technical resources, such as magnifying glasses, professional entomological nets, mounting materials and access to specialized taxonomic identification, however, these were overcome through creativity, collaborative work and the use of accessible digital tools such as Google Lens and iNaturalist, which demonstrates adaptation to available resources. This intervention demonstrates a high potential for replication in urban and rural educational contexts, provided there is an institutional and teaching commitment.

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