Teaching zoology in basic education in Brazil: an analysis of bibliographic publications (2010-2020)

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Abstract: The teaching of zoology, although recent in basic education, is questioned methodologically. The main criticisms are that zoology teaching still follows an Aristotelian essentialist view. It is based on traditional expositions in the classroom, and it fragments and decontextualizes contents. All this hinders learning, especially when we are dealing with such a complex area with a wide variety of names and concepts. Thus, through bibliographic research, we seek to identify, analyze, and describe some study trends in Brazil, during the period 2010-2020. We also verify the challenges involved in attaining improvement in pedagogical practices. A total of 197 articles, 32 dissertations, and one thesis were identified. The following descriptors were used: a) type of production; b) temporal distribution; c) geographic distribution; d) institution of origin of the publications; e) levels of education; f) thematic focus; g) type of research. With this, it was possible to describe the main aspects related to the teaching of zoology in basic education in Brazil, providing an insight into the direction of academic productions towards this theme, thus serving as a basis for other investigations.

Keywords: Zoology Teaching. Basic Education. State of the Art.

La enseñanza de la zoología en la educación básica brasileña: un análisis de publicaciones bibliográficas (2010-2020)

Resumen: La enseñanza de la zoología, aunque reciente en la educación básica, tiene sus metodologías bastante cuestionadas, principalmente porque aún sigue la esencia aristotélica, con el uso de metodologías tradicionales, clases exclusivamente expositivas, fragmentación y descontextualización de los contenidos cubiertos, lo que dificulta su aprendizaje, especialmente cuando se trata de un área tan compleja con una amplia variedad de nombres y conceptos. Así, a través de la investigación bibliográfica, buscamos identificar, analizar y describir algunas tendencias de estudio en el período 2010-2020, así como verificar cuáles son los desafíos para lograr la mejora de las prácticas pedagógicas. Se identificaron 197 artículos, 32 disertaciones y una tesis, en las que se utilizaron los siguientes descriptores: a) tipo de producción; b) distribución temporal; c) distribución geográfica; d) institución de origen de las publicaciones; e) niveles de educación; f) enfoques temáticos; g) tipo de investigación. Con esto, fue posible retratar los principales aspectos relacionados con la enseñanza de la zoología en la educación básica brasileña, proporcionando una visión de la dirección de las producciones académicas hacia este tema, sirviendo, así como base para futuras investigaciones.

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Introduction

Education exerts a fundamental role in society, by permitting the individual to develop both intellectually and socially, thus promoting and ensuring his rights to equality of opportunity (CURY, 2002). For Freire (1967), education is a liberating experience. As the individual better comprehends the surrounding reality, he develops a critical conscience, which permits his effective integration into society and the promotion of necessary interventions.

Under this perspective, science teaching is responsible for ensuring scientific literacy, in other words, for developing the capacity of comprehension, interpretation, and transformation of the world, either natural or social. Learning is based on the stimulus to question, to observe, to experiment, to investigate, to plan, and to create (NASCIMENTO; FERNANDES; MENDONÇA, 2010; BRASIL, 2017).

Zoology is one of the areas that make up the teaching of science, being responsible for the study of animals in an evolutionary-ecological context. It encompasses the interaction of Science, Technology, and Society. Its study is primordial for a socioenvironmental perception, particularly for countries like Brazil, which has such a great diversity of species (SEIFFERT-SANTOS; FACHÍN-TERÁN, 2016).

Yet, Amorim (2008), Rocha, Duso and Maestrelli (2013) noticed that the practices
adopted in the teaching of sciences, and, consequently, of zoology, becomes removed from their aims, because they continue to adopt lecture classes, disregarding the previous knowledge of students. Classes thus become centered on an outdated essentialist concept, relying simply on memorization of morphological characters, without establishing any evolutionary or ecological relationships. This promotes a fragmentation of content, making learning more difficult, particularly when we are dealing with such a complex area, having a plethora of names and concepts.

Such difficulties may also be attributed to initial deficiencies in teacher training, to lack of interest in the socialization of scientific knowledge, to lack of didactic resources and technological support, to excessive teaching loads, to lack of depth in the approached concepts, and even to mistakes in the didactic books, among other possible causes (AMORIM, 2008; SEIFFERT-SANTOS; FACHÍN-TERÁN, 2016).

The traditional methods related to the teaching of zoology may reflect its origins. Richter et al. (2017) indicate that the teaching of zoology is historically recent. Zoological studies begun in the 20th century, within natural history, which was marked by a technical outlook and traditional approaches. After 1950, zoology starts to be included in the discipline biology, and new methodological perspectives arise that become incorporated into the curricular systems, such as the recent Base Nacional Comum Curricular (BNCC), sanctioned in 2017.

The BNCC is a normative document that sought to standardize the curriculum across the country, as recommended in the in art. 26 of the Law of Guidelines and Bases of Education (LDB, Law No. 9,394/1996)⁴. The contents related to Zoology are included in Life and Evolution, with teaching characterized to be promoted by curiosity, reasoning, and scientific arguments (BESSA et al., 2018).

However, this new approach is criticized, especially for the rationing and level of detail of zoology contents. These are worked only during the 2nd and 3rd year of elementary school. In this stage the main aspects of zoology cannot be fully addressed due to the age of the children, which will only review these contents again in high school. This is worrying considering the great biodiversity of our country, that must be valued and

⁴ Early childhood education, primary and secondary education curricula must have a common national basis, to be complemented, in each education system and in each school establishment, by a diversified part, required by the regional and local characteristics of society, culture, economy and students (BRASIL, 1996).
preserved, but the propagation and formation of these values becomes limited, whereas first we must better understand organisms and their habitats, information that could be provided by more detailed teaching of zoology (BESSA et al., 2018).

Through a systematic revision of the literature, the present study aimed to identify, analyze, and describe some aspects and tendencies in the teaching of zoology during the period 2010 – 2020. We also attempt to verify which main challenges remain to be overcome in order to improve pedagogical practices in the context of basic education.

One decade may appear to represent a short period. But considering the frequent advances in communication and information technologies, such as communication by satellites, video, audio, multimedia technology, among others, and reflecting upon how these advances reflect on forms of learning in all modalities of teaching, then a period of ten years may in fact represent a period of changes in the educational system (RICHTER et al., 2017).

Garcia (2016) considers that revisionary works contribute to describe tendencies, gaps and limits of research. They also serve as a basis for other types of investigations because they aim to bring a new perspective to existing themes and provide a view about the direction of academic productions.

2 Methodology

This research is based on a qualitative approach of the descriptive analytical type, with a systematic revision of the literature. It accesses the state of the art of the teaching of zoology. According to Romanowski and Ens (2006), the expansion of research in the area of education intensified the interest in the investigation of these productions, in which the state of the art, and the research of a bibliographic nature, aim to map these academic productions and to systematize their main aspects (FERREIRA, 2002).

A research aimed at the state of the art of a certain area should involve the whole area of concern, valuing amplitude in the search for these academic productions. In order to achieve this, it is necessary to include all places generating these researchers, such as periodicals, congresses, seminars, meetings, not restricting research exclusively to abstracts of dissertations and thesis. Otherwise, the study becomes only the state of knowledge (ROMANOWSKI; ENS, 2006).

Data collecting was made exclusively by electronic media. Articles in periodicals,
and presentations in scientific events dealing with the teaching of sciences and biology were analyzed. The Biblioteca Digital Brasileira de Teses e Dissertações (BDTD), that integrates information from approximately 105 research and teaching institutions in Brazil, were also searched.

In our searches we used key-words such as ‘zoology’, ‘teaching of zoology’, ‘science teaching’, and biology teaching’, restricting further inquiry to areas involved in some way to the teaching of zoology applied to basic education during a period of 10 years (2010-2020).

By identifying these documents, it was possible to assemble the obtained information, organizing this information into tables, spreadsheets, and graphs, aiming to facilitate the analysis of their main institutional characters and study tendencies.

Abstracts aid in the categorization process, permitting a previous identification of the themes, issues, scholarly level, research modalities, etc. Original papers were further searched only when the abstracts did not provide all the required information for analysis.

Categorization was one following the model of Teixeira and Megid Neto (2017) in order to distinguish some descriptors: a) type of production; b) spatial distribution; c) geographical distribution; d) institute of origin of publications; e) level of learning; f) thematic focus; g) types of research.

3 Results and discussion

In all 230 works were analyzed, among which 197 articles, 32 dissertations and one thesis from 20 distinct institutions. All these selected research refer to processes of teaching and learning of zoology applied to basic education.

Type of production

Most frequently founded articles correspond to annals of events (about 54%), that is, they refer to papers presented in scientific meetings, congresses, seminars, and symposia, which indicates an expansion of this type of publication and of events that are interested in assembling knowledge related to teaching and learning in the area of zoology.

In table 1, it can be verified that, among the main outlets responsible for these publications, taking into account only those that had more than four in the area of
investigation, Encontro Nacional de Ensino de Biologia (ENEBio), Encontro Regional de Ensino de Biologia (EREBio), Congresso Nacional de Educação (CONEDU), and Encontro Nacional de Pesquisa em Educação em Ciência (ENPEC) stand out.

According to Mello (1996), publications in annals of scientific events are considered very efficient in the dissemination of scientific knowledge due to the rapidity in the disclosure of these results. On the other hand, their quality has been sometimes questioned, particularly for the absence of peer review, for the restricted availability of the published material, for the restricted geographical range of studies, and for the published information often being outdated.

With the development of new technologies, the publications in meeting annals were able to overcome these limitations, becoming more and more accessible. Those available in electronic media now predominate, ensuring universal access to information. There is also more and more concern for their quality, attained by rigorous norms of submission, and further being processed by peer-review before being published.

Table 1: Main sources generating academic production on the teaching of zoology in basic education

| Type of production            | Place of publication                                      | Analyzed productions |
|-------------------------------|-----------------------------------------------------------|----------------------|
| **Academic articles**         |                                                           |                      |
|                               | *Brazilian Journal of Development                         | 6                    |
|                               | *Revista Experiências em Ensino de Ciências               | 5                    |
| Other publications in journals in the field of science |                                                           | 42                   |
| Other publications in journals in the interdisciplinary area |                                                           | 38                   |
| *Revista da SBEnBio (ENEBio & EREBIO) |                                                           | 31                   |
| **Papers in scientific events** |                                                           |                      |
|                               | *CONEDU                                                   | 21                   |
|                               | *ENPEC                                                    | 10                   |
| Other publications at events in the field of science |                                                           | 30                   |
| Other publications at events in the interdisciplinary area |                                                           | 14                   |

* Journals or events that presented a higher concentration of the analyzed publications

Source: Data from this research

It should be stressed that many of these papers were conducted by undergraduates, which indicates an initial immersion in academic research. As noted by Pereira et al. (2016), research activity by undergraduates awakens interest in the development of projects that expand their knowledge, stimulating creativity, autonomy,
and providing practical experience necessary for their professional development, another factor that can be considered is that these students have been looking for technical rationality present in science education.

It thus becomes essential that universities maintain programs that integrate teaching, research, and extension activities, with the aim of enhancing the quality of courses aiming at the output of teachers, and to stimulate the formation of the research teacher, that constantly strives to investigate and to reflect about his pedagogical practice, making research an inseparable part of his work (MELO; LYRA, 2020).

Some Brazilian government programs, such as the Programa Institucional de Bolsas de Iniciação à Docência (PIBID), Programa de Licenciaturas (PROLICEN), Programa de Bolsas de Extensão (PROBEX), and more recently Residência Pedagógica, aid in this process of active participation of teacher courses in institutions of basic teaching in the public network.

On the other hand, few papers were produced by active teachers in basic education, because, despite all the incentive to the research teacher, they must often deal with some adversities. Maia, Fonseca and Silva (2014) attribute this situation to lack of theoretical and methodological support, lack of structural, administrative and pedagogical aid, and even to a certain teaching overload for basic level teachers.

We also observed a smaller number of dissertations in comparison with the number of articles. This occurs because dissertations are more complex, that demand a more complex theoretical foundation, and a longer period of time for their conclusion.

Thesis works in the theme under focus were scarce. Salem (2012) believes that this situation is due mainly to the difficulty in continuing research at the levels of Master of Science and Ph.D. levels, to lack of interest in the existing problems, or to lack of perspectives to follow an academic career with under this specialty.

**Temporal distribution**

A continuous increase in the papers about zoology teaching in basic education is notable along the last 10 years, as observed in Figure 1. These works (in periodicals and events) stand out quantitatively. Miranda, Carvalho and Costa (2018) stress that articles contribute with information that subsidizes fundamental discussions for scientific and technological advance, because of their quick spreading.
Dissertations fluctuated somewhat in number of annual publications, which may be related to the time dedicated to the development of projects and to the time required for registration of these projects in the data bank of CAPES. The highest number of dissertations was recorded for 2016, while only one was recorded for 2019.

According to Salem (2012), up to the end of the year 2000 the annual distribution of the thesis was superior to that of dissertations, while this pattern was inverted in 2009 as a result to the increase in the number of new graduation courses. Alternatively, this result may also indicate a stagnation in academic development, considering that most Masters in Science do not continue in the teacher/research career, due either to lack of investment in the area under focus, due to the reduction in the available number of scholarships, or even due to the absence of graduate programs in the area of interest of this research.

Teixeira and Megid Neto (2017) stress that the use of the BDTD as a source for thesis and dissertations is quite valid, but it is necessary to note that the updating of the data bank is quite irregular. The present study thus includes a significant number of these productions, but this does not guarantee that all the graduation titles obtained during the last decade have been recorded for the benefit of this research.

Concurrently to recording the ascension of scientific research in Brazil, it is inevitable to reflect upon the quality of these productions. The investment in this research implies in the responsibility of returning results with viable applications, aiming at an impact not only in the academic community, but also for society (BARATA, 2015; CRUZ; SOARES; HAGUENAUER, 2015; TRENTIN; ROCHA; SILVA, 2018).
Geographical distribution

Northeastern Brazil stands out with the production of most articles (37%), followed by Southeast Brazil (24%), Southern Brazil (19%), Northern Brazil (13%), and finally by the Midwest Region (8%), as illustrated in Table 2. According to Richter et al. (2017), the mapping of regions permits us to identify where the teaching of zoology is being most discussed in the scientific community.

Regarding dissertations, a certain disparity was observed when the Midwest Region (28%) is compared to the Southern (16%) and Northern Region (3%). These results are contrary to those obtained by Salem (2012) and Teixeira and Megid Neto (2017), who found an academic production centered in the South-Eastern axis regarding the teaching of sciences and biology.

Table 2: Distribution in the production in Zoology Teaching in Basic Education by Brazilian Region (2010–2020)

| Region     | Articles | Dissertations | Thesis | %   |
|------------|----------|---------------|--------|-----|
| Northeast  | 73       | 9             | 0      | 36% |
| Southeast  | 47       | 8             | 1      | 25% |
| South      | 37       | 5             | 0      | 18% |
| North      | 25       | 1             | 0      | 11% |
| Midwest    | 15       | 9             | 0      | 10% |
| Total      | 197      | 32            | 1      | 100%|

Source: Data from this research

Universidade de Brasília (UnB) presented a greater concentration in the number of dissertations, followed by Universidade Estadual do Sudoeste da Bahia (Uesb). The production of articles at Universidade Federal de Pernambuco (UFPE) and Universidade Federal do Rio Grande do Norte (UFRN) were outstanding.

This movement to decentralize the academic production is expected, as it reflects investments along the last decade in the North, Northeast, and Midwest Regions. Such public policies aiming at the creation of Institutions of Higher Education (IHE), and the financial support of research produced in the new graduation programs, have in fact contributed to increase the representativity of these regions (CAPES, 2017; NAZARENO; HERBETTA, 2019).
Institutions originating publications

Authors of the investigated papers belong predominantly to the Public Higher Institutions (Figure 2), a fact that enhances the importance of public universities for the training of Brazilian researchers. As many as 64,2% of authors are from Federal Universities or Federal Institutes, followed by State Universities (29,3%) and some private institutions (6,5%).

According to a research by CAPES (2017), an institution responsible for the approval, evaluation and financing of graduation courses, between 2011 e 2016, circa 99% of Brazilian scientific productions originate in public institutions, with emphasis on the Federal Universities, which detain about 61,8% of the scholarships.

Figure 2: Distribution of publications in zoology teaching in basic education according to institutional filiation (2010–2020)

A few private universities have created research groups, but their main objective is to obtain profits and consider that research demands great investments. These institutions end by depending on the influence of public planning for their management, an unattractive prospect (DURHAM, 1998).

Level of teaching

Actions developed in the articles prioritize the High-School (37%) and the Fundamental Level5 (33%). Some papers included both teaching levels (27%), few

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5 The teaching levels described refer to the stages (series) of Basic Education addressed in the analyzed publications, which include Elementary School (6th to 9th), High School (1st to 3rd), and the EJA modality and Special Education that run through all stages of education.
dealing with the teaching of young and adults (EYA) or inclusive education (1%), as shown in Figure 3.

According to Teixeira and Megid Neto (2017), preference for the High-School occurs due to the themes related to Science, Technology, and Society (STS), including environmental issues, biotechnological matters, subjects on evolutionary biology, ethics, among others, that ends by attracting researchers.

Regarding the number of papers directed at EYA and inclusive education, particularly when taking into account the peculiarities needed by these modalities, it becomes necessary to revert the results indicated in the table, stimulating research that contemplates these types of teaching.

Figure 3: Distribution of levels of teaching addressed in the publications on the Teaching of Zoology in Basic Education (2010-2020)

![Bar chart showing the distribution of levels of teaching addressed in the publications on the Teaching of Zoology in Basic Education (2010-2020).]

Middle Level (ML); Fundamental Level (FL); Middle and Fundamental Level (M/FL); Education of Young and adults (EYA); Inclusive Education (IE). Source: Data from this research.

Thematic foci

The thematic focus of each paper was identified based on the aims and methods of the papers. Articles and dissertations have differentiated approaches as their main focus, while the thesis presented the formation and training of the teacher.

These thematic axes are classified as belonging to the process of teaching and learning, while they deal with different aspects of cognitive, social, and emotional development, such as the elaboration of didactic models, teaching by investigation and/or experimentation, works in groups, didactic sequences, practical activities, relationships content/method, description of alternative methods, and evaluation of pedagogical practices (Teixeira and Megid Neto, 2017).

The analysis of the distribution of research among the thematic foci demonstrates
that the aims of the papers and their treatment on the processes of teaching and learning in zoology in basic education are diverse. The main tendencies are nevertheless put into evidence (Table 3).

Table 3: Distribution of thematic foci approached in the publications on the Teaching of Zoology in Basic Education (2010-2020)

| Thematic focus | Articles | Dissertations | Thesis |
|----------------|----------|---------------|--------|
| DA             | 52       | 13            | 0      |
| EDM            | 41       | 2             | 0      |
| DE             | 35       | 1             | 0      |
| TLC            | 35       | 8             | 0      |
| DB             | 21       | 3             | 0      |
| TFT            | 8        | 3             | 1      |
| ES             | 5        | 2             | 0      |

Differentiated Approach (DA); Elaboration of Didactic Material (EDM); Didactic Experience (DE); Teacher and Learner conception (TLC); Didactic Book (DB); Teacher Formation and Training (TFT); Etnozoological Study (ES). Source: Data from present research.

The concern with making the process of teaching/learning more dynamic is notorious. There is a search for innovative methods aiming to provide the teaching of zoology within an evolutionary context. Towards this aim, didactic sequences, parodies, evocation of pop stars, presentation of design in an evolutionary context, and visits to non-formal learning environments, are proposed.

Several researches discuss the relevance of non-formal educational environments, characterizing their historical roots, political dimensions, and practical aspects, as a means of helping the process of teaching/learning. Recommended activities are excursions to zoos, field classes (reef ecosystem, for example), visits to museums, practical classes, and visits to zoological collections in universities.

The research involving the production of didactic material is characterized by the construction of tridimensional models of organisms, elaboration of parodies, models of animal traps, multimedia material, software, or precepts of phylogenetic systematics.

The insertion of technological resources for the teaching of zoology is an interesting subject, for such digital tools are already a part of the everyday experience of the learners. When used adequately, they may contribute to the educational process by linking curricular contents with technological language (DANHÃO et al., 2019).

The focus on didactic experiences refers to interventive actions, as the main
objective of the work. Themes were: phylogenetic systematics, pedagogic workshops, evolutionary zoology, experience accounts during training, and ludic educational practices.

According to Moul, Moura and Araújo (2020), the observed necessity to include an evolutionary perspective in zoology is supported by the work of Hennig, titled Phylogenetic Systematics. This work represents a systemic view of systematics, and represents a paradigmatic shift from our tradition classificatory views derived from an Aristotelian essentialistic world view to a modern systemic view based on transformism.

Other studies diagnose the concepts of teachers regarding the teaching of zoology, aiming to draw a profile for teaching on the basis of the planning of other pedagogical practices, on the conditions of didactic material, and on the consistency of the contents of the adopted didactic materials and contents. On the other hand, the learners try to obtain a diagnosis of the diverse aspects that guide learning in zoology, starting with previous knowledge, and including representations and perceptions of learners.

The analysis of the zoological content in didactic books was another point approached by 24 papers. This aspect becomes essential for the teaching/learning process, as the book often represents the only resource available to teachers for preparing their lectures. Research in etnozoology and training of the teaching capacity is reduced, indicating the necessity of more focus on these themes.

Types of Research

Action-research, together with descriptive research, were the most common types of research on the analyzed papers (Figure 4). Contrasting with research that is limited to describing facts without interference, action-research involves the active participation of the researcher in interventions aiming to solve some of the difficulties encountered. Teixeira and Megid Neto (2017) justify the frequency of papers of this type invoking the concern of the researcher to validate their results.

Several researchers criticize action-research for its being often restricted to simple descriptions of experiences or to evaluations of results, without establishing a real compromise with the identified problem and without searching for changes in attitudes, situations, and conditions (CHISTÉ, 2016).
Bibliographic research is defined as the analysis of secondary data, such as books, articles, journals, among others. Garcia (2016) is of the opinion that bibliographic research helps researchers discuss ideologies, and to analyze progressive collaborations on a particular subject.

There is a smaller percentage of ethnographical research. This type of research aims to identify the main social perceptions and representations about a certain group on a specific theme. The researcher describes his observations, without interference on the results.

Figure 4: Distribution of the types of research addressed in publications on the Teaching of Zoology in Basic Education (2010-2020)

4 Final Considerations

This analysis of publications permitted us to obtain a panorama on the main aspects that guide research on the Teaching of Zoology in Basic Research during the last 10 years. Important factors were indicated that stimulate a discussion of their challenges and perspectives.

Most analyzed articles were published in annals of scientific events, demonstrating the relevance of this type of publication for the disclosure of new knowledge. It is notwithstanding necessary to verify the quality of these papers, to evaluate their academic and social impacts, beyond simply accounting the filling of existing gaps in our knowledge.

Regarding thesis, the percentage indicates that Master of Science projects need to be continued in Ph.D. programs, in order to receive more in-depth attention.
Another relevant observation refers to the advancement of studies in the North, Northeast, and Midwest Regions, expressing decentralization of research among regions, and which reflects the creation of new Graduate Programs.

The preponderant role of public institutions in the development of research is also stressed.

Regarding the main themes and types of research, it becomes perceptible that a notable expansion of these research is linked to the necessity of perfecting the process of teaching/learning. There is a search for innovative and practical methods, for using differentiated didactic resources, to visit less-formal environments of learning, to evaluate didactic books, and to evaluate the teacher practice aiming to increase the quality of formation and training courses.

One of the challenges that the papers try to overcome is the development of methods that rely on the contextualization of information, with a focus on evolution or ecology. It is important to evaluate the previous knowledge of students, and to understand how this knowledge influences the process of learning, culminating in the elaboration of more refined and elaborated knowledge.

On the basis of the analyzed data, one may conclude that practices related to the Teaching of Zoology need to be constantly thought through and investigated, in order to develop methodological proposals that constantly approach us to the true meaning of teaching and learning in zoology. The act of learning must become something pleasurable and that awakens our need to search for scientific knowledge.

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