GEODIVERSITY: PRE-SERVICE TEACHERS' KNOWLEDGE AND PERCEPTION OF ITS IMPORTANCE

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Abstract

The nonbiotic world has received less attention from the conservationists than the living world. Consequently, the formulation of concepts centred on the nonbiotic world seems to have emerged as a necessity. Thus, the term "geodiversity" began to be used in the 1990s to describe the existing variety within inanimate nature expressed in different scales. Geoconservation also became an important dimension of conservationism, especially due to the UNESCO Geoparks Programme, which started in 1997. A Geopark is a territorial area that has relevant geological heritage, usually spread over several geosites with scientific, educational, cultural, aesthetic and economic value.

Since the concepts in discussion are more recent than those related to biodiversity, the importance given by pre-service teachers about geodiversity and geoconservation remains uncertain. Thus, this study aims: 1) to identify pre-service teachers' knowledge about geodiversity and geoparks, based on the definition of these concepts; 2) to check how they value geodiversity, sometimes in confrontation with biodiversity value.

The study involved 84 pre-service teachers (75 – 89.3% female), age average 24.4, from an higher education institution, attending primary education training courses. A questionnaire was designed and included the following questions: 1. What is geodiversity?; 2. What is a Geopark? Give two examples of geoparks in Portugal; 3. What is your degree of agreement with several statements (presented in the results) related to geodiversity and biodiversity, using the scale from 1- Strongly Disagree to 5 – Totally Agree. Descriptive statistics was used to show the results. The questions that asked for a definition were classified as i) correct; ii) partially correct; iii) incorrect, given a complete definition.

Concerning the results, the concept of geodiversity was only defined correctly by five students, showing a large majority an incomplete idea of the concept. The incorrect answers were given by 8 participants, normally confounding geodiversity with biodiversity. The Geopark definition was presented correctly by almost half of the participants (41). Even so, none of the respondents associated the geological aspects with other features of nature, an aspect included in the definition of geopark proposed by the UNESCO. Half of the participants gave at least an example of a Portuguese geopark; the other half did not answer or gave wrong examples.

Finally, the majority of participants tended to value geodiversity. Only the beauty of landscapes with geodiversity received a wider range of opinions, perhaps due to their lack of contact with the geological world or to a kind of blindness concerning the abiotic world, hypotheses that need confirmation. Even so, they rejected the idea that the non-living world is less important than the living world or that is less important to preserve geodiversity comparing to biodiversity. They also agreed that geodiversity is essential for biodiversity, since it is responsible for the creation of different habitats, contributing to increase biodiversity.

Based on the results, it is considered relevant that the present issue can be deepened in the context of teacher training courses, without missing the inclusion of formal outdoor activities in geoparks. Since research dealing with the present issue is not frequent, we hope that the present exploratory study may help to develop interest on this educational issue in other countries.

Keywords: Geodiversity, geoparks, pre-service teachers, education.

1 INTRODUCTION

The nonbiotic world has received less attention from conservationists than the living world ([1] Almeida, 2020). Consequently, concern for biodiversity became widespread, although the concept is often interpreted in a restrictive way, since it includes not only the diversity of species and the genetic diversity

within the same species, but also the diversity of ecosystems and the richness of physical and chemical processes that allow life ([2] Miller & Spoolman, 2021). Consequently, in the field of Environmental Ethics, concern for the nonbiotic world is not a dominant concern, maybe because Life, and especially the mutilation of animals' welfare, frequently receives more attention, because of much better-known theories such as those of [3] Singer (2000) and [4] Regan (1983). Even so, [5] Rolston III (1994) is one of the few authors who highlight the importance of the nonbiotic world, and emphasizes the relevant particularities it contains, as symmetry, harmony, grace, space-time unity and continuity. For this reason, crystals, volcanoes, geysers, rivers, fountains, lakes, canyons, caves, are all examples of creative nature projects and should be valued, since they are products generated by the system in its formative processes.

However, as a result of a greater attention to biodiversity and bioconservation, the formulation of concepts centred on the nonbiotic world seems to have emerged more recently as a necessity. Hence, according to [6] Gray (2004), the term "geodiversity" has begun to be used in geosciences in the 1990s to describe the existing variety within inanimate nature expressed in different scales. [7] Brilha (2005) defines geodiversity as "the variety of geological environments, phenomena and active processes that give rise to landscapes, rocks, minerals, fossils, soils and other superficial deposits that are the support for life on Earth" (p. 17). With this new focus, the interest and the need to promote geoconservation has increased, especially because most geologists until the end of the 20th century dedicated their careers to extractive industries, which profoundly mutilate geodiversity ([8] Blatt, 1997). [9] Pemberton (2007) also proposes a similar idea, stating that most geologists work in extractive industries, while a large proportion of biologists carry out activities related to the preservation of biodiversity. But in the present century we have seen some change in this way of thinking with the emergence of the field of geoethics. According to [10] Peppoloni & Di Capua (2015), the term joins the prefix "geo" to the word "ethics", and means a concern and reflection about the human activities with impact in the geosphere, aiming to encourage the sustainable use of natural resources, to promote a careful management of natural risks and a correct dissemination of the results of scientific studies. It also aims to create a great awareness of the geological heritage and geodiversity of a region, especially through the promotion of geoeducation ([11] Brocx & Semeniuk, 2007).

Even so, [6] Gray (2004) states that this ethical concern of the preservation of geological heritage is not recent and exemplifies with two examples occurred in the 19th century: Siebengebirge in Germany, in 1836, and the Yellowstone National Park in the United States, in 1872. But this same author argues that geoconservation is still not a main aim in the field of conservationism. Even so, according to [12] Jones (2008), the support by UNESCO Geoparks Programme, which started in 1997, has been responsible for a continuous designation of Geoparks in different parts of the world, increasing precisely the awareness for the importance of the geological heritage and geodiversity. This process has started with a Global Network of National Geoparks from different European countries and China and has encouraged other countries to also develop Geoparks programmes.

According to [13] UNESCO (2024), UNESCO Global Geoparks are single and unified geographical areas which contain different sites and landscapes with geological relevance, and are managed in an integrated way, to promote preservation, education and sustainable development. Geoparks also use geological heritage to promote and highlight other natural and cultural values, helping to deepen awareness for a more sustainable use of the earth's resources and to mitigate climate changes and reduce natural hazard-related risks. The recognition by UNESCO of a Geopark could be seen as a way to promote a sense of place for the populations, opening up a range of opportunities for the development of a region at an educational, environmental, cultural, scientific, social and economic level, through the creation of jobs, and the development of sustainable geotourism. Still according to [9] UNESCO (2024), there were 213 Geoparks in 48 countries by March of the present year.

In Portugal, between 2006 and 2024, six areas were classified as Geoparks and a few more proposes are being prepared to be approved by UNESCO. Till now, the list includes the following areas with the data of their approval by the UNESCO ([14] ICNF, n.d): Geopark Naturtejo (2006), Arouca Geopark (2009), Geopark Terras de Cavaleiros (2014), Azores Geopark (2015), Estrela Geopark (2010) and more recently Oeste Geopark (2024). This is an impressive number considering the territorial dimension of Portugal, but it helps to recognize the importance of the natural and cultural heritage that exists in this country.

1.1 The present study

The concept of geodiversity is clearly more recent than the concept of biodiversity. And although geoparks offer educational programs to schools and promote many activities for the public in general, their impact on students about the importance of geoconservation remains uncertain. Furthermore, it is unknown whether students know about the existence of these areas recognized by UNESCO and the foundations that underlie them.

Thus, the present study has the following aims: 1) to identify pre-service teachers' knowledge about geodiversity and geoparks, based on the definition of these concepts; 2) to check how they value geodiversity, sometimes in confrontation with biodiversity value.

2 METHODOLOGY

The present study can be considered an exploratory one, as it seeks to collect data on a little explored issue in educational research. It involved 84 pre-service teachers (75 – 89.3% female), age average 24.4 from a Portuguese higher education institution. The students were attending primary education training courses, and have in their curricular plan a few Science units, with geological contents being approached in only one. Even so, geological content is part of the primary school Portuguese curriculum, as well as nature preservation but only with a focus in nature parks.

A questionnaire was designed and included the following questions:

1 Based on the image and your knowledge, what does geodiversity mean?

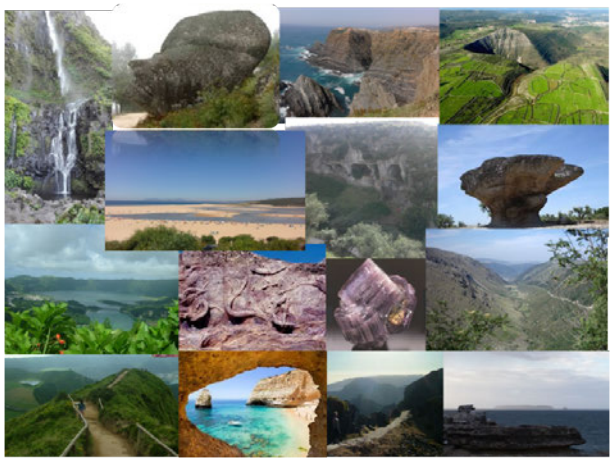

Figure 1. The image was included to help the participants to better define the concept of geodiversity, based on the perception that this concept could be less known if compared with the concept of biodiversity.

2 What is a Geopark? Please give two examples of geoparks in Portugal.

3 What is your degree of agreement with each of the following eight statements, using a scale from 1- Strongly Disagree to 5 – Totally Agree.

These statements are presented in the discussion section and assess students' opinions about the importance of geodiversity and biodiversity, sometimes confronting both concepts. Before the presentation of these statements, an operational and synthetic definition of geodiversity and biodiversity was included to ensure that the opinion expressed was not affected by a misunderstanding of the concepts.

The questionnaire was validated by two experts in Didactics of Science, and they considered it suitable for the aims presented. The questionnaire was also piloted in five students not included in the final sample and no problems of understanding were detected. This pilot process also allowed to check the time needed for the administration of the questionnaire, which was 20 minutes. The questionnaire was available in Google forms and the link was sent to all the students having classes in the same day. Only those who gave their informed consent were included in the sample.

Descriptive statistics was used to show the results, namely absolute and relative frequencies of the different items considered. The questions asking for a concept definition were classified as i) correct; ii) partially correct; iii) incorrect. In the results section a few examples of answers are presented. In the case of geodiversity, it is important to state that the answers considered correct should include a reference to geological environments, processes and elements. In the case of Geoparks, an answer, to be considered correct, should highlight the importance of the geological heritage in relation with other natural and cultural values. The classification of the answers was made by each researcher separately and compared later. Differences were discussed to obtain a consensus between the research team. The interrater agreement Fleiss Kappa was 0.89, which means an almost perfect agreement. This value is also relevant, since one of the researchers is not directly related to geoscience education.

3 RESULTS

The results concerning the two first questions of the questionnaire are included in Table 1.

Table 1. Correction of the definitions of geodiversity, geopark and examples of these parks given by the participants.

Concepts	*Correct*	*Partially Correct*	*Incorrect*	*No answer/ Redundant*
Geodiversity	5 (6%)	64 (76.2%)	9 (10.7%)	6 (7.1%)
Geopark	41[1] (48.8%)	23 (27.4%)	5 (6%)	15 (17.9%)
Two examples of Geoparks	22 (26.2%)	20 (23.8%)	5 (6%)	37 (44%)

Note: In fact, the definition was not totally correct, since the articulation of the geological heritage with other natural and cultural values was not totally expressed. Even so, all the answers considered in this column were more closely related to the intended definition.

The concept of geodiversity was only defined by five students in a more complete way. Examples of these responses were: “All earth processes giving rise to abiotic elements” and “The variety of geological elements and processes”. But a large majority only showed to have an incomplete idea, mentioning elements of geodiversity as the different types of rocks, landscapes or soils. Some examples of these types of answers are: ”It is the diversity of rocks”; “It is the diversity of geological places as beaches, mountains and volcanic structures”; or “It includes different types of soils”. The incorrect answers were given by 8 participants, considering geodiversity the geological resources, earth diversity or associating it with biodiversity, e.g., “Variety of elements that compose the fauna and flora”. A few others did not answer, or gave redundant answers, e.g., “It is the geological diversity”, certainly based on the decomposition of the term in two parts: “geo” and “diversity”.

A geopark definition was presented more correctly by almost half of the participants (41), e. g., “A park where geodiversity is preserved, and which can be enjoyed by humans “; “A protected area where the biotic elements are also preserved”. Even so, none of the respondents associated the geological aspects with other aspects of nature and with cultural aspects simultaneously. The answers that were considered partially correct focused only on geological features, e.g., “A place with geological elements” or “Where different types of rocks can be found“. Also 15 participants did not answer or gave redundant answers. Half of the participants gave at least an example of a Portuguese geopark; the other half did not answer the question or gave wrong examples, e.g., stating national or nature parks and other places rich in biodiversity.

After having access to a definition of biodiversity and geodiversity, the majority of participants tended to value geodiversity, as it is showed in the values obtained for each statement using a Likert scale. Therefore, they tended to disagree with the lesser importance of the non-living world and the lesser importance of its preservation when compared to life. They also agreed that the non-living world is essential of livings beings creating different habitats, which allow more biodiversity. They also tended to agree that geodiversity is essential to better understand the history of the Earth. Only the beauty of landscapes with geodiversity received a wider range of opinions (Table 2). This aspect is curious and deserves more research, since it can be related to a less interest and motivation to study earth sciences.

*Table 2. Degree of agreement of the participants about the importance of geodiversity, when compared with some statements about biodiversity. A Likert scale was used from **1- Strongly Disagree to 5 – Totally Agree** and the absolute and relative (%) frequencies for each item are included.*

	1	*2*	*3*	*4*	*5*	*Average*	*Median*
1. The non-living world is less important than living beings.	40 (47.6)	21 (25.0)	12 (14.3)	9 (10.7)	2 (2.49)	1.95	2
2. Landscapes with biodiversity are usually more beautiful than those with geodiversity.	20 (23.8)	20 (23.8)	22 (26.2)	15 (17.9)	7 (8.3)	2.63	3
3. Without the non-living world, living beings would not exist.	2 (2.4)	1 (1.2)	6 (7.1)	20 (23.8)	55 (65.5)	4.48	5
4. Geodiversity allows for the existence of habitats for living beings.	-	-	4 (4.8)	10 (11.9)	70 (83.3)	4.78	5
5. The preservation of geodiversity is less important than the preservation of biodiversity.	52 (61.9)	17 (20.2)	9 (10.7)	6 (7.1)	-	1.63	1
6. Geodiversity allows a better understanding of the Earth's past.	-	-	5 (6.0)	11 (13.1)	68 (81.0)	4.75	5
7. Greater geodiversity contributes to greater biodiversity.	-	-	9 (10.7)	16 (19.0)	59 (70.2)	4.59	5
8. Certain landscapes with geodiversity are monuments that must be preserved.	-	-	4 (4.8)	11 (13.1)	69 (82.1)	4.77	5

4 CONCLUSIONS

Most of the pre-service teachers inquired have a partial idea of the concept of geodiversity. The concept of geopark was defined correctly by half of the respondents, showing more difficulty in giving examples. Even so, and due to the type of answers, several respondents seem to define the concepts by decomposing the words rather than by a deep knowledge of the issue. The difficulty in giving examples of geoparks can also be related to a lack of visitation of these areas. Perhaps students' difficulties in highlighting the aesthetic value of landscapes rich in geodiversity was the result of this lack of contact, although they recognized its importance as a support for biodiversity or a way to understand the Earth's past.

Thus, it is considered relevant that the present issue can be deepened in the context of teacher training courses, without missing the inclusion of formal outdoor activities in geoparks. Since research dealing with the present issue is not frequent, comparisons with studies from other countries were not included. But given that geodiversity and geoconservation have gained greater attention in the last two decades, it is hoped that the present study may help to develop interest on this educational issue in other countries.

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