

## Insects as a pedagogical tool for teaching ecological concepts

### ABSTRACT

Most of all living organisms on Earth varies in color patterns and with insects it is not different. Color patterns are related to several functions, being camouflage, mimicry and aposematism the most widespread strategies. This article aims to describe the importance of research and extension activities reporting an extension project entitled “Insetos na Praça” developed by the Biological Sciences course of the State University of Piauí in Corrente, Piauí state, and also evaluate the use of insects as a didactic tool for teaching ecological concepts related to animals’ coloration. A questionnaire with fourteen questions was applied to the participants and the concepts of camouflage, mimicry and aposematism were taught. The use of insects facilitated the participants’ understanding of the ecological concepts. Therefore, it could be used as a practical, efficient and low-cost didactic tool to teach biological concepts.

**KEYWORDS:** Entomology. Didactic resources. Coloration.

**Mariana Silva Lustosa**

[marianasilvalustosa@gmail.com](mailto:marianasilvalustosa@gmail.com)

0000-0001-5441-6122

Universidade Estadual do Piauí, Corrente,  
Piauí, Brasil.

**Helena Onody**

[helenacarolina@cte.uespi.br](mailto:helenacarolina@cte.uespi.br)

0000-0003-3570-8183

Universidade Estadual do Piauí, Corrente,  
Piauí, Brasil.

**Edilma Mendes**

[edilmamendes@cte.uespi.br](mailto:edilmamendes@cte.uespi.br)

0000-0003-3727-5430

Universidade Estadual do Piauí, Corrente,  
Piauí, Brasil.

## INTRODUCTION

Research and university extension play an important role in generating new knowledge, new technologies and improving the practical, critical and reflective spirit of the student (SANTOS; ROCHA; PASSAGLIO, 2016). Thus, the objective of this study is to describe the importance of research and extension activities in teacher training courses. This article reports the experience of a university extension project entitled "Insetos na praça" (Insects in the square) developed by Biological Sciences undergraduate course, at the State University of Piauí (UESPI), at the Campus de Corrente, during the second term of 2019.

The extension activity in the university, in addition to encouraging research in academic activities, aimed to inform the importance of insects to the local community. Despite the great ecological and economic importance, most people's perception of insects is generally negative and generates feelings such as repudiation, disgust, and fear (LOPES, *et al.*, 2014). In this sense, the practice of research and development of university projects has great relevance with regard to the contributions it can bring to society, connecting the university with the demands of the majority of the population (RODRIGUES *et al.*, 2013).

It is understood that from the moment the academy brings its projects to life outside the classroom, the student can put into practice everything learned in it. The contact between university and society promotes benefits for both, according to Hennington (2005, *apud* RODRIGUES *et al.*, 2013). In this way, research and extension provide differentiated knowledge, which leads to the development of actions that enable contributions to society.

These projects of interaction between university and society can occur place in various spaces such as schools, churches, hospitals, squares, among other public places. Squares, for example, have the function of integration, experience, and coexistence in society, and can be used as an environment for carrying out activities that develop the transmission of knowledge to the general population (OLIVEIRA; ARAÚJO; DINARDI, 2017). Therefore, the project was developed in the Joaquim Nogueira Paranaçu square, located in the center of the municipality of Corrente, PI, so that people could visit the stands and effectively participate in the activities developed by the students.

The thematic stands were produced by academics who, divided into groups, made different exhibitions about the types of insects, foods, games, and didactic activities. The exhibition had the visit and participation of people and students from several public and private schools in the city of Corrente, who were amazed at the information and curiosities about the importance of these beings to the environment.

In this regard, it is interesting to develop studies with the objective of bringing the research and practices that happen at the university to the reality of society in general. It is pertinent to emphasize that the practice of research in initial training contributes to the personal and professional maturation of future teachers because, through research activities, the theory fostered during the course can be put into practice. In addition, research is an alternative to expand the scientific, theoretical and practical knowledge of academics in the face of the thematic diversity that involves their area of training (RIBEIRO; ORTEGA; DARSIE, 2013).

It is also important to highlight the role of pedagogical materials in the transmission of knowledge, since “didactic resources are of fundamental importance in the process of cognitive development” (COSTOLDI; POLINARSKI, 2009, p.2). In addition, they develop the ability to observe, bring the individuals closer to reality and allow more easily the fixation of the content and more effective learning, where they will be able to use this knowledge in any situation of their daily life (SANTOS, 2013).

In this context, the use of insects as teaching resources on display allows the observation of their great biodiversity, greater awareness of their importance and their main survival attributes, together with the construction of a database that can be used by the community, students and people interested in the topic as stated by Wommer (2013).

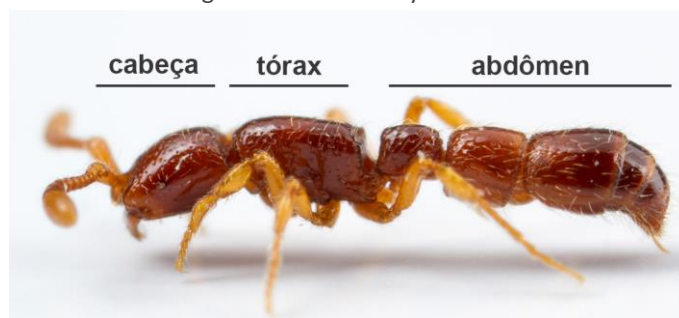
Insects are often associated with economic and medical losses, as many act as pests of cultivable plants and stored products, as well as vectors of important human and animal diseases. The use of insects in educational activities can help to reduce the repulsive and negative ideas associated with these beings (SANTOS; SOUTO, 2011).

Regarding that, it is important to stimulate knowledge and understanding of the role of these animals in the environment, as well as helping society to deal with the negative aspects caused by them (TRINDADE, 2012 apud WARDENSKI; GIANNELLA, 2017). Thus, in the following section, more about insects, their importance to the environment, and aspects related to their color will be discussed.

## INSECTS AND THEIR COLORATION

Insects are invertebrate animals that belong to the phylum Arthropoda and have the greatest richness of known species among animals. The more than one million described species are distributed in almost all habitats, which makes insects the most successful group on the planet (GULLAN; CRANSTON, 2012). Insects have a body divided into three regions: head, thorax and abdomen. The head contains most of the sensory and food intake organs; the thorax houses the muscles responsible for locomotion and the locomotor appendages (the legs and also the wings when present) are inserted into it; in the abdomen, there are the digestive and reproductive organs (RAFAEL, *et al.*, 2012) (Figure 1).

Figure 1 – Insect body division.



Source: IDE (2019).

This class of arthropods has great ecological importance and in different ecosystems they act as pollinators, herbivores, predators, parasitoids, saprophages and coprophages, in addition to assisting in aeration, fertilization and soil turning. From an economic point of view, insects are important in the production of commercial products such as honey, dyes and wax, in animal and human food, and they can also be an important tool in criminology (forensic entomology), helping to solve criminal cases (AMARAL; MEDEIROS; 2015; LEITE, 2012).

In insects, as in other animal groups, coloration plays a fundamental role in thermoregulation, evasion of predation and inter and intraspecific communications and, consequently, in their survival in their habitats (ENDLER; MAPPE, 2017, QUICKE, 2017). In the case of insects, most display colors through the absorption or reflection of sunlight using pigments, cuticular surface structures or their combination (CHAPMAN; SIMPSON; DOUGLAS, 2013; QUICKE, 2017).

In terms of predation evasion, coloration patterns have been interpreted as an evolutionary result driven by predation by visually oriented animals (KREBS; DAVIES, 1996, VASCONCELLOS-NETO; GONZAGA, 2000). They are part of the animal's primary defenses, but, obviously, a number of other factors act and/or interact with animal coloration patterns in evading predation, such as body size and shape, behavior, chemical repellents, among others.

In terms of predation evasion, coloration patterns have been interpreted as an evolutionary result driven by predation by visually oriented animals (KREBS; DAVIES, 1996, VASCONCELLOS-NETO; GONZAGA, 2000). They are part of the animal's primary defenses, but, obviously, a number of other factors act and/or interact with animal coloration patterns in evading predation, such as body size and shape, behavior, chemical repellents, among others.

Although the subject is much more complex, survival strategies related to coloration and its patterns involve camouflage, aposematism and mimicry. These concepts are widely worked on in the school years and are of fundamental importance for students to understand how the characteristics of living beings can give them advantages and disadvantages in a given environment and in their survival. In addition, they are concepts present in the daily lives of many people, even though they may not know how to formally correlate names to their meanings.

Camouflage is a strategy in which the potential prey resembles its habitat in order to avoid detection by a predator (DEL CLARO; VASCONCELLOS-NETO, 1992, TEIXEIRA, 2012). In some cases, insects can achieve imperceptibility by having part of the body, such as wings, transparent (QUICKE, 2017).

Another striking feature for some insect species is the warning or warning coloration, called aposematism. Harvey and Paxton (1981, apud QUICKE, 2017) and Jarvi *et al.* (1981, apud QUICKE, 2017), define an aposematic organism as one that meets two criteria: the animal must be unpalatable and easily recognizable by predators through strong colors and tones so that they can be easily avoided. The main colors of aposematic organisms are red, black, yellow, white, blue and green, which can cover the body structure of an individual uniformly with only one of the colors or by combinations between them (ARONSSON; GAMBERALE, 2009 apud QUICKE, 2017; TEIXEIRA, 2012).

Mimicry is an adaptation in which one species imitates another for the purpose of protection against possible predators and can be of two main types: in Batesian mimicry, a harmless and palatable species imitates a dangerous and unpalatable species (model species), keeping away possible predators; in Mullerian mimicry, two unpalatable or aggressive species converge to the same appearance, distancing possible predators from both (DEL CLARO; VASCONCELLOS-NETO, 1992, TEIXEIRA, 2012).

Among the various objectives pursued by the extension project, we report in this paper that of making entomological boxes and evaluating the use of insects as a tool in the dissemination of concepts related to their diversity, especially the aspects of their coloration associated with the ecological concepts of aposematism, camouflage, and mimicry. There was, however, no intention to delve into these themes or to associate species names with these strategies.

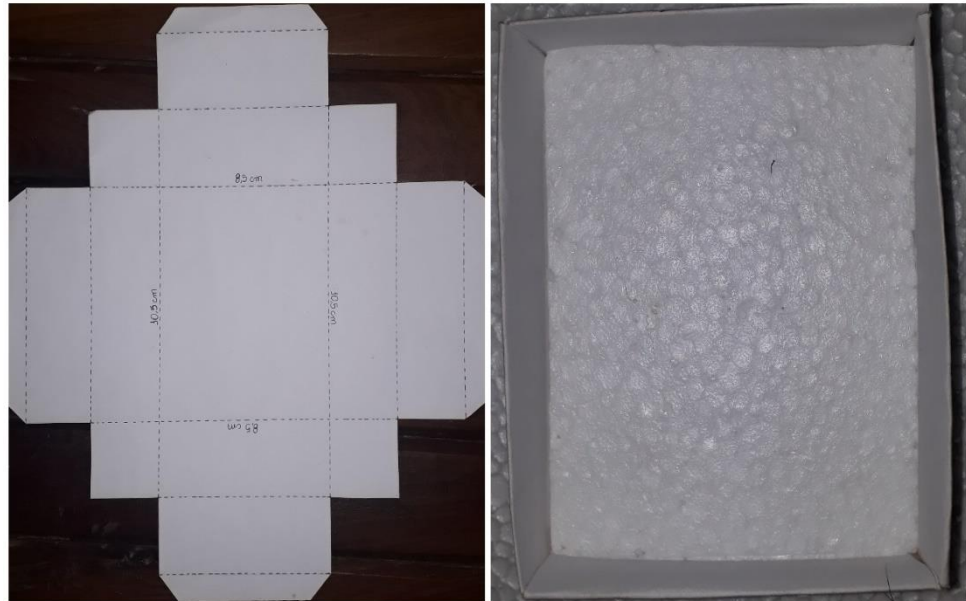
The group responsible for exhibiting the insects divided the work into two stages; in the first stage, the assembly of the entomological boxes happened and, the second stage comprised the presentation of the concepts and the application of a questionnaire to the community at the exhibition held in the square.

#### **PRESENTING THE EXPERIENCES: MATERIAL AND METHODS**

The activities were developed during the execution of the extension project entitled “Insects in the Square”, carried out in Praça Joaquim Nogueira Paranaguá, municipality of Corrente, PI. The event was held on November 6, 2019, and was open to the entire community. The project had the participation of several students and teachers of basic education from public and private schools, as well as people who passed by the place.

The entomological boxes were made of white cardboard, 10.5 cm long and 8.5 cm wide (Figure 2). In the first image, the dotted lines represent the places where the folds were made and the second image corresponds to the box mounted with styrofoam at the bottom for fixing the insects. Specimens were selected and arranged to illustrate ecological concepts.

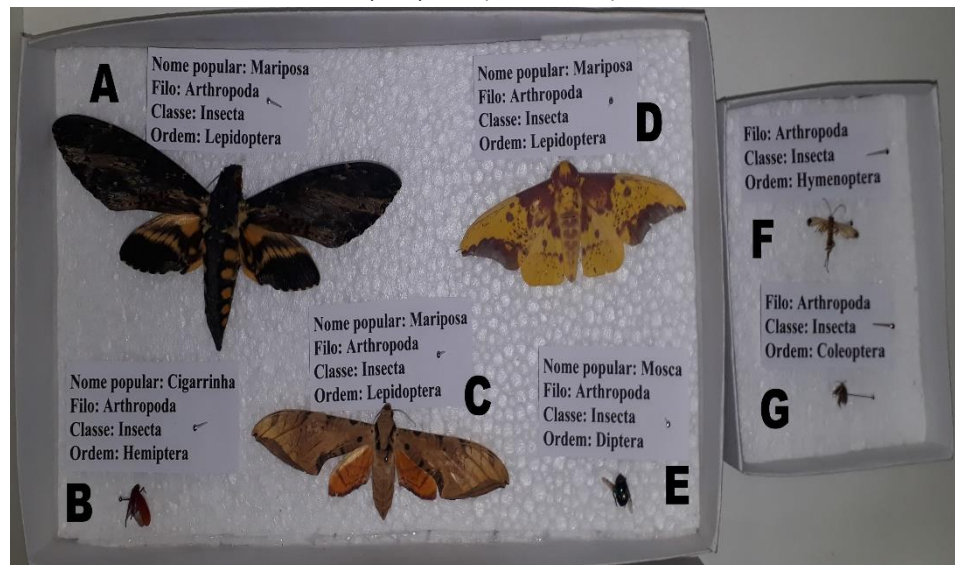
Figure 2 - Model used to make the entomological boxes used in the presentation of insects.



Source: The authors (2019).

To exemplify aposematism, specimens of the orders Coleoptera, Diptera, Hemiptera, Hymenoptera and Lepidoptera were selected (Figure 3). These insects have strong and attractive colors representing danger to their predators.

Figure 3 - Entomological boxes prepared with aposematic specimens of the orders Coleoptera (letter G), Diptera (letter E), Hemiptera (letter B), Hymenoptera (letter F) and Lepidoptera (letters A, D).

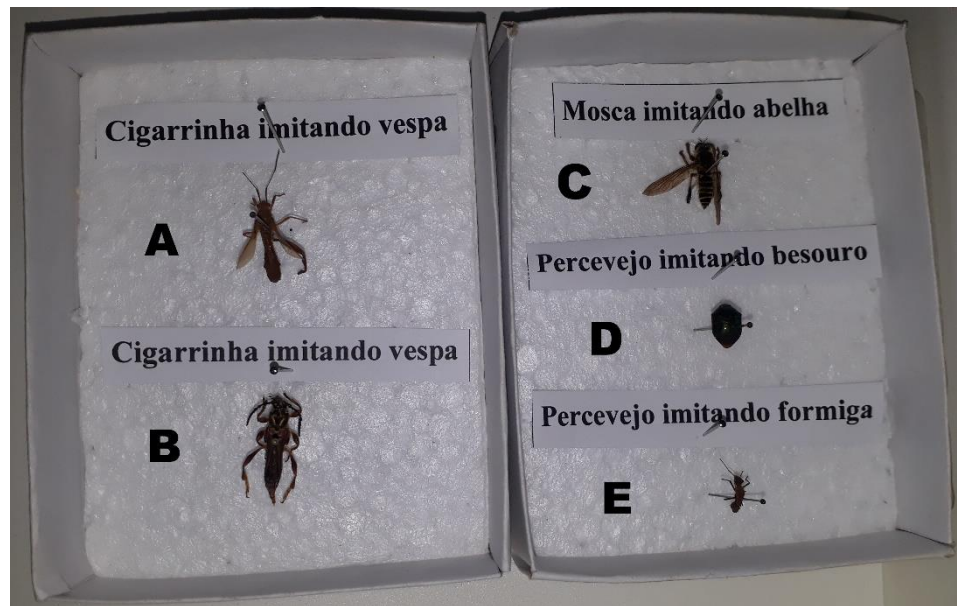


Source: The authors (2019).

Mimicry was represented by specimens of the Diptera and Hemiptera orders (Figure 4). These insects use mimicry as a tactic to ward off potential predators.



Figure 4 - Entomological boxes prepared with mimetic specimens of the orders Diptera mimicking a bee (letter C) and Hemiptera mimicking wasps, beetle and ant (letters A, B, D,E).



Source: The authors (2019).

In camouflage, specimens of the orders Hemiptera, Lepidoptera, Orthoptera and Phasmatodea were used (Figure 5). In the camouflage boxes, the specimens were placed together with leaves and tree bark to better show how their color manages to blend in with the environment, making it difficult for their predators or prey to detect them.

Figure 5 - Entomological boxes with specimens of the orders Hemiptera (letter B), Lepidoptera (letters A, G), Orthoptera (letters C, D, F) and Phasmatodea (letter E) camouflaged in tree bark and leaves.



Source: The authors (2019).

The entomological boxes were placed in drawers arranged in a booth set up during the event, along with a banner that explained the three ecological concepts: aposematism, mimicry, and camouflage.

The second stage of the work covered the application of a form to the visitors of the stand with fourteen questions (Chart 1) and took place in two stages. In the first, the first ten questions were asked and then the entomological boxes were presented and the concepts were worked with the participants. At the end of the explanation, the last four questions were asked to assess the efficiency of this tool in building participants' knowledge on the topic.

Chart 1 - Questionnaire applied to participants of the extension project "Insetos na praça", Corrente, PI.

Chart of Questions	
Question 1	Age?
Question 2	Gender?
Question 3	Education?
Question 4	Address?
Question 5	Do you know what is a entomological box?
Question 6	Have you ever observed the coloring of insects?
Question 7	Can you name an example of insect coloring?
Question 8	Do you think there is na intention for the coloring of insects?
Question 9	Can you name any importance of the coloring of insects?
Question 10	Have you heard of aposematism, mimicry and camouflaje before?
Question 11	Can you think of an insect that exemplifies one of these cases?
Question 12	Can you think of an animal that exemplifies one of these cases?
Question 13	Do you think that the entomological box facilitated the understanding of the concepts of aposematism, mimicry and camouflaje?
Question 14	Which example of the entomological box caught your attention the most?

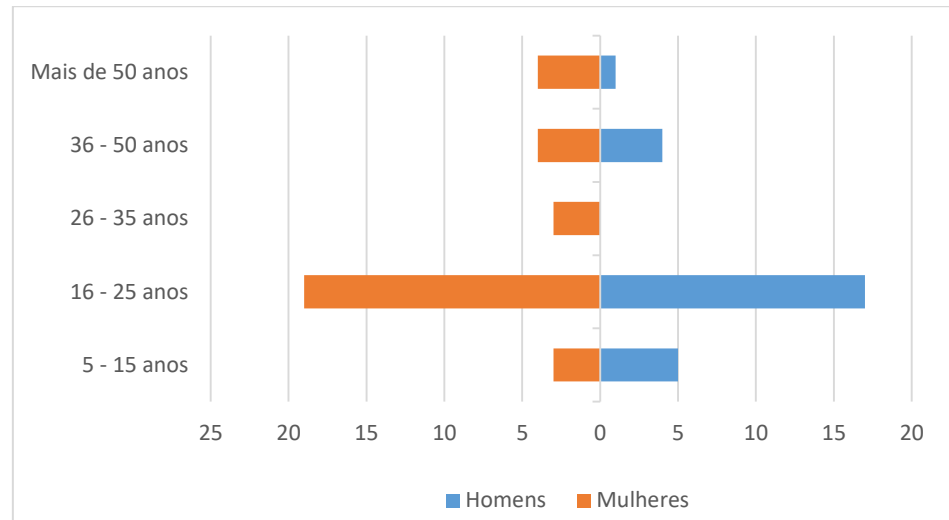
Source: The authors (2019).

## RESULTS AND DISCUSSION

The questionnaire was answered by 59 people, 32 female, and 27 male. According to the data collected, the rate of people aged between 16 and 25 years old was higher (Figure 6). The education level of the people who answered the questionnaire varied a lot, with 44% went to College, 33% completed High school and 23% Elementary school. Two students from APAE - Associação de Pais e Amigos dos Excepcionais (the association of parents and friends of people with Down syndrome) also participated.



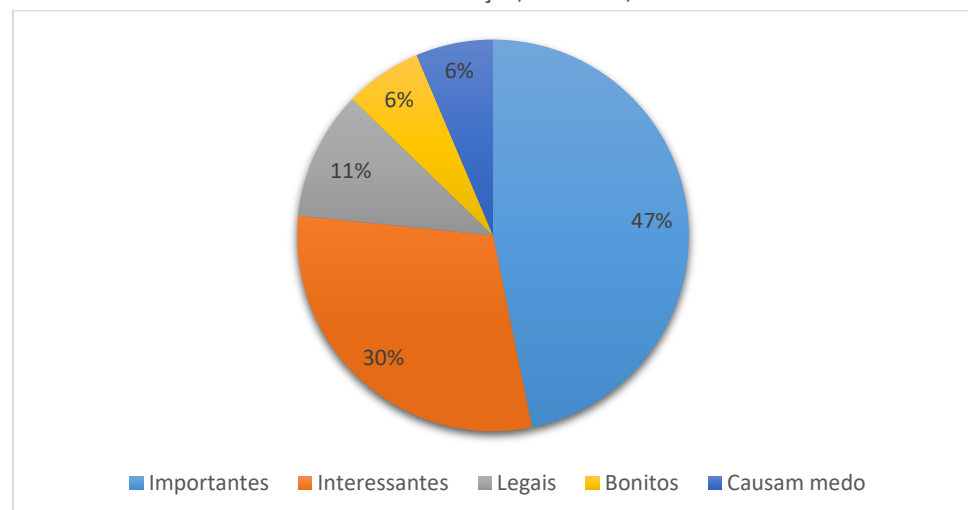
Figure 6: Age group of the participants of the activity performed at the event “Insetos na Praça”, Corrente, PI.



Source: Survey data (2019).

Most respondents considered insects as “important” animals, followed by “interesting”, “cool”, “beautiful” and “cause fear” (Figure 7). The use of these adjectives is commonly associated with insects and has already been verified in other works on the perception of insects by people (LOPES; VALDUGA; ATHAYDES; DAL-FARRA, 2014; SOUZA; COSTA; SANTOS, 2014). Asked if they had already observed the coloring of insects, 92% of respondents answered yes, 8% answered no. When asked if they knew about an entomological box, 27% of respondents who have completed Elementary school, 43% High school, and 33% went to College responded that they did not know.

Figure 7: Perception of insects by the participants of the activity performed at the event “Insetos na Praça”, Corrente, PI.



Source: Survey data (2019).

In some questions, it was noted that the answers varied more intensely according to the education level of each individual. Asked if they could cite an example of insect coloring, 10% who have completed Elementary school, 31%

High school and 45% who went to College answered yes, with red and green being the most cited colors by the participants.

On the role of insect colors, 14% of respondents who have completed Elementary school, 40% High school, and 46% who went to College responded that they thought that color influences the behavior of the animal. Asked if they could cite any importance of insect coloring, 17% of respondents who completed Elementary school, 38% High school, and 45% who went to College answered yes. Camouflage (52%), defense (21%), protection (21%), and diversity (6%) were the answers to this question.

Regarding the question about aposematism, mimicry, and camouflage, 5% of people who have completed Elementary school, 37% High school, and 58% went to College answered that they already had knowledge about some of these concepts. Of those interviewed, 18% who have completed Elementary school, 34% High school, and 48% went to College cited butterfly (72%), bee (15%), grasshopper (8%), and moth (5%) as examples of these concepts. When asked about any other animal that exemplified one of the ecological concepts, 26% of people who have completed Elementary school, 36% High school and 38% College said they could not answer this question. Chameleon (80%), snake (15%), and earthworm (5%) were the responses of people who were able to answer this question.

The results cited above coincide with the work by Bomfim *et al.* (2016) on Ethnoentomology in a rural community in the Cerrado of Piauí, where it was identified that the way insects are perceived is also influenced by the academic level of the interviewees.

When asked if the entomological box would have facilitated the understanding of the contents, most respondents (86%) answered yes, and that the boxes on camouflage would have attracted more attention (62%). Coelho *et al.* (2018) in their work "Insects: a didactic tool for teaching Biology", say that 92.5% of the people related to the study developed and better understood the concepts due to the use of pedagogical models. The use of different teaching resources contributes to enabling, assisting and establishing the necessary unification between theory and practice. Nicola and Paniz (2016) from their analyses, conclude that the use of different methodologies can improve the teaching and learning process.

Silva e Vieira (2021) in his work on the use of entomological collections as a tool in Biology teaching identified that when used as a didactic resource, the best development of the students was noticeable with the specimens present in the box. The practice favored motivation, interaction, and greater knowledge about insects. Santos and Souto (2011) came to the conclusion that this didactic methodology can be easily adapted to be used in other topics in Science teaching, thus facilitating learning.

## **FINAL CONSIDERATIONS**

Entomological collections are a database that can be used by society as important sources of scientific research and also in education. These organisms support many types of studies, such as environmental changes, patterns of geographic distribution, biodiversity, biological cycles, human health, pest

control, etc. (CAMARGO, 2005 apud CAMARGO, *et al.*, 2015), but they can also be used as a pedagogical tool for teaching different biological/ecological concepts, and even on issues applied to health and agriculture. It is worth mentioning that pedagogical activities involving insects and the making of entomological boxes have low cost and make them more attractive and motivating (GUTJAHR; OLIVEIRA; CABRAL, 2017). It must be considered, however, that depending on the subject to be addressed, some difficulties may be faced and that are associated, for example, with the legal procedures of collections with the responsible bodies and in the obtaining of certain species in some localities of the country.

Through the project we had the opportunity to investigate the obstacles that people have in contextualizing some concepts, and that the use of insects as a didactic tool provided greater learning about the coloring of insects and the associated ecological concepts. The didactic model can be a practical strategy and easily adaptable to the reality where it is being inserted, which makes the teaching-learning process more interesting and easily assimilated. In addition, practices that use insects as a pedagogical tool help to demystify and reduce negative impressions often associated with them.

The development of the project in Corrente allowed greater interaction with the community, which can enjoy the activities not only in an educational way but also in a recreational way, which generates a greater positive impact, especially in municipalities that lack spaces for culture and leisure.

# INSETOS COMO FERRAMENTA PEDAGÓGICA PARA O ENSINO DE CONCEITOS ECOLÓGICOS

## RESUMO

Os mais variados grupos de organismos presentes no meio ambiente apresentam variação no padrão de coloração, e com os insetos isso não é diferente. Os padrões de coloração estão relacionados a uma série de funções, e as estratégias mais difundidas são a camuflagem, o mimetismo e o aposematismo. O artigo tem como objetivo descrever a importância das atividades de pesquisa e extensão em um curso de formação de professores com o relato de experiência de um projeto de extensão universitária intitulado “Insetos na Praça” desenvolvido no Curso de Licenciatura Plena em Ciências Biológicas, da Universidade Estadual do Piauí (UESPI), no Campus de Corrente, e avaliar o uso de insetos como ferramenta didática para o ensino de conceitos ecológicos. Um questionário com quatorze perguntas foi aplicado e os conceitos de camuflagem, mimetismo e aposematismo foram trabalhados. Verificou-se que o uso de insetos facilitou a compreensão dos conceitos e que estas podem ser uma ferramenta didática prática, eficiente e de baixo custo para serem utilizadas no ensino de conceitos biológicos.

**PALAVRAS-CHAVE:** Entomologia. Recursos didáticos. Coloração.

## ACKNOWLEDGEMENT

The project had the financial support of the municipality of Corrente, PI, and the National Institute of Science and Technology of Hymenoptera Parasitoides (FAPESP Process 2008/57949-4 and 2014/50940-2, and CNPq Process 465562/2014-0). The authors are grateful for the image provided from the personal archive of Guilherme Ide and Mônica Antunes Ulysséa.

## REFERENCES

AMARAL, K. O.; MEDEIROS, M. A. Análise das concepções de estudantes do ensino fundamental sobre insetos, por meio da metodologia do discurso do sujeito coletivo. **Brazilian Geographical Journal**, v. 6, n. 1, p. 156-180, 2015. Available at: <https://seer.ufu.br/index.php/braziangeojournal/article/view/28068>. Access on: Nov. 09th, 2020.

BOMFIM, B. L. O. *et al.* Etnoentomologia em comunidade rural do cerrado piauiense. **Revista Desenvolvimento e meio ambiente**, v. 39, p. 189-205, 2016. DOI 10.5380/dma.v39i0.44597 Available at: <https://revistas.ufpr.br/made/article/view/44597/30134>. Access on: Apr. 20th, 2020.

CAMARGO, A. J. A. *et al.* **Coleções entomológicas: legislação brasileira, coleta, curadoria e taxonomia para principais ordens**. 1. ed. Embrapa, Brasília, DF, 2015.

CHAPMAN, R. E; SIMPSON, S. J; DOUGLAS, A. E. **The insects: structure and function**. 5. ed. New York: Cambridge University Press, 2013. 959 p.

COELHO, J. B. *et al.* Insetos: uma ferramenta didática para o ensino de biologia. *In: ENCONTRO NACIONAL DAS LICENCIATURAS*, 7., 2018, Fortaleza. **Anais [...]**. Fortaleza, 2018, p. 1-23. Available at: <https://editorarealize.com.br/artigo/visualizar/52234>. Access on: Apr. 20th, 2020.

COSTOLDI, R; POLINARSKI, C. A. A utilização de recursos didático-pedagógico na motivação da aprendizagem. *In: SIMPÓSIO NACIONAL DE ENSINO DE CIÊNCIA E TECNOLOGIA*, 1., 2009, Paraná. **Anais [...]**. Paraná, 2009, p. 684-692.

DEL CLARO, K.; VASCONCELLOS-NETO, J. Os padrões de coloração animal: exemplos na Serra do Japi. *In: L. P. C. Morellato (org.). História Natural da Serra do Japi. Ecologia e preservação de uma área florestal no sudeste do Brasil*. Campinas: Editora da Unicamp, 1992. Cap. 13, p. 288-309.



ENDLER, J. A.; MAPPES, J. The current and future state of animal coloration research. **Philosophical Transactions of the Royal Society B**. London, 372: 20160352. 2017. DOI <http://doi.org/10.1098/rstb.2016.0352>. Available at: <https://royalsocietypublishing.org/doi/10.1098/rstb.2016.0352>. Access on: Feb. 09th, 2021.

GULLAN, P. J.; CRANSTONR, P. S. **Insetos do Brasil**: um resumo de entomologia. 4. ed. São Paulo: Editora Roca Ltda, 2012. 496 p.

GUTJAHR, A. L. N.; OLIVEIRA, P. G. N.; CABRAL, T. R. Coleção didática temática de besouros: uma ferramenta para o ensino de ciências. **Enciclopédia Biosfera**. Centro científico conhecer, v. 14, n. 25, p. 1659-1671, 2017. DOI: 10.18677/EnciBio\_2017A138. Available at: <https://www.conhecer.org.br/enciclop/2017a/human/cole%C3%A7%C3%A3o%20didatic%20a.pdf>. Access on: Nov. 09th, 2020.

IDE, G. **Divisão do corpo dos insetos**. 2019. 1 Fotografia. Coleção Particular.

KREBS, J. R; DAVIES, N. B. **Introdução à ecologia comportamental**. São Paulo: Atheneu, 1996. 432 p.

LEITE, G. **Entomologia Básica – UFMG**, 2012. 46 p. Available at: [https://www.ica.ufmg.br/wp-content/uploads/2017/06/ap\\_ent\\_basica.pdf](https://www.ica.ufmg.br/wp-content/uploads/2017/06/ap_ent_basica.pdf). Access on: Mar. 03th, 2019.

LOPES, L. A. *et al.* As concepções sobre insetos no ensino fundamental em escola pública Sapucaia do Sul, RS. **Acta Scientiae**, Canoas, v. 16, n. 4, p. 214-223, 2014. Available at: <http://www.periodicos.ulbra.br/index.php/acta/issue/view/107>. Access on: Mar. 03th, 2019.

NICOLA, J., A.; PANIZ, C. M. A importância da utilização de diferentes recursos didáticos no ensino de biologia. **InFor, Inovação e Formação**, São Paulo, v. 2, n. 1, p. 355-381, 2016. Available at: <https://infor.ead.unesp.br/index.php/nead/article/view/InFor2120167/pdf>. Access on: Mar. 03th, 2019.

OLIVEIRA, M. J. D; ARAUJO, S. C; DINARDI, A. J. O uso de praças públicas como ferramenta para o ensino de botânica. *In: SALÃO INTERNACIONAL DE ENSINO, PESQUISA E EXTENSÃO*, 9., 2017, Santana do Livramento. **Anais [...]**. Santana do Livramento: Universidade Federal do Pampa, 2017, p.1-6. Available at: [https://guri.unipampa.edu.br/uploads/evt/arq\\_trabalhos/12494/seer\\_12494.pdf](https://guri.unipampa.edu.br/uploads/evt/arq_trabalhos/12494/seer_12494.pdf). Access on: 03 mar. 2019.

QUICKE, D. L. J. **Mimicry, crypsis, masquerade and other adaptive resemblances.** Hoboken, Nova Jersey, EUA: Wiley Blackwell, 2017. 576 p.

RAFAEL, J. A. *et al.* Insetos do Brasil: Diversidade e Taxonomia. **Holos Editora.** Ribeirão Preto, SP, 2012. 810 p.

RIBEIRO, E. S; ORTEGA, J. M; DARSIE, M. M. P. A prática da pesquisa na formação docente: concepções de professores de licenciatura em matemática de uma universidade no contexto da Amazônia brasileira. **Revista REAMEC- - Rede Amazônica de Educação em Ciências e Matemática**, n. 1, p. 22-43, 2013. DOI: <http://10.26571/2318-6674.a2013.v1.n1.p22-43.i5284>. Available at: <https://periodicoscientificos.ufmt.br/ojs/index.php/reamec/article/view/5284/3481>. Access on: Mar. 03th, 2019.

RODRIGUES, A. L. *et al.* Contribuições da extensão universitária na sociedade. **Cadernos de Graduação - Ciências Humanas e Sociais**, Aracajú, v. 1, n. 16, p. 141-148, 2013. Available at: <https://periodicos.set.edu.br/cadernohumanas/article/view/494>. Access on: Mar. 03th, 2019.

SANTOS, D. C. J; SOUTO, L. S. Coleção entomológica como ferramenta facilitadora para a aprendizagem de Ciências no ensino fundamental. **Scientia Plena**, v. 7, n. 5, p. 1-8, 2011. Available at: <https://www.scientiaplena.org.br/sp/article/view/310/186>. Access on: Mar. 03th, 2019.

SANTOS, J. H. S; ROCHA, B. F; PASSAGLIO, K. T. Extensão Universitária e Formação no Ensino Superior. **Revista Brasileira de Extensão Universitária**, v. 7, n. 1, p. 23-28, 2016. Available at: <https://periodicos.ufes.edu.br/index.php/RBEU/article/view/3087/pdf>. Access on: Mar. 03th, 2019.

SANTOS, O. K. C. **Recursos didáticos: Uma melhoria na qualidade da aprendizagem.** 2013. 12 f. Trabalho de conclusão de curso (Graduação em Pedagogia). Faculdade Evangélica Cristo Rei – PI. Available in: <https://www.google.com/url?sa=t&source=web&rct=j&url=https://docplayer.com.br/6373506-Recursos-didaticos-uma-melhoria-na-qualidade-da-aprendizagem.html&ved=2ahUKEwi-w5e37vj5AhWIqpUCHQmIDWoQFnoECAsQAQ&usg=AOvVaw2eFQnRFAIPsnGpbPbsgoVW>. Access on: Mar. 5th, 2020.

SILVA, T. M. S; VIEIRA, J. H. O uso de coleções entomológicas como ferramenta do ensino de biologia. In: SENHORAS, E. M. (org). **Deflagração de ações voltadas à formação docente 2.** Ponta Grossa - PR: Editora Atena, 2021. Cap 14, p. 128-141.

Available at: <https://www.atenaeditora.com.br/post-artigo/49237>. Access on: Aug. 25th, 2021.

SOUZA, E. A.; COSTA, E. M.; SANTOS, G. C. B. As concepções que estudantes da sexta série do ensino fundamental do Centro de Educação Básica da Universidade Estadual de Feira de Santana possuem sobre os insetos. *Gaia Scientia*, v. 8, p. 8-16, 2014. Available at: <https://periodicos.ufpb.br/ojs/index.php/gaia/article/view/17924/10217>. Access on: Mar. 03th, 2019.

TEIXEIRA, I. A. S. **Camuflagem e mimetismo como estratégias de sobrevivência**. Dissertação. 2012. 67 f. Trabalho de Conclusão de Curso (Graduação em Ciências Biológicas) - Universidade do Vale do Paraíba, São José dos Campos, São Paulo. Available at: <https://biblioteca.univap.br/dados/000004/00000455.pdf>. Access on: Mar. 03th, 2019.

VASCONCELLOS-NETO, J.; GONZAGA, M.O. 2000. Evolução de padrões de coloração em artrópodes. pp. 337-370. In MARTINS, R. P., LEWINSOHN, T. M. & BARBEITOS, M. S. (eds). **Ecologia e comportamento de Insetos**. Série Oecologia Brasiliensis, vol. VIII. PPGE-UFRJ. Rio de Janeiro, Brasil.

WARDENSKI, R; GIANNELLA, T. Insetos no ensino de Ciências: objetivos, abordagens e estratégias pedagógicas. In: ENCONTRO NACIONAL DE PESQUISA EM EDUCAÇÃO EM CIÊNCIAS, 11., 2017, Florianópolis. *Anais [...]*. Florianópolis, 2017, p.1-8. Available at: <http://www.abrapecnet.org.br/enpec/xi-enpec/anais/trabalhos.htm>. Access on: 03 mar. 2019.

WOMMER, F. G. B. **Coleções biológicas da entomologia: aspectos morfológicos dos insetos**. 2013. 45 f. Trabalho de conclusão de curso (Especialização em Educação Ambiental) - Universidade Federal de Santa Maria, RS. Available at: [https://repositorio.ufsm.br/bitstream/handle/1/659/Wommer\\_Fernanda\\_Gabrie\\_la\\_Bitencourt.pdf?sequence=1&isAllowed=y](https://repositorio.ufsm.br/bitstream/handle/1/659/Wommer_Fernanda_Gabrie_la_Bitencourt.pdf?sequence=1&isAllowed=y). Access on: Mar. 03th, 2019.

**Received:** Feb. 23rd, 2021.

**Approved:** Dec. 20th, 2021

**DOI:** 10.3895/rbect.v15n2.13863

**How to cite:** LUSTOSA, M. S.; ONODY, H.; MENDES, E. Insects as a pedagogical tool for teaching ecological concepts. *Brazilian Journal of Science Teaching and Technology*, Ponta Grossa, v.15, p. 1-16, 2022. Available at: <<https://periodicos.utfpr.edu.br/rbect/article/view/13863>>. Access on: XXX.

**Mailing address:** Mariana Silva Lustosa – [marianasilvalustosa@gmail.com](mailto:marianasilvalustosa@gmail.com)

**Copyright:** This article is licensed under the terms of the Creative Commons-Atribuição 4.0 Internacional License.

