



Fotografía
Gonzalo M. A. Bermudez

THE TOPIC OF SNAKES IN TEACHER TRAINING

O tema serpente e o professor em formação

El tema de las serpientes en la formación del profesorado

Gilcelany Alves da Silva* 

Zaida Ortega** 

Suzete Rosana de Castro Wiziack*** 

Vanda Lúcia Ferreira**** 

Fecha de recepción: 30 de abril de 2023
Fecha de aprobación: 10 de octubre de 2023

Cómo citar:

Alves da Silva, G., Ortega, Z., de Castro Wiziack, S. R and Ferreira, V. (2024). The Topic of Snakes in Teacher Training. *Bio-grafía*, 17(32), 93-107. <https://doi.org/10.17227/bio-grafia.vol.17.num32-20437>

Abstract

Perceptions about snakes range from fascination to phobia, making them a relevant topic for discussion in environmental issues of basic education. This topic requires a safe and empathetic approach by teachers. Considering that environmental education is a curriculum guideline to be developed by teachers from different areas of knowledge, we investigated some factors that may influence the attitude of undergraduate students in teaching degrees when addressing this topic in an extracurricular activity.. We evaluated 120 future teachers through an online survey regarding their area of expertise, training stage, values, and emotions or feelings towards professional behavior when encountering a snake during an environmental education activity in a non-formal setting. The results indicate that only “fear” and “scientist” values interfered with the performance of future teachers. We propose that environmental education involving stigmatized animals be emphasized in teaching degrees to expand positive didactic experiences, minimize prejudices and fears, and facilitate the reconstruction and dissemination of knowledge through the conscious action of future educators.

Keywords: education; ophidians; degree; teaching; conduct

* Doutoranda do programa de pós-Graduação em Ensino de Ciências, Universidade Federal de Mato Grosso do Sul. gilcelany.silva@ufms.br

** Pesquisadora contratada, Universidade de Granada, Universidad de León, León, Spain.

*** Professora, Universidade Federal de Mato Grosso do Sul. suzete.wiziack@ufms.br

**** Professora, Universidade Federal de Mato Grosso do Sul. vanda.ferreira@ufms.br

Resumo

As percepções sobre as serpentes envolvem entre fascínio e fobia, tornando-as um tema relevante para discussão em questões ambientais na educação básica. Esse tema exige abordagem segura e empática por parte dos professores. Considerando que a educação ambiental é uma diretriz curricular a ser desenvolvida por docentes das diferentes áreas do conhecimento, investigamos alguns fatores que podem influenciar a atitude de estudantes de cursos de graduação em licenciatura ao tratar este tema em uma atividade extrassala. Avaliamos 120 futuros professores através de formulário online sobre sua área de atuação, estágio de formação, valores, emoções ou sentimentos em relação à atitude profissional ao encontrarem uma serpente durante uma atividade de educação ambiental em ambiente não formal. Os resultados indicam que apenas o “medo” e o valor “cientista” interferem na atuação dos futuros docentes. Propomos que a educação ambiental com animais estigmatizados seja enfatizada nas licenciaturas para ampliar experiências didáticas positivas, minimizar preconceitos e temores, e facilitar a (re)construção e disseminação do conhecimento por meio da ação consciente dos futuros educadores.

Palavras-chave: ensino; cobras; licenciatura, docência; conduta

Resumen

Las percepciones sobre las serpientes varían entre la fascinación y la fobia, lo que las convierte en un tema relevante para la discusión sobre cuestiones ambientales en la educación básica. Este tema requiere un enfoque seguro y empático por parte de los docentes. Considerando que la educación ambiental es una directriz curricular a ser desarrollada por profesores de diferentes áreas del conocimiento, investigamos algunos factores que pueden influir en la actitud de los estudiantes de grados de licenciatura al tratar este tema en una actividad extracurricular. Evaluamos a 120 futuros profesores mediante un formulario en línea sobre su área de actuación, etapa de formación, valores, emociones o sentimientos hacia el comportamiento profesional al encontrarse con una serpiente durante una actividad de educación ambiental en un entorno no formal. Los resultados indican que sólo el “miedo” y el valor “científico” interfieren en el desempeño de los futuros docentes. Proponemos que la educación ambiental con animales estigmatizados se enfatice en las licenciaturas para ampliar experiencias didáticas positivas, minimizar prejuicios y temores, y facilitar la reconstrucción y difusión del conocimiento a través de la acción consciente de los futuros educadores.

Palabras clave: enseñanza; ofidios; grado; enseñanza; conducta



Introduction

Human-animal relationships are common narratives for different communities of people worldwide. In this context, snakes are mentioned in several legends, myths, and beliefs in different ethnicities and religions since the beginning of humanity, often resulting in antagonistic views, ranging from sacred and renewal beings to dangerous and deadly creatures, depending on religious and cultural contexts (Vizzoto, 2003; Alves et al., 2014; Cosendey & Salomão, 2016; Vasconcelos-Neto et al., 2018). These aspects can influence many people, adding difficulty to dealing with the danger issues that these animals may represent. This innate fear can be as extreme as a phobia (Andersson et al., 2013). According to Öhman and Mineka (2003), fear of snakes may in fact comprise an evolutionary and innate response, as reptiles have been associated with danger throughout human evolution, and it is likely that snakes represent a fear stimulus.

Snakes exhibit recognized value in ethnozoology (Fita et al., 2010; Linares-Rosas et al., 2021) and ecology (Mills et al., 1993; Pinto-Coelho et al., 2021), as well as a food resource (Klemens & Thorbjarnarson, 1995), in medicine (Alves & Alves, 2011), and as pets (Kusrini et al., 2021). In this complex scenario, snakes can trigger admiration, fascination, curiosity, and protective feelings in people. However, hostility is still widespread (Moura et al., 2010; Shankaret al., 2013; Onyishi et al., 2021). The conflicting relationship between humanity and snakes may result in people fleeing from these animals, avoiding their presence, or even confronting them for extermination purposes, resulting in indiscriminate snake killing. Secco et al. (2014) demonstrated that snakes are intentionally run over when they attempt to cross the roads, with vehicles modifying their normal trajectories to reach these animals. This behavior represents a threat to snake conservation. However, research on how human attitudes in relation to snakes may intensify this type of conflict is still lacking (Mendes, 2018). In this context, investments in research and awareness campaigns can comprise an important strategy to minimize this problem (Mendes, 2018). Consequently, educational actions aimed at training citizens to employ critical and scientific thinking regarding the need for environmental preservation and its surrounding biodiversity become paramount (Freitas et al., 2020).

Knowledge dissemination on the importance and preservation of feared and rejected animals, such as bats, scorpions, and snakes (Cosendey & Salomão, 2013), is a major challenge for Environmental Education (EE) because conservation efforts are often focused on or strengthened only for animals considered charismatic (Ballouard et al.,

2013). Studying environmental perception and working on EE projects that aim to correct this bias are, therefore, vital in generating citizen awareness regarding the environment as an essential life maintenance component (Bixler & Floyd, 1997; Freitas et al., 2020; Freitas et al., 2022). This becomes specifically relevant as a topic to be taken into the classrooms of aspiring teachers, who are at the forefront in training future citizens (Freitas et al., 2020).

In this regard, one of the roles of university degree courses is to provide knowledge on nature components and opportunities for the intellectual improvement of future educators, aiming at developing skills and abilities that enhance EE as a transversal topic (Santos & Fachín-Téran, 2012). Brazilian legislation determines the inclusion of socio-environmental ethics content in initial professional training and in technical and professional specialization course activities. It also underscores the need to incorporate complementary teacher training, as established in the Brazilian National Curriculum Guidelines for basic education teacher training, as well as at higher levels in full graduation degree courses since 2001, as stipulated in the EE principles and objectives set in the National Council of Education Resolution nº 2, of June 15, 2012. In this regard, educational institutions must provide academics with the possibility of integrating both knowledge and experience arising from school education (Vasconcelos & Lima, 2010). The more confident a teacher is about their teaching knowledge, being skillful (displaying mastery of conceptual content integrated with their actions) and aware of the cultural influence of certain subjects, the more effectively their work can be optimized in the classroom and in other non-formal spaces. In this context, studies that present and value the important contributions of snakes are primordial, especially regarding environmental preservation efforts and particularly those evidencing care for these animals in the daily lives of people in contact with nature, even in urban settings.

An environmental approach must be present in Brazilian teacher training, and the research that intends to understand the abilities of teachers on this topic enhances its implementation (Freire & Rodrigues, 2020). Therefore, by gaining knowledge on socioenvironmental realities, humans need to feel that they are an essential part of the environment, displaying awareness that environmental problems must be addressed. Freirean Pedagogy proposes a type of education in which human relationships with both other humans and the world are questioned. This aims to provide opportunities for discovery processes and social transformation (Freire, 1999), as well as reflections on ethics and the necessary respect for

every life form and its multiple actions and relationships, which implies connections with surrounding nature. Thus, one of the roles of teachers, as collaborators in citizen training, is to develop strategies that allow students to understand the environment in which they live (Oliveira, 2006). Freire (1987) argued that educating to educate does not mean imposing a specific world vision. Educators play a role in expressing their vision and in understanding student views, so both can dialogue and reflect on the living world. Therefore, universities would need to invest in the training of professionals within the socioenvironmental vision, and offer solutions according to the social needs, in a historical context (Araújo & França, 2013).

In the teaching-learning process, challenging topics – such as issues involving religion, legends, or beliefs, mystical beings, and monsters, as well as animals like snakes – require special attention in the classroom to generate interest, curiosity or even doubts for both students and teachers (Cosendey & Salomão, 2013). However, conceptual errors regarding snakes are noted in schools and textbooks (Sandrin et al., 2005; Pandey & Khanal, 2013), which contributes to continuing misperceptions and misconceptions (Cosendey & Salomão, 2013). For example, Sandrin et al. (2005) detected questions associated to the concept, identification and identification of venomous and non-venomous snakes and their biology in textbooks, where they were described, in general, as dangerous to humans. This approach to snakes (see Sandrin et al., 2005; Moura et al., 2010) demonstrates the need for educational approaches that enlighten the fact that some snake species can cause serious accidents but are also important in many aspects, such as maintaining life equilibrium on Earth (Cornelis et al., 2021), biotechnological applications (Patlak, 2004; Koh et al., 2021), or providing important ecosystem services (Dodd Jr., 1987; Fraga et al., 2013; Pandey et al., 2020), requiring preservation. Reflecting on this content as an EE theme, *i.e.*, as an interdisciplinary proposal, aims at facilitating the production and (re)construction of both knowledge and values (Jerónimo, 2013). Thus, professionals should experience and develop EE activities and/or projects focusing on environmental issues, during their teacher training (Tozoni-Reis & Campos, 2014). This will strengthen decision-making skills regarding their attitude in exercising teaching activities, *i.e.*, interdisciplinary topics, and the use of non-formal uncontrolled environments (Yavorski et al., 2021).

In this sense, concepts and values regarding the biota, particularly snakes, must be approached safely and empathetically by teachers from different areas, conside-

ring that these professionals are exposed to experiences with these animals, even in urban spaces such as green areas, parks, lakes, and their surroundings (Parkin et al., 2020). Therefore, based on Paulo Freire's guidelines and contributions, our study evaluated the values and attitudes of teachers in the initial training stages at a higher education institution in the center-west of Brazil when faced with a snake in a non-formal educational environment, considering the relationship between certain scientific contents and sociocultural knowledge. To achieve this, we asked the following questions: a) What factors influence student emotions when faced with a snake? b) Do information and culture, through legends and popular stories, influence the fear of snakes? c) Do people from different backgrounds exhibit different values when it comes to wildlife? d) What factors influence future faculty to act as teachers when faced with a snake? Do Biology students have different wildlife values and attitudes when it comes to snakes compared to other areas?

Methodology

A Google Forms survey approved by the Ethics Committee was applied (Protocol 30719920.2.0000.0021). Two types of questions were included in the survey: 1) multiple-choice questions, where participants could mark more than one option and write their opinion in a text field labeled “others,” and 2) open questions, where participants were able to report legends and myths about snakes and explain if these had influenced their perceptions about these animals (Appendix 1). The survey was sent via e-mail to students from the Federal University of Mato Grosso do Sul Biological Sciences, Physics, Geography, History, Literature, Chemistry and Pedagogy undergraduate courses at the Aquidauana, Três Lagoas, Pantanal, Ponta Porã and Cidade Universitária *campi* (Brazil). Student electronic addresses were provided by course coordinators. To emphasize the interdisciplinary character advocated in school EE approaches, a selection of the target audience comprising teachers in training in different knowledge areas was applied (Ministério da Educação, 2012). A total of 774 e-mails were sent to undergraduate students December 7, 2020, to April 27, 2021.

Considering the theoretical assumptions of environmental perception studies (Tuan, 1983; Kozel, 2018), we identified some parameters to assess whether intrinsic factors (*i.e.*, emotions, feelings and wildlife values), the knowledge area of the course, and the training period could be associated with future teacher attitudes, and we classified their potential for professional (teaching) performance. Environmental perception focuses on

the understanding of human actions as a way of living and acting in society within the human-environment relationship (Tuan, 1983). Thus, future teachers' answers were categorized into four groups based on course enrollment level, namely "beginning", "medium", "advanced" and "graduated" (Table 1), aiming to characterize participant instructional conditions and, indirectly, the knowledge acquired from their study areas.

Table 1. Participant classification in terms of teacher training stage at the time the forms were answered.

Training stage	Categories
1st or 2nd semester	Beginning
3rd to 6th semester	Medium
7th to 14th semester	Advanced
Alumni or Graduated	Graduated

Source: Authors.

Emotions were classified into three groups: "indifferent," "positive," or "negative" (Izard, 2009), while feelings expressed towards snakes were categorized as "afraid" or "not afraid" (Öhmnan, 2005). Wild animal values were determined according to Kellert and Berry (1980) (Table 2), a routinely employed classic classification system (Fischer & Santos, 2021). In general, attitudes in this regard are considered as resulting from four interrelated factors, namely core values, wildlife understanding, species perceptions and human-animal interactions (Clark & Kellert, 1988; Kellert, 1994, 2009; Yorek, 2009). In this context, to identify the basic values of future teachers is important to understand their role as teachers when the opportunity to teach or not to teach about the topic of snakes arises. Although such values may overlap, with the answers potentially presenting more than one value (e.g., both "naturalist" and "scientist" values), only the most prominent answer was assigned (Table 2). Future teacher attitudes were then classified as "teaching" and "non-teaching" activities.

Table 2. Description of the Wildlife Core Value classification (c.f. Kellert & Berry, 1980)

Naturalistic: Primary interest and affection for wildlife and the outdoors
Ecologicistic: Primary concern for the environment as a system, for interrelationships between wildlife species and natural habitats
Humanistic: Primary interest and strong affection for individual animals, principally pets, and highly emotional perspective of the natural world
Moralistic: Primary focus on the right and wrong treatment of animals and nature, with strong opposition to environmental exploitation and cruelty towards animals
Scientific: Primary interest in the physical attributes and biological functioning of animals and the nonhuman world
Aesthetic: Primary interest in the physical attractiveness and symbolic characteristics of animals and the natural environment
Utilitarian: Primary concern for the practical and material value of animals and the natural environment
Dominionistic: Primary interest in the mastery and control of animals and nature, often in sporting situations
Negativistic: Primary orientation an avoidance of animals and natural objects due to indifference, dislike or fear

Source: Authors.

A multinomial regression model using the multinom() function of the *nnet* R package was applied to assess whether teacher knowledge areas are associated with participant emotions. This analysis consists of a logistic regression model used in situations where the objective is to classify subjects based on the values of a set of predictor variables (Ripley et al., 2016; R Core Team, 2021). In this case, emotion served as the response variable and knowledge area as the explanatory variable. A Generalized Linear Model (GLM) with the binomial family of errors, specifically a logistic regression, was employed applying the *glm()* R function, to analyze whether "fear" was related to knowledge area and training stage. Here, "fear" was the response variable, while study area, training stage, and their interactions comprised the explanatory

terms. We predicted that biology students, as they have more contact with nature and are familiar with different animals, would exhibit less fear. To test if the knowledge area was associated with wildlife values, a multinomial regression was fitted using the multinom() function available in the *nnet* R package (Ripley et al., 2016), with "wildlife values" as the response variable and knowledge area as the explanatory one.

In addition, we analyzed whether factors such as area, activity stage, values, emotions, or feelings condition future teacher attitudes during occasional snake encounters, leading them to discuss the subject with students or just observe the animal without intervening as a teacher. A multiple logistic regression model was fitted by

applying the glm() R function and the binomial family of errors (*i.e.*, logistic regression). Finally, to assess whether awareness of any legend or myth about snakes influenced students' representations in terms of emotion, feeling, or professional attitude, a Chi-square test was applied. This test compared the variable "knowing the legend" with the variables "emotion", "feeling" and "professional attitude". A significance level of $p < 0.05$ was established for all analyses.

Results and Discussion

Just 5% of these e-mails returned with an error message, and 15% of the forms were answered ($n=120$). However, this study was conducted during the coronavirus pandemic (SARS-CoV-2), which made face-to-face interviews impossible. Most responses were received from students in Biological Sciences ($n=39$), Geography ($n=31$), and Pedagogy ($n=29$) (Table 3). The majority of respondents were second-year students or were nearing the end of their courses, comprising "medium" and "advanced" training stages (Table 4). The reason students are often in an advanced stage (7th to 14th semester) of training is due to the Teaching Institution allowing them to complete the course with a delay of up to two years; thus, a 5-year course (10 semesters), can be completed in up to 7 years (14 semesters).

Table 3. Frequency (%) values of undergraduate licentiate students who participated in the present study distributed by expertise area ($n=120$).

Area of operation	Frequency (%)
Biology	32.50
Physics	5.84
Geography	25.83
History	3.33
Letters	3.33
Pedagogy	21.67
Chemistry	7.50

Source: Authors.

Table 4. Frequency values (%) of undergraduate students who participated in the present study according to training stage ($n=120$).

Training internship in the course	Percentage
Start	16.66
Average	30.00
Advanced	46.67
Graduated	6.67

Source: Authors.

Only three Kellert and Berry (1980) values were identified among study participants ($n=120$): "naturalist", "scientist" and "negativist" (Table 5). A total of 83.33% of potential future teachers would not use the opportunity to talk about snakes, an attitude present in all wildlife animal value categories, although the first two categories accounted for almost 81% of the sample (Table 5).

Table 5. Quantitative (N) and percentage (%) values concerning undergraduate licentiate students with regard to wild animals according to Kellert and Berry (1980).

Value in relation to wild animals	N	Percentage
Scientist	35	29.17
Naturalist	62	51.67
Negative	23	19.16

Source: Authors.

In the associations between participant knowledge areas and emotions ("indifferent", "negative", or "positive"), only Physics students exhibited fewer positive emotions ($p = 0.04$). However, this difference was not statistically significant compared to the other knowledge areas ($p > 0.05$ in all cases). Although only seven Physics course students were evaluated, and the "p" value was close to 0.05, it stands to reason that the knowledge area does not significantly influence teachers in training emotions when faced with a snake (Figure 1).

Although we predicted that biology students would display less fear of snakes due to their familiarity with these animals, mainly in advanced training stages, the knowledge area was not significantly associated with "fear" ($p > 0.05$ for both factors and their interaction). Thus, the knowledge area, training stage or feelings when encountering a snake did not influence their attitude to act as a teacher. Additionally, no significant relationship was found between student knowledge concerning legends or myths about snakes and their representations, emotions, feelings, or professional attitudes. Hence, familiarity with legends or myths about snakes did not modify their emotions, feelings, or professional attitudes towards these animals.

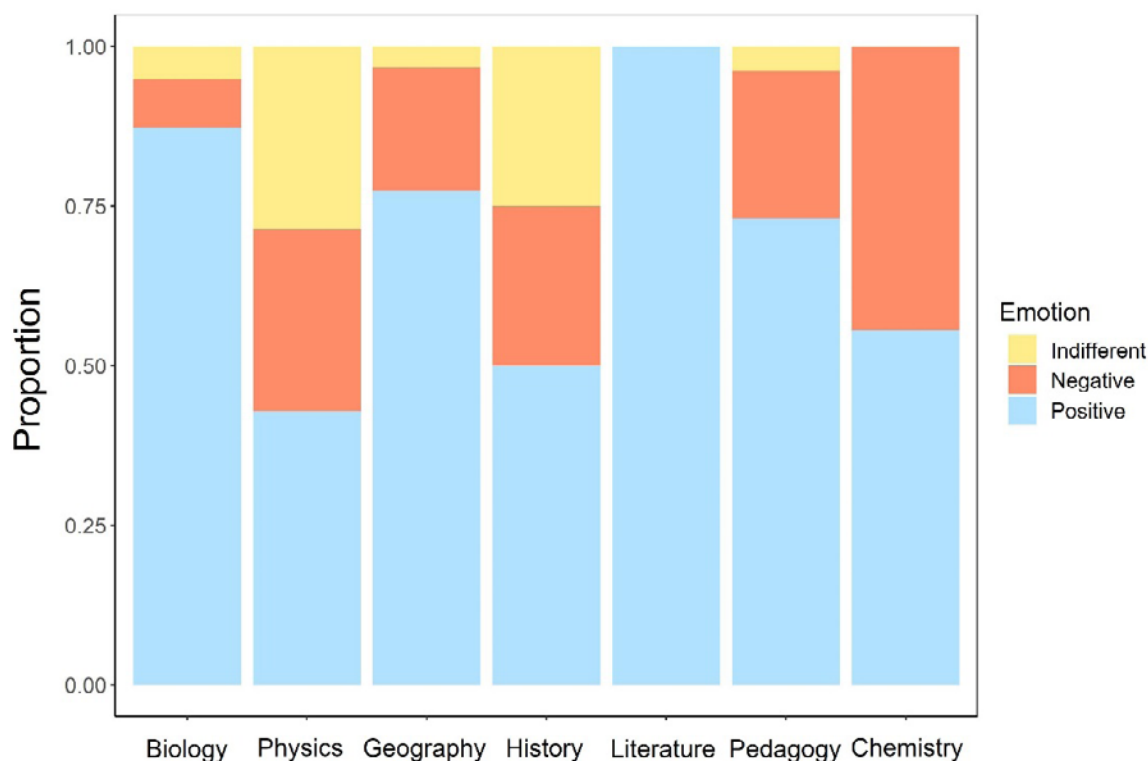


Figure 1. Emotion distribution (I= “indifferent”, N= “negative”, P= “positive”) demonstrated by teachers in training (n= 120) from different knowledge areas. These variables were not associated ($p > 0.05$ in all cases).

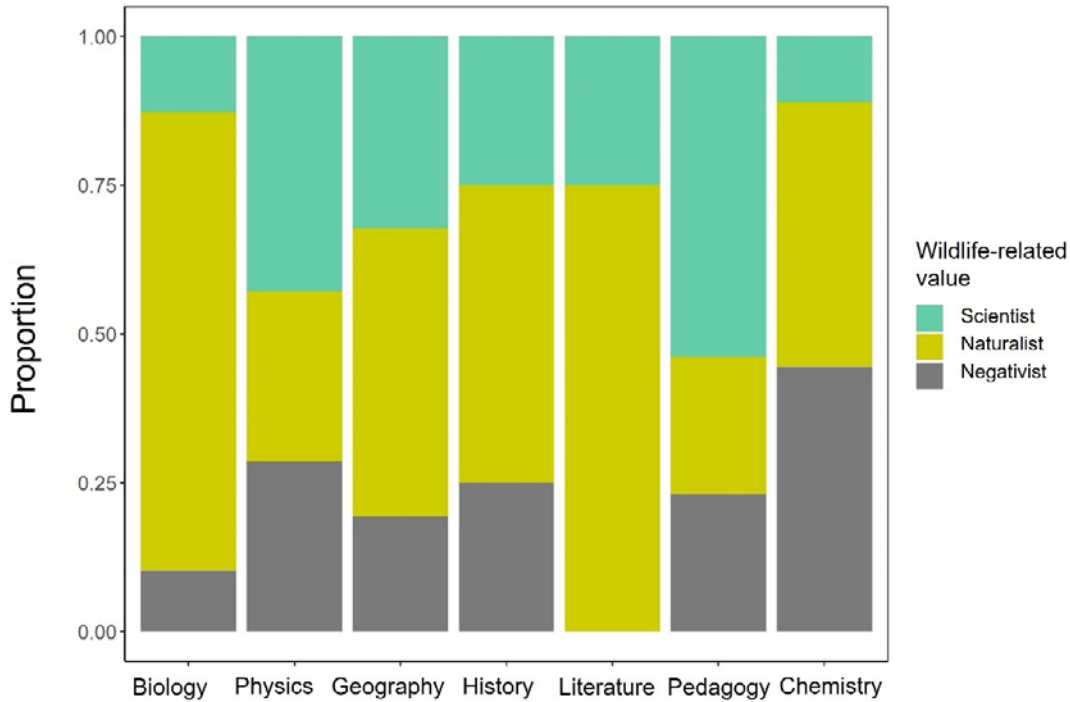
Source: Authors.

Basic wildlife values suggest how people perceive a particular species or animal, pointing out that specific knowledge in this regard can interfere with attitudes towards animals (Kellert, 1994). This represents the influence of learning and of regional cultures, which may vary between individuals and groups (Kellert, 2009). Our results indicate that only three values (“naturalist”, “scientist” and “negative”, cf. Kellert & Berry, 1980) were identified among the undergraduate students who participated in this study, reflecting a public presenting order, meaning, connection, knowledge, understanding, critical thinking ability, and profiles of protection or fear (Kellert, 2009). Consequently, teaching involves much more than wisdom, knowledge, or understanding of a certain life form, requiring the development of other skills and abilities. So future teachers would have to understand how to act in specific situations, such as encountering a snake in open-air classes (Ministério da Educação, 2001; Santos & Fachín-Terán, 2012). To teach

requires practice and methodology to contextualize each topic. However, professionals without this expected profile exist and, as non-classroom methodologies are scarce (Santos & Fachín-Terán, 2012; Guerra et al., 2020), hindering the advancement of EE.

As mentioned previously, the knowledge area did not influence the emotions of future teachers towards snakes (“indifferent”, “negative” or “positive”) (Figure 2), although we predicted that biology students would present different results due to their direct contact with this topic in their training (a bias towards a “positive” emotion was expected). Another interesting result is the feeling of “fear”; although fear may be associated with some professions and the degree of intensity was not assessed among the participating groups (see Maurice et al., 2018), our analyses indicate that the “fear” is not associated with the assessed knowledge areas or the training stage.

Figure 2. Wildlife values (“scientist”, “naturalist” and “negativist”) of teachers in training who participated in this study (n=120) varied between different knowledge areas. Pedagogy, Geography and Physics students exhibited more “scientist” values, while biology exhibited more “naturalist” values. No differences were found for the other knowledge areas.



Source: Authors.

The “scientist” wildlife value was remarkable among Pedagogy, Geography and Physics students, and the “naturalist” value, among Biology students (Figure 2). The “scientist” value is characterized by a primary interest in the physical animal attributes and biological functioning, whereas the “naturalist” value focuses on the interest and affection for both wildlife and nature (Kellert & Berry, 1980). Students categorized as “scientists” exhibited a profile focused on the systematic and empirical study of snakes, while biology students were more oriented towards exploration and discovery (Kellert, 2009). Students from all courses predominantly exhibited a “positive” emotion in relation to snakes.

Our results suggest that future teachers categorized as “scientists” are more able to work as teachers compared to those identified as “naturalists” (Figure 2). Kellert (2009) indicates that scientists reflect the human desire to understand the world with authority, providing intellectual development and cognitive skills through studies and systematic observations. This author also highlights that the natural world offers a great set of opportunities to improve these skills, particularly problem-solving

and critical thinking. This clarifies why teachers in the training categorized as “scientists” display aptitudes conducive to future teaching roles.

Another significant factor for future teacher actions was “fear”, as students who displayed “fear” were those less likely to act as teachers when encountering snakes (Figure 3). Ophidiophobia (snake phobia) is one of the most common phobias (Dinh et al., 2021). According to Öhman and Mineka (2003), fear is considered evolutionary, and the brain has been trained to activate defensive behaviors such as immobility or fight-flight in the presence of threats. This reaction is more evident in the presence of animals considered threatening in the evolutionary past, like reptiles. Studies suggest that an innate fear of snakes is present in humans and may be associated with aversion or unconscious and instinctive snake avoidance (Dinh et al., 2021).

In this context, it is expected that interactions between teachers and students will significantly motivate beliefs, feelings and attitudes related to covered content (e.g., Machado et al., 2010). Therefore, the influences of teachers and experienced learning are relevant for students

in the medium and long term, interpreted by students as significant impacts made by teachers (Leite & Tagliaferro, 2005). Thus, if an educator expresses fear in front of students, this may influence fear in the student, although the aforementioned studies indicate that fear is an often-uncontrolled feeling, presenting an evolutionary or even innate basis.

Final considerations

The “fear” of snakes and the values of undergraduate students can determine how they react to snakes when acting as teachers; while the knowledge area, instruction stage (training) and emotion were not associated with this reaction.

The development of EE with snakes and other stigmatized animals is highly recommended, as it can substantially contribute to bring people closer to nature, especially snakes, and encourage appreciation of them as part of the environment (see Wojnowski, 2008; Moura et al., 2010; Guerra et al., 2020), aiming to minimize innate prejudices and fears (Onyishi et al., 2021). According to Tuan (1983), reinforced by Kozel (2018), even if people behave as cornered and suspicious animals or as scientists (even coldly), humans are complex beings, capable of experiencing new sensations, emotions, feelings, and knowledge (Kozel, 2018). Humans are capable of transforming themselves and the world. “It is in the incompleteness of the being, which is known as such, that education is founded as a permanent process [...]” (Freire, 1996, p. 64).

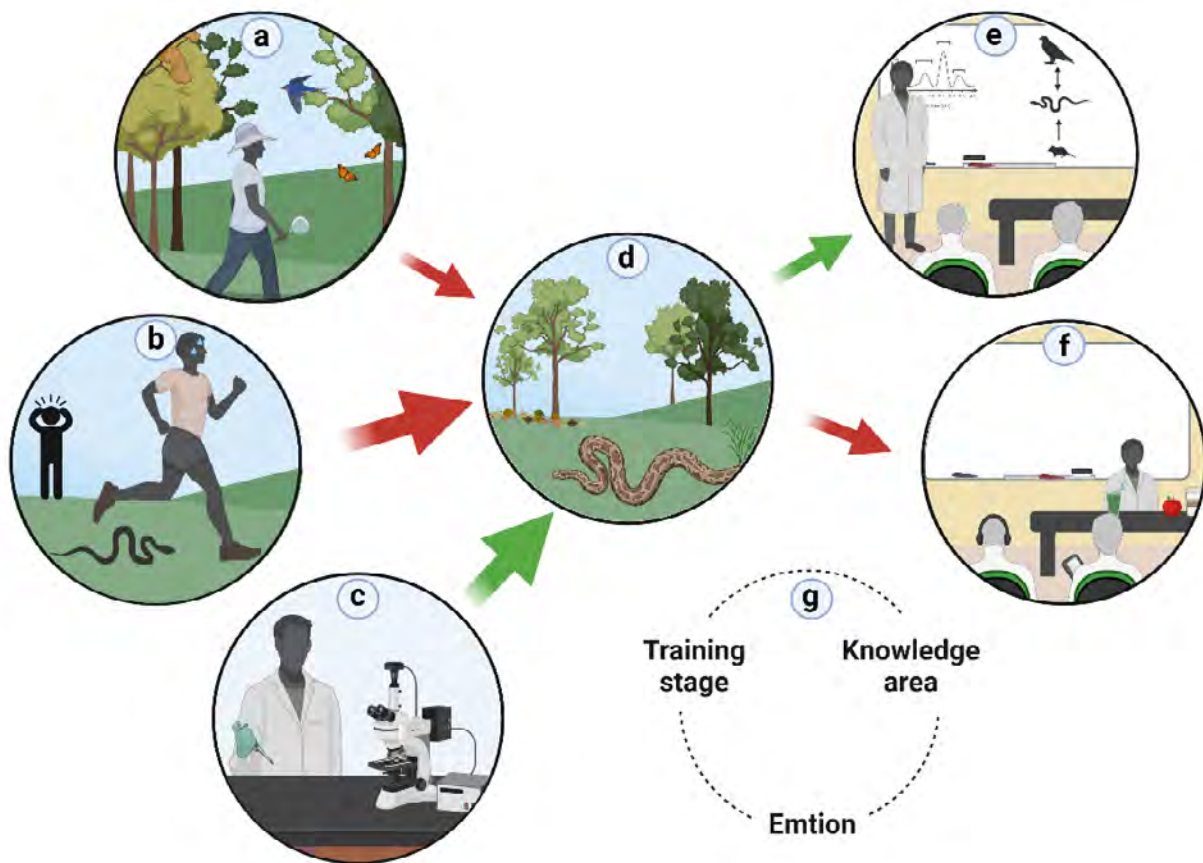


Figure 3. The “fear” of snakes and the values of undergraduate students (a, b, c) can determine how they react to the presence of snakes (d) when acting as teachers (e, f). However, knowledge area, instruction stage (training) and emotion were not associated with this reaction (g). Arrows indicate positive (green) or negative (red) associations when undergraduate students encounter a snake and act as teachers, and the thickness of the arrows indicates the intensity of the interaction. Thus, future teachers categorized as “naturalists” (a) are less probable of acting as teachers (e) than “scientists” (c). Furthermore, the “fear” of snakes (b) may determine that they are also less likely to act this way (f). (Created with BioRender.com).

Source: Authors.

Acknowledgments

The authors would like to thank the Ethics Committee (#30719920.2.0000.0021) for authorization and the UFMS course coordinators for logistical support with student emails. This study was financed in part by the Federal University of Mato Grosso do Sul Foundation – UFMS/MEC – Brazil, Coordination for the Improvement of Higher Education Personnel (CAPES) – Brazil (Finance #001) and GAS master’s scholarship (#88887.687859/2022-00). zo was funded by a postdoctoral talent-attraction contract from the Junta de Andalucía, co-funded with European Commission funds.

References

- Alves, R. R. N., Silva, V. N., Trovão, D. M. B. M., Oliveira, J. V., Mourão, J. S., Dias, T. L. P., Alves, A. G. C., Lucena, R. F. P., Barboza, R. R. D., Montenegro, P. F. G. P., Vieira, W. L. S., & Souto, W. M. S. (2014). Students’ attitudes toward and knowledge about snakes in the semiarid region of Northeastern Brazil. *Journal of Ethnobiology Ethnomedicine*, 10(30), 1-8. <https://doi.org/10.1186/1746-4269-10-30>
- Alves, R. R., & Alves, H. N. (2011). The faunal drug-store: Animal-based remedies used in traditional medicines in Latin America. *Journal of Ethnobiology and Ethnomedicine*, 7(9), 1-43. <https://doi.org/10.1186/1746-4269-7-9>
- Andersson, G., Waara, J., Jonsson, U. L. F., Malmaeus, F., Carlbring, P., & Öst, L. (2013). Internet-based exposure treatment versus one session exposure treatment of snake phobia: a randomized controlled trial. *Cognitive Behaviour Therapy*, 42(4), 284-291. <https://doi.org/10.1080/16506073.2013.844202>
- Araújo, M. L. F & França, T. L. (2013). Concepções de educação ambiental de professores de biologia em formação nas universidades públicas federais do Brasil. *Educar em Revista*, 50, 237-252. <https://doi.org/10.1590/S0104-40602013000400015>
- Ballouard, J-M., Ajtic, R., Balinth, H., Brito, J. C., Crnobrnja-Isailovic, J., Desmots, D., Elmouden, E. H., Erdogan, M., Feriche, M., Pleguezuelos, J.M., Prokop, P., Sanchez, A., Santos, X., Slimani, T., Tomovic, L., Usak, M., Zuffi, M., & Bonnet, X. (2013). Schoolchildren and one of the most unpopular animals: are they ready to protect snakes? *Anthrozoos a Multidisciplinary Journal of the Interactions of People & Animals*, 26(1), 93-109. <https://doi.org/10.2752/175303713X13534238631560>
- Bixler, R. D., & Floyd, M. F. (1997). Nature is scary, disgusting, and uncomfortable. *Environment and Behavior*, 29(4), 443-467. <https://doi.org/10.1177/001391659702900401>
- Clark, W. T., & Kellert, R. S. (1988). Toward a Policy Paradigm of the Wildlife Sciences. *Renewable Resources Journal*, 6, 7-16.
- Cornelis, R., Parkin, T., & Bateman, P. W. (2021). Killing them softly: a review on snake translocation and an Australian case study. *Herpetological Journal*, 31(3), 118-131. <https://doi.org/10.33256/31.3.118131>
- Cosendey, B. N., & Salomão, S. R. (2013). Visões sobre as serpentes: répteis ou monstros? *IX Encontro Nacional de Pesquisa em Educação em Ciências (ENPEC)*, Águas de Lindóia, São Paulo. http://abrapecnet.org.br/atas_enpec/ixenpec/atas/resumos/R0947-1.pdf
- Cosendey, B. N., & Salomão, S. R. (2016). Mídia e educação: Os ofídios por trás das câmeras–répteis ou monstros? *Revista Eletrônica de Educação*, 10(3), 251-265.
- Dinh, H. T., Nishimaru, H., Le, Q. V., Matsumoto, J., Setogawa, T., Maior, R. S., Tomaz, C., Ono T., & Nishijo, H. (2021). Preferential neuronal responses to snakes in the monkey medial prefrontal cortex support an evolutionary origin for ophidiophobia. *Frontiers in Behavioral Neuroscience*, 15(653250). <https://doi.org/10.3389/fnbeh.2021.653250>
- Dodd Jr., C. K. (1987). Status, Conservation and Management. In R. A. Seigel, J. T. Collins, & S. S. Novak (Eds.), *Snakes: Ecology and Evolutionary Biology* (pp. 478–513). McGraw-Hill.
- Fischer, M. L., & Santos, J. Z. (2021). Ethical Conduct with Invertebrate Animals: Routes for Inclusive, Humanitarian, and Sustainable Education. *Current World Environment*, 16(3), 679.
- Fita, D. S., Costa-Neto, E. M., & Schiavetti, A. (2010). 'Offensive' snakes: cultural beliefs and practices related to snakebites in a Brazilian rural settlement. *Journal of Ethnobiology and Ethnomedicine*, 6(13), 1-13. <https://doi.org/10.1186/1746-4269-6-13>
- Fraga, R., Lima, A. P., Prudente, A. L. C., & Magnusson, W. E. (2013). *Guia de cobras da região de Manaus - Amazônia Central*. Instituto Nacional de Pesquisas da Amazônia. <https://ppbio.inpa.gov.br/guias>

- Freire, L. M., & Rodrigues, C. (2020). Formação de professores e educadores ambientais: diálogos generativos para a práxis. *Pesquisa em Educação Ambiental*, 15(1). <https://doi.org/10.18675/2177-580X.2020-14666>
- Freire, P. (1987). *Pedagogia do Oprimido*. Paz e Terra.
- Freire, P. (1996). *Pedagogia da autonomia: saberes necessários à prática educativa*. Paz e Terra.
- Freire, P. (1999). *Pedagogia da autonomia: saberes necessários à prática educativa*. Paz e Terra.
- Freitas, D. C., Gomes, W. P. B. S., Silva, R. C. C., & Seibert, C. S. (2020). Serpentes: é possível conviver com elas? *Revista Brasileira de Ecoturismo*, 13(3), 572-586. <https://doi.org/10.34024/rbecotur.2020.v13.9354>
- Freitas, P. R. S., Silveira, W. L. S., Silva, G. A., Lucena, C. M., & Lucena, R. F. P. (2022). Percepção de estudantes sobre a herpetofauna e implicações para a educação ambiental no sertão da Paraíba, Nordeste do Brasil. *Revista Brasileira de Gestão Ambiental e Sustentabilidade*, 9(23), 1237-1253. [https://doi.org/10.21438/rbgas\(2022\)092308](https://doi.org/10.21438/rbgas(2022)092308)
- Guerra, L., Oliveira, F. V., Candito, V., & Chitolina, M. R. (2020). Atividade didática a partir da temática serpentes: um desafio para a formação inicial de pedagogos. *Revista de Educação, Ciência e Tecnologia*, 9(2), 1-15. <https://doi.org/10.35819/tear.v9.n2.a4344>
- Izard, C. E. (2009). Emotion theory and research: highlights, unanswered questions, and emerging issues. *Annual Review of Psychology*, 60(1), 1-25. www.annualreviews.org
- Jeronimo, B. C. (2013) *A educação ambiental na preservação das serpentes*. [Trabalho de Conclusão de Curso Bacharel em Ciências Biológicas/Instituto de Biociências da Universidade Estadual Paulista]. Repositório Institucional Unesp. <https://repositorio.unesp.br/server/api/core/bitstreams/5d605077-27c8-4eda-9f44-9bb1c0b05d83/content>
- Kellert, S. R. (1994). Public attitudes toward bears and their conservation. *Bears: Their biology and management*, 9, 43-50.
- Kellert, S. R. (2009). A Biocultural basis for an environmental ethic. In S. R. Kellert & J. G. Stephen (Eds). *The coming transformation. Values to sustain human and natural communities* (pp. 21-38). Yale school of forestry & Environmental studies.
- Kellert, S. R., & Berry, J. K. (1980). *Knowledge, affection and basic attitudes toward animals in American society: Phase III*. Washington: US Department of the interior fish and wildlife service.
- Klemens, M. W., & Thorbjarnarson, J. B. (1995). Reptiles as a food resource. *Biodiversity & Conservation*, 4(3), 281-298. <https://doi.org/10.1007/BF00055974>
- Koh, D. C., Armugam, A., & Jeyaseelan, K. (2006). Snake venom components and their applications in biomedicine. *Cellular and Molecular Life Sciences*, 63, 3030-3041. <https://doi.org/10.1007/s00018-006-6315-0>
- Kozel, S. (2018). *Mapas Mentais: dialogismo e representações*. Appris.
- Kusrini, M. D., Palesa, S. P., & Masy'ud, B. (2021). Snake pet ownership in the city: A case study in greater Jakarta, Indonesia. *Biodiversitas Journal of Biological Diversity*, 22(4), 1790-1798. <https://doi.org/10.13057/biodiv/d220424>
- Leite, S. A. S., & Tagliaferro, A. R. (2005). A efetividade na sala de aula: um professor inesquecível. *Psicologia Escolar e Educacional. Psicologia Escolar e Educacional*, 9(2), 247-260. <https://doi.org/10.1590/S1413-85572005000200007>
- Linares-Rosas, M. I., Gomez, B., Aldasoro-Maya, E. M., & Casas, A. (2021). Nahua biocultural richness: na ethnoherpetological perspective. *Journal of Ethnobiology and Ethnomedicine*, 17(33), 1-17. <https://doi.org/10.1186/s13002-021-00460-1>
- Machado, M. C., Frade, C., & Falcão, J. T. R. (2010). Influência de aspectos afetivos na relação entre professor e alunos em sala de aula de matemática. *Bolema*, 23(36), 683-713. <https://www.periodicos.rc.biblioteca.unesp.br/index.php/bolema/article/view/4036>
- Maurice, M. E., Fuashi, N. A., Ebong, E. L., Veronique, M., Mesame, N. L., & Chutame, C. I. (2018). The Investigation of snake-phobia management by the inhabitants of the city of Kumba, Southwest region, Cameroon. *International Journal of Rural Development, Environment and Health Research*, 2(3), 20-30. <https://doi.org/10.22161/ijreh.2.3.3>
- Mendes, B. M. (2018). Estudo da percepção ambiental de estudantes: ferramenta para a conservação de serpentes. *Revista Presença Geográfica*, 5 (1). <https://periodicos.unir.br/index.php/RPGeo/article/view/2640>

- Mills, L. S., Soule, M. E., & Doak, D. F. (1993). The keystone-species concept in ecology and conservation. *BioScience*, 43(4), 219-224. <https://doi.org/10.2307/1312122>
- Ministério da Educação. (2001). *Diretrizes Nacionais Curriculares para os Cursos de Ciências Biológicas*. <http://portal.mec.gov.br/cne/arquivos/pdf/CES1301.pdf>
- Ministério da Educação. (2012). *Diretrizes Curriculares Nacionais para a Educação Ambiental*. http://portal.mec.gov.br/dmdocuments/rcp002_12.pdf
- Moura, M. R., Costa, H. C., São-Pedro, V. A., Fernandes, V. D., & Feio, R. N. (2010). The relationship between people and snakes in eastern Minas Gerais, Southeastern Brazil. *Biota Neotropica*, 10(4), 133-41. <https://doi.org/10.1590/S1676-06032010000400018>
- Öhman, A. (2005). The role of the amygdala in human fear: Automatic detection of threat. *Psychoneuroendocrinology*, 30(10), 953-958. <https://doi.org/10.1016/j.psyneuen.2005.03.019>
- Öhman, A., & Mineka, S. (2003). The malicious serpent: Snakes as a prototypical stimulus for an evolved module of fear. *Current Directions in Psychological Science*, 12(1), 5-9. <https://doi.org/10.1111/1467-8721.01211>
- Oliveira, N. A. (2006). A educação ambiental e a percepção fenomenológica, através de mapas mentais. *Revista Eletrônica do Mestrado em Educação Ambiental*, 16, 32-46. <https://doi.org/10.14295/remea.v16i0.2779>
- Onyishi, I. E., Nwonyi, S. K., Pazda, A., & Pprokop, P. (2021). Attitudes and behaviour toward snakes on the part of Igbo people in southeastern Nigeria. *Science of the Total Environment*, 763(143045), 1-8. <https://doi.org/10.1016/j.scitotenv.2020.143045>
- Pandey, D. P., & Khanal, B. P. (2013). Inclusion of incorrect information on snakebite first aid in school and university teaching materials in Nepal. *Journal of Toxicology and Environmental Health Sciences*, 5(3), 43-51. <https://doi.org/10.5897/JTEHS12.059>
- Pandey, D. P., Chaudary, B., Pandey, G. S., Piya, R. C., & Devkota, N. R. (2020). School students' perceptions on snakes, their uses, and snakebite in Nepal: Implications for snake conservation and snakebite prevention. *Advances in Clinical Toxicology*, 5 (1), 1-21. <https://doi.org/10.23880/act-16000180>
- Parkin, T., Jolly, C. J., De Laive, A., & Von Takach, B. (2020). Snakes on an urban plain: temporal patterns of snake activity and human-snake conflict in Darwin. *Austral Ecology*, 46(3), 449-462. <https://doi.org/10.1111/aec.12990>
- Patlak, M. (2004). From viper's venom to drug design: treating hypertension. *Federation of American Societies for Experimental Biology*, 18(3), 421. <https://doi.org/10.1096/fj.03-1398bkt>
- Pinto-Coelho, D., Martins, M., & Guimarães Junior, P. R. (2021). Network analyses reveal the role of large snakes in connecting feeding guilds in a species-rich Amazonian snake community. *Ecology and Evolution*, 11(11), 6558-6568. <https://doi.org/10.1002/ece3.7508>
- R Core Team (2021). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, <https://www.R-project.org/>
- Ripley, B.; Venables, W.; Ripley, M. B. (2016). *Package 'nnet'*. R package version, vers. 7.3-12. <https://cran.microsoft.com/snapshot/2016-08-05/web/packages/nnet/index.html>
- Sandrin, M. F. N., Puerto, G., & Nardi, R. (2005). Serpentes e acidentes ofídicos: um estudo sobre erros conceituais em livros didáticos. *Investigações em Ensino de Ciências*, 10(3), 281- 298. <https://www.if.ufrgs.br/cref/ojs/index.php/ienci/article/view/508>
- Santos, S. C. S., & Fachín-Terán, A. (2012). Competências e habilidades profissionais para o ensino de zoologia na formação docente de ciências. *Revista Amazônica de Ensino de Ciências*, 5(9), 67-83. <http://periodicos.uea.edu.br/index.php/arete/article/view/48>
- Secco, H., Ratton, P., Castro, E., Lucas, P. S., & Bager, A. (2014). Intentional snake road-kill: a case study using fake snakes on a Brazilian road. *Tropical Conservation Science*, 7(3), 561-571. <https://doi.org/10.1177/194008291400700313>
- Shankar, P. G., Singh, A., Ganesh, S. R., & Whitaker, R. (2013). Factors influencing human hostility to King Cobras (*Ophiophagus hannah*) in the Western Ghats of India. *Hamadryad*, 36(2), 91-100.
- Tozoni-Reis, M. F. C., & Campos, L. M. L. (2014). Educação ambiental escolar, formação humana e formação de professores: articulações necessárias. *Educar em Revista*, (3), 145-162. <https://doi.org/10.1590/0104-4060.38112>

- Tuan, Y. (1983). *Espaço e Lugar: a perspectiva da experiência*. Difel.
- Vasconcelos, S. D., & Lima, K. E. C. (2010). O professor de Biologia em formação: reflexão com base no perfil socioeconômico e perspectivas de licenciandos de uma universidade pública. *Ciência & Educação*, 16(02), 323-340. http://educa.fcc.org.br/scielo.php?pid=S1516-73132010000200004&script=sci_abstract
- Vasconcelos-Neto, L. B., Garcia-da-Silva, A. S., Brito, I. A. S., & Chalkidis, H. M. (2018). O conhecimento tradicional sobre as serpentes em uma comunidade ribeirinha no centro-leste da Amazônia. *Ethnoscintia-Brazilian Journal of Ethnobiology and Ethnoecology*, 3, 1-7. <https://doi.org/10.18542/ethnoscintia.v3i0.10206>
- Vizzoto, L. D. (2003). *Serpentes: Lendas, Mitos, Superstições e Crendices*. Plêiade.
- Wojnowski, D. (2008). *Traditional and Scientific Conceptions of Snakes in Kenya: Alternative Perspectives for Teaching/Tese* [Tese de Doutorado, College and Graduate School of Education, Health, and Human Services, Kent State University]. OhioLINK Electronic Theses and Dissertations Center.
- Yavorski, R., Ribeiro, M. L., & Sossae, F. C. (2021). Análise de temas ambientais desenvolvidos por professores do 1º ao 5º do ensino fundamental em Maringá- PR. *Revista Brasileira Multidisciplinar*, 24(2). <https://doi.org/10.25061/2527-2675/Re-BraM/2021.v24i2.1290>
- Yorek, N. (2009). The only good snake is a dead snake: secondary school students' attitudes toward snakes. *Biotechnology & Biotechnological Equipment*, 23(1), 31-35. <https://doi.org/10.1080/13102818.2009.10818358>

Appendix 1

Questionnaire sent to students:

Imagine that you organized a class or meeting with children or teenagers outdoors in a park, and at some point you come across a boa (which is a non-venomous snake) perched on a fence, what is your reaction towards the students?

- a. Collect all students from the place
- b. Take advantage of the moment to observe the animal
- c. Take the opportunity to explain the animal, capturing
- d. would kill her
- e. Rescue call
- f. I would ignore your presence and follow the class normally
- g. Others

Do you know any legends or myths related to snakes?

- a. Yes
- b. No

What is the influence of this legend or myth on the representation of snakes for you?

- a. Negative
- b. Positive
- c. Did not influence