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Geoheritage and Geodiversity Education in Romania: Formal and Non-Formal Analysis Based on Questionnaires

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Abstract: This paper aims to present how education for geoheritage and geodiversity should take place both in the school curriculum and in extracurricular activities at all levels of Romanian education (middle school, high school and university). The research method consisted in applying two questionnaires (10 questions, most with answers to choose from) both to pre-university teachers (especially those in geography) and students/graduates (especially from geography faculties in the country). The obtained results demonstrate the existence of two different visions: for middle and high school education, education on geoheritage and geodiversity takes place sometimes formally (based on curriculum hours according to the school's decision) but predominantly informally (based on practical field applications), with most schools educationally limited in terms of environment/sustainable development; in contrast, university education on these subjects has a formal character (based on dedicated courses or field practice modules). The results, although encouraging for the moment, show that there is a need to intensify awareness and education on geoheritage and geodiversity at all levels, especially in higher education, by introducing specific courses/content at all universities in the country.

Keywords: geoheritage; geodiversity; geoeducation; Romania

1. Introduction

In most scientific papers, geological heritage is considered to be composed of all geosites in an area, while the geomorphological heritage is the set of geomorphosites [1]. Geoheritage is also related to cultural heritage, in which links are established over time between human society and relief [1–5]. Its educational component is highlighted by the relationship between geoheritage and the biological or cultural–historical elements of the respective space [6]. In the scientific literature on the inventory and evaluation of geoheritage, there are numerous and varied methods, differing depending on their purpose [7–20]. Geodiversity represents the totality of geological, geomorphological, pedological and hydrogeological elements in a certain area [21,22] or the connection between people, landscape and culture [23,24]. A more nuanced definition is formulated by [25], who defines geodiversity as “the critical and specific assessment of the geomorphological characteristics of a territory, comparing them in an intrinsic and extrinsic way, taking into account the scale of investigation, purpose and scientific level of research” [26]. The purpose and scientific level of the research takes into account the educational component of geodiversity. The theoretical framework and evaluation methodologies have evolved over time [27–29]. Thus, the assessment of geodiversity must take into account the following types of values: intrinsic, cultural, aesthetic, economic, education and research, and support for the functioning of the geosystem [27,30]. The value for education and research has special importance, and it must be the basis of a specific form of seducation, namely geoeducation.

According to [31], geodiversity can be used by the scientific community (geoscientists, social scientists) and for educational purposes (formal or informal) to provide students and society with knowledge about changes that occur over time in Earth's geospheres.

In the international literature, the concept of geoeducation [32–35] refers to education about the Earth as a whole to provide an understanding of how the natural and human components of the geographic environment function and interact locally, regionally and globally [36]. Geoeducation involves learning both in and out of school (Figure 1). In school, geoeducation takes place in several subjects of the traditional national curriculum, and out of school, it takes place through guided experiences (field trips, projects, visits) both in the natural and in the anthropized environment.

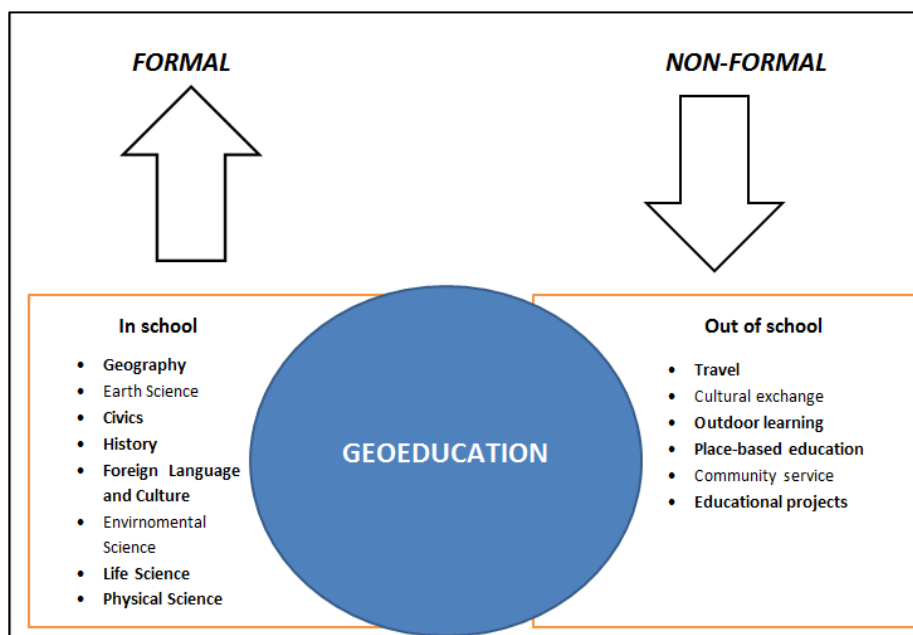


Figure 1. Geoeducation—formal and non-formal components (according to [36] with modifications and additions) (with bold elements specific to Romania).

In Romania, the concept of geoeducation was introduced simultaneously with those related to geomorphosites, geotourism, geodiversity and geoheritage. The vision related to geoeducation is synonymous with environmental education, especially for earth-related components, and aims to raise public awareness of the important position that geoheritage and geodiversity play in knowing the values of an area and its sustainable development, such as and for establishing the most appropriate ways for to exploit tourism (geotourism) and for protection and conservation (geoconservation) [16].

There are a small number of works dealing with the concrete ways in which geoeducation is carried out in different countries of the world, and these are completely missing in the Romanian scientific literature.

The purpose of this paper is to observe the way in which an important side of geoeducation (that of geoheritage and geodiversity) is perceived and understood in the Romanian school.

2. Methodology

The questionnaire method (using two types of questionnaires applied to pre-university teachers and students) was used to achieve the proposed goal (Tables 1 and 2). The data obtained were correlated with other information from the literature or with discussions with teachers in higher education, both in the field of geography and education sciences.

The questionnaire given to pre-university teachers (Table 1) included three sections: Section 1, the interviewee's form, in which the respondent's identification data are requested (the educational

institution where they work, the discipline taught, the study cycle they teach and seniority in education); Section 2, general notions about heritage and geodiversity (knowledge of concepts and related terms, biodiversity and evaluation of their importance); Section 3, teaching experience (use of specialized terminology in curricular and extracurricular context, activities/projects proposed/carried out with students, the need to introduce these notions in the curriculum and designing a curriculum at the school's decision that contains this issue).

The questionnaire given to students/graduates from geography faculties (Table 2) was also structured in three parts: part 1, interviewee's form (higher education institution and the faculty where is a student/graduate, study cycle, specialization and year); part 2, general notions about geoheritage and geodiversity (knowledge of concepts, type of didactic activity with which they were taught, the importance of natural heritage and measures for its conservation); part 3, didactic component (need to include in the curriculum some disciplines/contents related to these notions, carrying out non-formal activities and assessing the importance of the notions of natural heritage and geodiversity).

The questionnaires were applied between June and September 2020, on samples as representative as possible in structure (Tables 3 and 4). Thus, 120 responses were collected for pre-university teachers and 71 for students.

In the case of the sample of pre-university teachers, teachers from 37 counties and the city of Bucharest responded (88.37% of the country's territorial administrative units), who teach mainly geography and geography in association with another discipline (94.18%) or auxiliary geography such as Tourism and Tourist Orientation (1.66%). Notably, some respondents were located in the southern part of the country, around the university center of Bucharest. The interviewees taught at all cycles of education (a slight predominance of those in high school) and were distributed in all categories of seniority at the school.

It can be noticed in the case of the sample of students that it is quite heterogeneous, covering a wide range of study programs (there were a number of equivalences of the name of programs between faculties) in Geography and Environmental Science (4 undergraduate specializations and 5 master's degree) and the whole range of study cycles. Students were enrolled in 7 universities (six public and one private), with the University of Bucharest showing a clear dominance as an institution of origin (85.9%).

In the case of both samples, identification data related to age, sex, place of origin, etc. were not considered necessary.

Table 1. The questionnaire given to pre-university teachers.

<p>I. Respondent's file</p> <ol style="list-style-type: none"> 1. The educational institution where you teach 2. Discipline taught 3. The study cycle you teach 4. Seniority in education <p>II. General notions about geoheritage and geodiversity</p> <ol style="list-style-type: none"> 1. Do you know and use the concept of natural heritage (geological and geomorphological)/geodiversity, or their synonyms)? <ul style="list-style-type: none"> -Yes -Not 2. Do you know and use the concept of biodiversity (or its synonyms)? <ul style="list-style-type: none"> -Yes -Not 3. On a scale of 1 to 10 (1—lowest, 10—highest), how important do you consider the concepts of natural heritage (geological and geomorphological) and geodiversity? 	<p>III. Teaching experience</p> <ol style="list-style-type: none"> 4. Did you use these concepts (or their meaning) in your classwork? <ul style="list-style-type: none"> -Yes -Not 5. If so, in what context? <ul style="list-style-type: none"> -CN (national curriculum) -CDS (curriculum at the school's decision) -Other types of activities 6. If you answered other types of activities, mention which ones. 7. If you answered CDS, mention the title of the optional subject and the class you are taking. 8. Do you think it would be useful to introduce such notions in the curriculum? <ul style="list-style-type: none"> -Yes -Not 9. If you answered yes, in what context (subject, year of study)? 10. What educational projects have you done/intended to do about natural heritage/geodiversity?
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Table 2. The questionnaire given to students.

<p>I. Respondent's file</p> <ol style="list-style-type: none"> 1. Higher education institution (University/Faculty) 2. Specialization 3. Bachelor's/Master's/Postgraduate courses 4. Year of study <p>II. General notions about geoheritage and geodiversity</p> <ol style="list-style-type: none"> 1. Do you know and use the concept of natural heritage (geological and geomorphological)? <ul style="list-style-type: none"> -Yes -Not 2. If so, from where? <ul style="list-style-type: none"> -Course/seminar (which?) -Further reading -Field trips -Other 3. Do you know and use the concept of geodiversity? <ul style="list-style-type: none"> -Yes -Not 4. If so, from where? <ul style="list-style-type: none"> -Course/seminar (which?) -Additional reading 	<ul style="list-style-type: none"> -Field trips -Other <ol style="list-style-type: none"> 5. Do you consider it important to preserve the natural heritage? <ul style="list-style-type: none"> -Yes -Not 6. If yes, list 3 steps that should be taken for this purpose. <p>III. Didactic component</p> <ol style="list-style-type: none"> 7. Do you think that more subjects/contents related to natural heritage/geodiversity should be included in the curriculum? 8. Do you think that more non-formal activities should be carried out on this topic? <ol style="list-style-type: none"> 9. If you answered yes to the previous point, give 3 examples. 10. On a scale from 1 to 10 (1—lowest, 10—highest), how important do you consider the concepts of natural heritage (geological and geomorphological) and geodiversity?
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Table 3. Sample structure for teachers.

Discipline Taught (%)		Study Cycle They Teach (%)		Seniority in the Department (%)	
Geography	88.36	Lower secondary education	41.66	Less 5 years	23.20
Geography–History	3.33	Upper secondary education	30.00	5–10 years	17.30
Geography–Biology	0.83	Mixed	28.34	10–15 years	8.30
Geography–Chemistry	0.83			15–20 years	16.90
Geography–Foreign Language	0.83			20–25 years	11.80
Mathematics	0.83			More 25 years	22.50
Tourism	0.83				
Tourist Orientation	0.83				
Logic–Philosophy	0.83				
Technical disciplines	2.50				

Table 4. Sample structure for students.

Higher Education Unit from Which They Come (%)		The Study Cycles (%)		Specialization (%)	
University of Bucharest	85.9	Bachelor	43.6	Geography	52.21
Ovidius University Constanța	7.1	Master	32.4	Geography of Tourism	18.30
University of Craiova	1.4	Post-graduate study	24.00	Geographic Information Systems	5.63
Hyperion University of Bucharest	1.4			Cartography	2.80
Valahia University of Târgoviște	1.4			Geomorphology and Cartography with Elements of Cadastre	5.63
Babeș—Bolyai University of Cluj Napoca	1.4			Integrated Environmental Assessment	5.63
Ștefan cel Mare University of Suceava	1.4			Management of Tourist Resources and Activities	4.20
				Climatology and water resources	2.80
				Hydrology–Meteorology	1.40
				Disaster Management	1.40

3. Results and Discussion

The results obtained from the data processing contained in the two questionnaires shall be presented comparatively; there are many similar items, and it shall follow from student to teacher in describing how their use of the concepts of geoheritage and geodiversity evolved.

Regarding the knowledge of the notions of geoheritage and geodiversity, there is a very high percentage of respondents from both categories (over 97.00%, with a slightly higher percentage of students) (Figure 2) who understand and use this terminology, which proves that in recent years, significant progress has been made in introducing these concepts in Romania. Progress has been made especially in universities by introducing dedicated courses or content (e.g., Geomorphosites at the University of Bucharest, content at the University of Oradea, Craiova, Cluj Napoca, etc.), by the presence of specialized sites and also by the increasing number of scientific and popular works in the field, including doctoral, master's or bachelor's theses with such subjects.

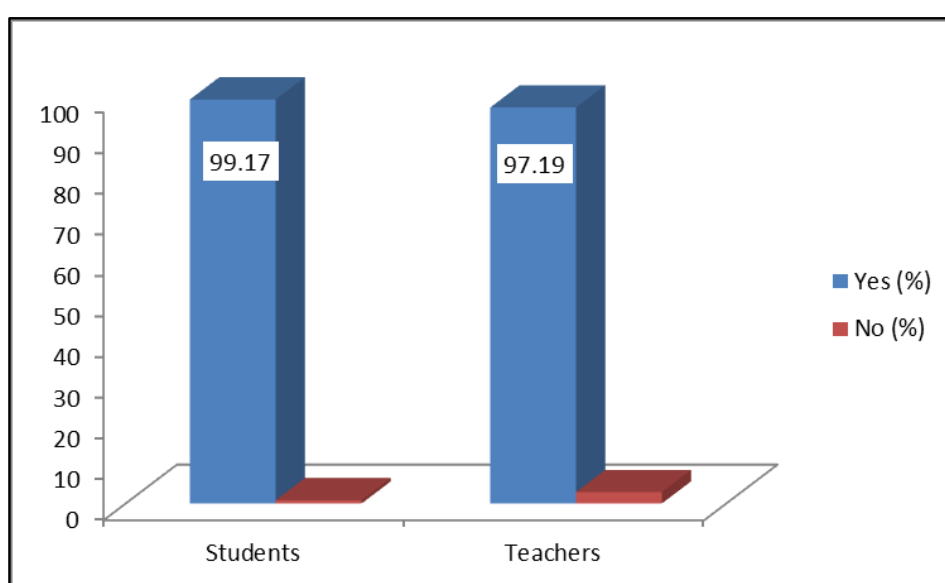


Figure 2. The percentages of interviewees who know/use the notions of geoheritage and geodiversity.

The term biodiversity is used by all interviewed teachers. Unlike geodiversity, which has been in the Romanian literature for about 10 years [16], the concept of biodiversity has been operating in Romania for over 20 years, with numerous works/projects/sites with this content.

For students, the concept of natural heritage is known from courses and seminars (54.65%), additional readings (27.90%) and field trips (17.45%). The concept of geodiversity was addressed in courses and seminars (52.29%), additional readings (25.68%) and field trips (22.03%). Among the disciplines teaching about these concepts are the following: Geology, General Physical Geography, Physical Geography of Romania, Geomorphology, General Tourist Potential, Environmental Geography. Of course, there may be some confusion: for example, in the subject General Tourist Potential, the terms of tourist/cultural heritage have been introduced, and in Geography of the Environment, that of biodiversity.

In order to highlight the connection between the didactic context (course and seminar, additional reading and practical activities) in which the acquisition of the two notions took place, we see that such a connection between geoheritage and geodiversity among students is direct and strong, with a correlation coefficient of 0.98 (Figure 3). This coefficient, very close to 1, indicates that the two notions were introduced in parallel in the curriculum (either in the course/seminar or in practical activities).

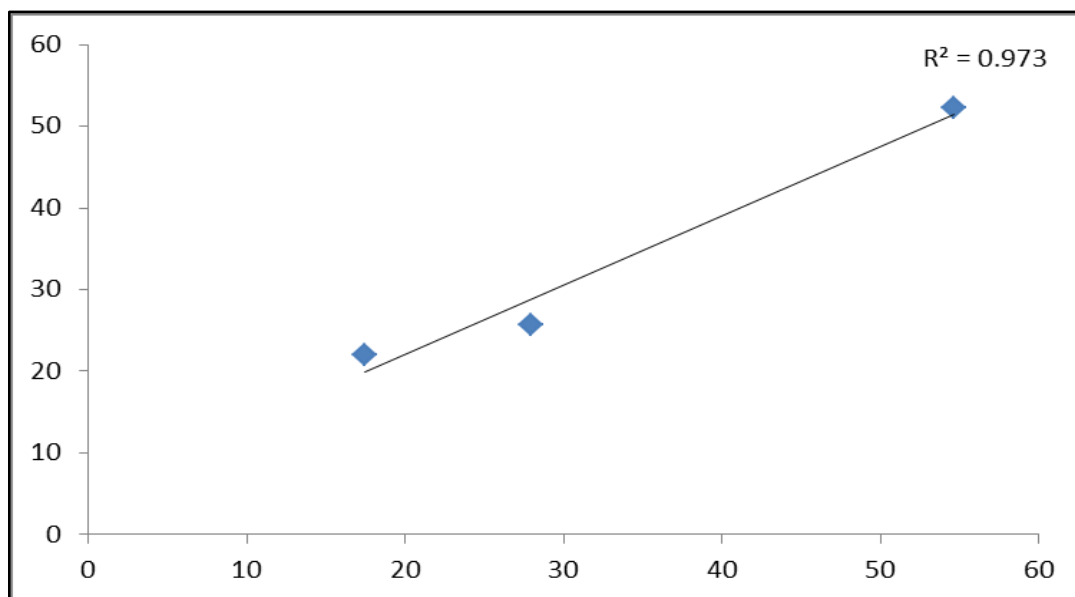


Figure 3. The correlation between the didactic context in which they introduced the concepts of geoheritage and geodiversity.

Students considered that these concepts should be deepened in the university curriculum (94.36%), 4.22% answered that it depends on their approach and 1.42% considered that it is not necessary (the question was not understood because of the observation that children should not be overloaded). A series of additional remarks can also be made: the theoretical activities must be integrated with the practical ones (practical activities in the field) or non-formal ones (volunteer activities, students' involvement in projects). Thus, 92.95% considered non-formal activities on this topic absolutely necessary, while 7.05% did not consider them important or did not answer the question.

The non-formal activities indicated by the respondents are as follows: making advertising materials in order to raise awareness of the importance of natural heritage; establishing indicators along some geotourism routes; excursions/thematic camps/hiking/practical applications; creation of panels showing the importance of biodiversity/geodiversity and their display in schools; activities in kindergartens; thematic activities carried out by museums, botanical gardens, natural protected areas; thematic exchanges of experience with other states; involvement in the activities of students of the Ministry of Environment and NGOs; presenting short films/video material on the issue of natural heritage on public television; greening campaigns; workshops and summer schools; competitions on this topic held in schools; arranging geographical lands in the courtyard of the schools/research stations of the Universities; thematic photographic exhibitions.

At a rate of 94.36%, teachers use these concepts in formal or non-formal activity. The exceptions are either teachers of another specialty (Mathematics) or teachers who have more than 20 years of experience in the school or teach in rural areas, so less contact with new scientific ideas. In order to highlight the context in which these notions were used by the teachers, multiple answers were accepted, and results obtained are summarized in Figure 4.

Respondents who highlighted other situations mentioned a wide range of situations, such as non-formal education, activities within the methodical commission, volunteer actions, first degree paper, national geography competitions, extracurricular projects ("Eco-school, Eco-education for green schools"), field trips/visits in the local area, school geography magazine, geography debates, conferences and symposia for students and teachers.

A wide range of curricula were also presented at the decision of the school where the analyzed notions were introduced; most subsumed environmental issues and its conservation, tourism or geography of the local space ("Ecology and environmental protection, Natural and anthropogenic

disasters, Natural and anthropogenic hazards, Let's live in an ecological environment, Create your environment, Green ideas for the blue planet, Earth and its geospheres, Let's learn to love nature, Superlatives of the Earth, World curiosities, Enigmas on Earth, Picturesque Romania, Geography of the native county, Geography tourism, Romania's relief—unity in diversity, Romania's tourism potential, Europe—geographical regions, Sustainable development in tourism, Tourism heritage, Tourism in the world, Tourism in the Carpathians, Tourism in Europe, Travel through Romania counties").

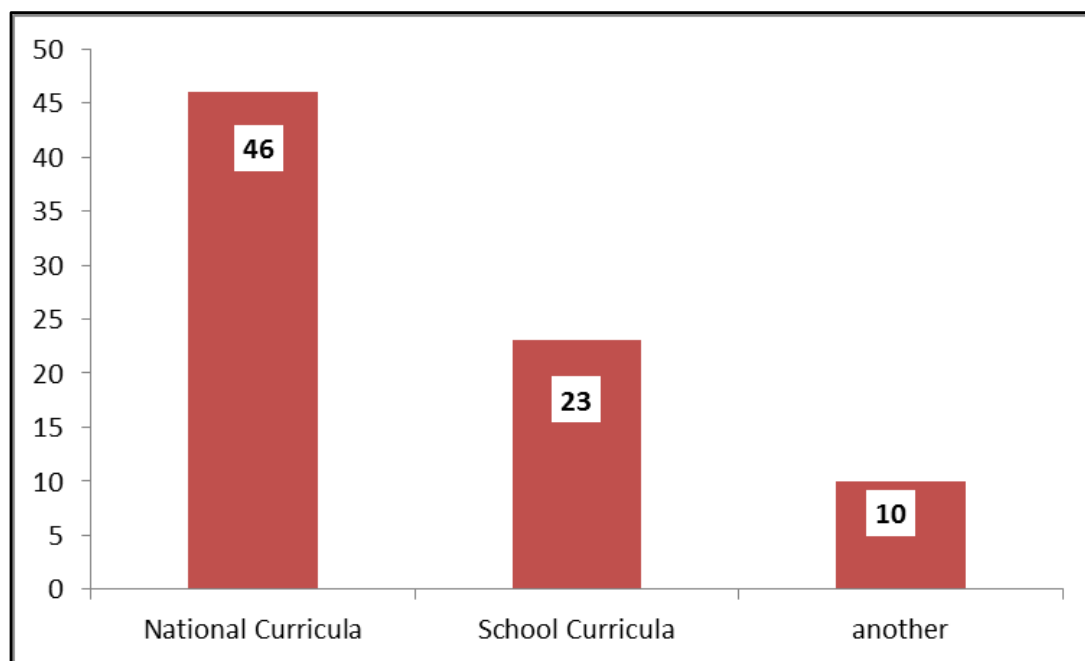


Figure 4. The educational context in which teachers used the geoheritage and geodiversity concepts.

At a rate of 98.61%, the teaching staff (with one exception, the respondent teaching Mathematics) consider it necessary to introduce such notions in the national curriculum (learning units such as Biogeography; Relief; Local Geography; Environmental Protection; Environment, Landscape and Human Society) as well as in the school decision curriculum (grades V, VI, VIII, IX, XI, XII). Although the sample was mainly composed of geography teachers, in 14 cases (19.44%), they mentioned other disciplines such as biology, history, philosophy, civic culture, tourism and environmental protection (in vocational classes at technology high schools) where these notions can be introduced, proving that teachers understand and become aware of the inter- and transdisciplinary nature of these concepts (“starting with young people in subjects such as environmental knowledge, geography, biology, even in Romania, dedicated papers can be found with and information about the environment, texts that students can use to later analyze aspects related to vocabulary and grammar, as well as when studying foreign languages”). Teachers also appreciate the importance of knowing these notions as an educational/scientific foundation and compulsory competence, but they also appreciate the fact that for the 12th grade, it is useful that there is “a better understanding of them in order to motivate more students to choose to study at a University and in order for them to be involved in projects for conservation, protection and promotion of natural heritage. There is also a deeper awareness of the aspects related to protection, conservation, laws, projects, involvement of today's students ... tomorrow's people”.

When asked about the educational projects carried out with the students, 53.93% of the interviewed teachers carried out different types of projects, while 46.07% did not get involved in such activities. Among the exemplified projects, we drew attention to trips, especially in the local horizon (*Local space—past and present*); projects related to the environment (“Reservations in a certain area, monuments of nature; Nature—laboratory for research, education, innovation; Children's environmental guard; Nature-friendly

schools; Children in support of nature; Forest moon; Earth—our home; ECO School; Tree school; Let's learn about nature; Blue Danube river project—Save water; Don't destroy what you did not create") and tourism (at the level of Romania, "With my virtual backpack, on the mountain paths"); the celebration of certain days ("Biodiversity, Environment, Earth, GIS Day"); competitions on various environmental topics, geology and speleology, heritage projects ("Protecting heritage—innovative ideas, Heritage promotion techniques in the context of sustainable development").

Regarding the interviewees' grading on a scale from 1 to 10 of the importance of the concepts of geoheritage and geodiversity, it was found that the respondents of both categories were aware of their value, with the average of the grades obtained being 9.45 for teachers and 9.58 for students. For both samples, we noted that there were no grades lower than 7.

One hundred percent of students considered these notions important, especially in terms of geoheritage conservation. Thus, from the question addressed to the students related to the measures to be taken for its conservation (multiple answers were allowed), six directions of action were established (Table 5, Figure 5). Of these, the largest share of responses was for the direction of education (92.00%), and the lowest was for promotion (19.00%). This demonstrates that students are convinced that knowledge, protection and conservation of geoheritage is promoted primarily through education.

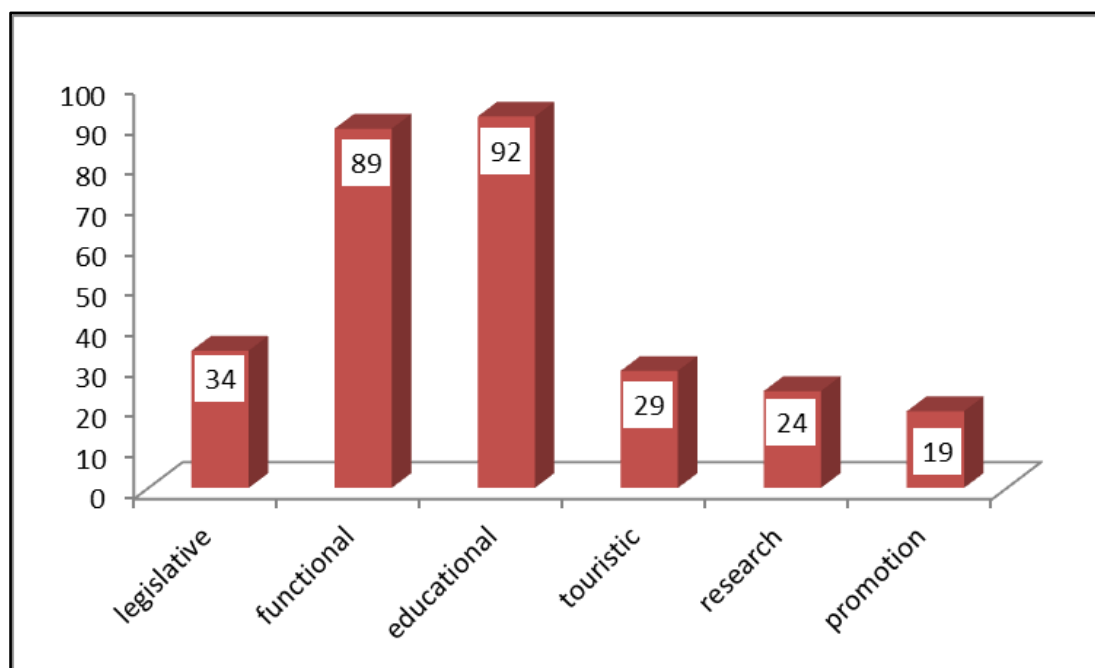


Figure 5. The weight of student responses (%) for each type of measures proposed for geoheritage conservation.

Table 5. The types of measures proposed for geoheritage conservation (according to the students).

Direction	Measures
Legislative	<ul style="list-style-type: none"> • More active involvement of local and central authorities • Identifying specific problems for each region • Adequate and coherent legislation for the conservation of natural heritage/in the field of natural protected areas • Monitoring compliance with legislation • Strict rules for tourists and restrictions on visits/activities in protected areas • Allocation of a more generous budget for the arrangement of protected natural areas/natural heritage • The classification in the heritage category of some geological elements, of the floristic and faunal species of value, which are not already included • Declaration of natural/national parks, geoparks and other structures of protection/sustainable tourist exploitation
Functional	<ul style="list-style-type: none"> • Stopping illegal deforestation • Combating pollution • Stopping the expansion of the built space, especially in valuable natural areas • Prohibition of the exploitation of these areas and protection against human destruction • Waste recycling, stopping the dumping of garbage in illegal places • Maintaining the biodiversity/geodiversity of vulnerable environments by limiting anthropogenic activities • Achieving adequate infrastructure in natural and national parks • Delimitation of areas of strict protection of geodiversity
Educational	<ul style="list-style-type: none"> • Early thematic education at the gymnasium level and its continuation in high school • Introducing into the curriculum some disciplines/contents aimed at the protection of the natural heritage • Carrying out programs of awareness, education and involvement of the population in the spirit of respect for nature, conservation of biodiversity/geodiversity • Educating the population through materials and seminars given by students in regions where there are elements of heritage (explanation of basic concepts) • Creating volunteer programs • Inclusion in the school program of some applicative activities in natural parks/geomorphological reservations in which the students can study the conserved elements • Establishment of NGOs for this purpose • Organizing thematic excursions with childrens and field trips with geography students in areas with heritage elements
Tourist	<ul style="list-style-type: none"> • Carrying out guided tours and information panels in areas with natural heritage elements • Limiting tourist access (maximum number per day), higher taxes (to discourage mass tourism), more efficient administration of sites • Practicing organized tourism • Recognition of the potential of each site for conservation and tourism development
Research	<ul style="list-style-type: none"> • Increasing budgets for research funding in the field • Carrying out advanced research to show the importance of heritage and its protection measures • Promoting the results of scientific research among the population • Inventory and mapping of high-value areas of geological and geomorphological heritage • Determining and presenting the importance of geodiversity as a support for biodiversity • Establishing a scientific basis and implementing active measures for conservation and promotion of natural heritage
Promotion	<ul style="list-style-type: none"> • Promotion of natural heritage • Promoting protection measures in the media • Promoting the areas where there are heritage objectives for attracting funds

4. Conclusions

Geoeducation must be carried out both in and out of school; it involves the formation of not only attitudes and skills, but also the knowledge of concepts that people will need in life. The main objectives of geoeducation and the study of geoheritage, on a larger scale, are: understanding how social, physical and living systems work and interact; knowledge of various cultures, ecosystems and natural physical systems; the ability to communicate across cultural and geographical boundaries; analysis of various situations (especially in nature) using the tools and perspectives of different sciences [36]. In Romania, the results obtained from the application of the questionnaire show us significant differences between the educational cycles: for pre-university education, it takes place either formally (in the curriculum at the school's decision) or non-formally (trips, projects), and in university education, it is formal (courses or content dedicated to most universities in the country, or in field applications included in the curriculum). When it is non-formal, it is organized by student associations/NGOs.

There is a need for some positive elements of the German experience [37] to be applied in Romania by supporting teachers, especially those in middle and high school education, to achieve interdisciplinary geoeducation, both in and out of the classroom, to use educational platforms and practical materials/samples from museums, especially science museums, and to benefit from the experience of researchers.

In the United States [36], the results are not so gratifying: especially in recent decades, the teaching of geosciences has suffered greatly compared to that of traditional sciences (biology, physics, chemistry), and allotted time to geography and social sciences has been decreasing significantly in the national curriculum. Moreover, the main way in which geoeducation is performed in school is through the use of geographical information systems.

In Switzerland [38], geoeducation is closely related to the application of geographical information systems in schools and to the processing of such information by students.

In France, geoeducation is carried out in an interdisciplinary manner (involving geography, history and social sciences), being a model in this regard. Outdoor activities are encouraged, involving children's free discovery of the elements of the natural environment.

Proof that geoeducation is of great importance for the future was shown in Africa, with the African Network for Geo-education. "The African Network for Geo-Education exists to develop a [way for] professional geoscientists and educators to provide geoscience outreach to all" [39].

The limitations of the present study may arise from the rather limited number of questionnaires that were applied, from the limited geographical distribution of respondents and from the terminological confusions discovered. Furthermore, the special period in which questionnaires were given (in the middle of the COVID 19 pandemic) greatly limited the spectrum of formal and non-formal activities carried out as well as the availability of pre-university teachers to respond to our requests.

In the future, we intend to apply similar questionnaires focused on the target group of teachers in university education who teach or research these notions and to correlate them with the opinions of the beneficiaries of education, namely students. A stronger connection is also required between the university space where these concepts have penetrated strongly and correctly and the pre-university space, which, despite remarkable efforts, is still limited to environmental education and where the trans-/interdisciplinary character remains a theoretical goal.

We intend to disseminate the results of this study among decision-makers and determine the most appropriate ways for there to be a greater presence of these concepts both formally and informally in the Romanian education system.

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