Chapter 10
Geoeducation and Geoethics Among the Children for Sustainable Tourism and Development of Aliage Geological Park in Spain

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Abstract Most part of the population finishes their secondary studies without basic notions about Earth Sciences. For this purpose, the geoscientific community is promoting a reintroduction of this discipline and Geoethics, by means of field activities in geosites, geoparks, and geological parks. The survey conducted by the manager of the Geological Park of Aliaga (Teruel, Spain) aims to compare the geological, environmental, and ethical knowledge acquired by the children of the community attending summer courses on Geology and nature with regard to other children and adults. Results show that children who have been attending the summer courses had a higher knowledge than adults, not only about the environment, but also about the implications of the human activities in the territory. Children no students and young people have shown lower geological and environmental knowledge than adults, and therefore, they are falling behind in the basic education. This minor knowledge is inadmissible, due to the fact that they will become a predatory society incapable of judging the repercussions of the actions in the territory. On the other hand, the higher knowledge of the ex-students of the intensive courses shows the positive effect that these courses can have on the education of future professionals.

Keywords Geoethics · Geological knowledge · Geological park · Intensive courses

10.1 Introduction

Modern society development has been threatening and damaging relevant geosites for several decades; by means of open mining, building, highways, and intensive farming among other activities. Furthermore, environmental issues are being emerged in delicate as yet unknown areas in the countryside, due to the fact that nowadays

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city dwellers are coming as tourists covering almost every holiday period of the year (Escorihuela 2017a).

On the other hand, several destructive examples caused by academic disciplines have made the scientific development impossible by eliminating relevant outcrops, now called "geovandalism" (Mansur et al. 2017).

For all the above reasons, not only is lack of geological knowledge of the population being highlighting by a lot of geologists (Escorihuela 2016), but also lack of geological knowledge of students who get to the universities of Geology. These facts show that the most part of population finishes their secondary studies without basic notions about Earth Sciences (Pedrinaci 2012). This ignorance also affects politicians, technicians, journalists, and scientific communicators that act and give their opinion in natural resources and environmental issues without a global comprehension, helping to increase the confusion in the public (Lacreu 2017).

It is not possible to suitably teach Natural Sciences if the Geology is absent, and for this purpose the geoscientific community is promoting a reintroduction of this discipline, using a new approach by means of field activities in geosites, geoparks, and geological parks (Escorihuela 2017b, c). But, at the same time, it is not possible to forget that the geologists have a relevant extra role in sustainability. Geoethics appears in this context; this new discipline investigates the values that support the behaviors and practices in any of the interactions of professional activity in the environment.

This way, it is believed by many teachers that moral issues related to Earth Sciences are better understood by means of Geoethics, and so Geoethics develops sustainability strategies (Vasconcelos et al. 2016). Nevertheless, there are not any practical studies focusing on this approach (Allan 2015). This is the reason why the manager of the Geological Park of Aliaga—Spanish pioneer in promoting Geotourism and geodidactics in relation to Geoethics at early ages—has been organizing intensive summer courses for 8 years with the children of the locality (Escorihuela 2017b, c).

The present article tries to outline the geological, environmental, and ethical knowledge acquired by the children of the community, by means of the study of the environmental–geological knowledge of the adults and children—population and visitors—and the ethical considerations underlying this knowledge. Results show that children who have been attending the summer courses have a major knowledge than adults, not only about the environment, but also about the implications of the human activities in the territory. This fact is allowing them to be able to develop a more critical analysis, and major ethical skills when they value the repercussions of projects affecting the municipality.

10.2 Methodology

10.2.1 Study Site: Geological Park of Aliaga and Its Geomorphological Context

The Geologic Park of Aliaga is situated in the Teruel Region of Spain (Fig. 10.1). Teaching about and promoting geology by guiding visitors along with several points of special interest —providing a sound overview of the past 200 million years—were the main objectives when it was founded in 1993. Since then, scientists have been evaluating the park as a unique example of geology due to its geologic structures and formations, offering impressive landforms (Soria de Miguel et al. 1996). In addition, stratigraphic record from Upper Triassic to the Quaternary is completely shown by means of its exceptional outcrops, while Cretaceous and Tertiary formations have an important relevance. Moreover, the diversity of tectonic structures allows us to appreciate the two fold systems superposition (North–South and East–West). This way, the research of the Earth history can be possible through the superposition of rock layers created by the history of the Planet Earth.

Fig. 10.1 Location of Geological Park of Aliaga within Spain, in the same region as Cultural Park of Maestrazgo. Being the first one the coordinator of the second one in the Red Ibérica de Espacios Geomineros

Fig. 10.2 Panoramic view of "La Olla", spectacular meandering fold with an international relevance because of its singularity and dimension

An old erosion surface limits the summits of hills and plateaus surrounding Aliaga, raising no more than 1500 m of altitude. Selective erosion due to different rock types has modeled the several degrees of the slopes, and so crest and cliffs are formed in the more resistant limestone, dolomitic and conglomeratic beds, whereas gentle slopes coincide with clay, marl, and sandy beds. This erosion process has enabled us to observe these complex folding structures, which have been completely leveled by the erosion surface (Fig. 10.2).

This geological framework gives the manager of the Geological Park of Aliaga the opportunity to lead 3 main axes of action: Earth science teaching and territorial awareness/protection by means of Geoethics, promotional activities, and developing the understanding of the Aliaga territory in a scientific way. The background of knowledge acquired by the manager of the Park through these activities (addressed to different public groups—of various age and career—and intensive summer courses), gives an important experience in adapted contents for various educational levels (Escorihuela and Dowling 2015) all these activities are created and coordinated by the local company charged of the management of the Geological Park from 2002 until the present, called "Jumdosiv".

10.2.2 Summer Courses Methodology

In summer courses, concepts as biodiversity and geodiversity of the municipality were introduced, and so as the idea of a possible sustainable development if we

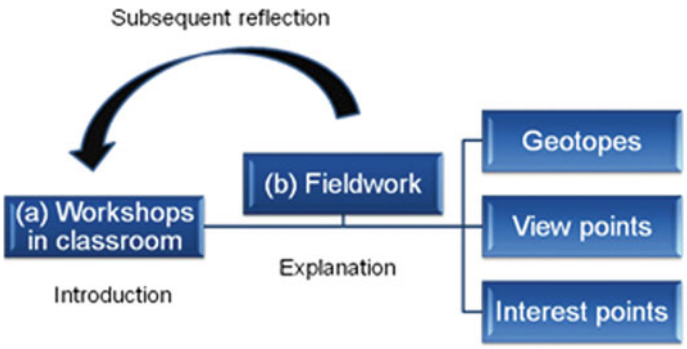

Fig. 10.3 Structure of Geologic Park of Aliaga method in intensive courses. *Source* Escorihuela (2016)

use the Geoethics principles in the management of the area. Classes (Fig. 10.3) were taught indoors (a) and outdoors (b) by means of several interest points: (b.1) outcrops, known in the scientific community as geotopes, (b.2) viewpoints in which different elements and processes can be observed, and (b.3) panoramic views that allow students think in a territorial scale.

Likewise, the holistic approach to enable the preservation of the land and its inhabitants is pointed in EGN (European Geopark Network) foundations. In the foundational statement of EGN, it is said that geological and cultural heritage must be joined in order to promote a recognized place (McKeerver et al. 2010). Furthermore, the inhabitants of an area with a relevant landscape own the real knowledge to correctly manage the territory. This important principle is shown by the manager of the Geological Park of Aliaga, because of the fact that research carried out in the Park has highlighted the importance of this local "savoir faire" in the Geosciences apprenticeship.

In the educational activity carried out in Geological Park, the analysis of the way of teaching the different concepts to different kinds of students is crucial for successful learning. The authors as Hamm (Ham 1992) have pointed out the idea of the necessity of translating the technical concepts of environmental sciences into a more comprehensible language to create the interest of children (Fig. 10.4).

10.2.3 Selected Groups Characteristics

Three groups were studied in this research. One of the three groups consisted of ex-students of intensive summer courses, aged 12–17, it served to assess their general environmental-geological knowledge acquired after these summer courses. The second group was composed of children age 12–17 years. The environmental–geological acquired knowledge was examined in this group to study children who

Fig. 10.4 Children in a field activity of the summer course in Aliaga

did not attend these intensive courses, and so they had just the environmental knowledge acquired from the school and family. On the other hand, the third group consisted of adults: parents, relatives of the children, people from Aliaga and other regions of Spain that visited the village during the summer. With this last group, we wanted to compare with respect of children, not only the differences between generations, but also the effect that the intensive summer courses had on children's environmental–geological knowledge.

First two groups—ex-students and no students—consisted of 60 children each. The study was approved by the families of the children and privacy was guaranteed.

The 60 adults of the third group were divided as follows: 20 of them aged 25–35, 20 were aged 35–45, and 20 were older (>45 year old). Figure 10.5 shows a group of young people doing an interview next to the visitors 'center of Geological Park of Aliaga. These three groups of adults were divided on the basis of a general behavior analyzed by the interviewer, depending on the number of successes and failures.

10.2.4 Studied Topics

The six topics evaluated in this research were

1. Environmental contamination: It happens when chemicals alter our environment, producing negative effects on living beings' lives. Pollution has reached its peak with modernization and development in our lives; contributing to climate change and worsening human health.

Fig. 10.5 Young people doing the interview

2. Earth resources: Our society based its energy and products on resources becoming from the Earth. Likewise, energy is highly dependent on these resources.
3. Hydrological cycle. This cycle makes possible the redistribution of water, and so the interactions among the different spheres of the Planet Earth. Groundwater, led by the terrestrial system is crucial to life and ecosystems.
4. Water erosion. Ecosystems are based on this process caused by the interaction of rocks, water, and plants. The material movement caused by water is the origin of landforms and system soil.
5. Animal's and plant's habitat. Habitat is the environment that has all the properties—nutrients and physical elements—for animals and plants to birth, grow, and reproduce. The good quality of a habitat is produced by a balanced mixture of the natural elements. Knowing these properties is crucial to understand the animals' and plants' requirements and how to act or manage them.

In order to value this general knowledge of population, it must be highlighted the fact that all these concepts were understood by everybody. So, the geology, plants, and animals of the interviews were present in the area, and due to this fact, we have called as general this type of environmental–geological knowledge, because it must be known by the population in a general way, like the general cultural knowledge.

On the other hand—and in a complementary way to the analyzed topics—all the interviewed adults were asked if they would attend a course on geology and nature.

Table 1 Index and items evaluated in interviews

Variables	
$\text{Generalenvironmental} - \text{geologicalknowledge} = \frac{e*16.6}{10} + \frac{er*16.6}{10} + \frac{ec*16.6}{10} + \frac{php*16.6}{10} + \frac{ahp*16.6}{10} + \frac{hc*16.6}{10}$	erosion (e)
	Earth resources (er)
	environmental contamination (ec)
	plant's habitat preservation (php)
	animal's habitat preservation (ahp)
	hydrological cycle (hc)

10.2.5 Procedure and Description of Interviews

The study follows the methodology proposed by Valles (2002) by planning a themed analysis in the surveys, clustering the achieved contents in meaningful topics, to finally highlight the results in ecological-geological understanding in an analytical and quantitative way. Furthermore, thanks to the qualitative interview, a discussion about Geoethics of all the interviewed could be carried out. Table 10.1 shows how the values for environmental–geological general knowledge were integrated and the related variables evaluated.

The methodology of the interviews was improved using additional procedures and interactions with the participants by means of observation and improvised conversations. The responsibility of this study lead all the interviews in order to prevent any interference.

10.2.6 Data Analysis

In order to study the differences in the general environmental–geological knowledge in ex-students and no students, the Mann–Whitney U test was utilized. This test is suitable to compare two independent groups with ordinal or continuous dependent variables without a normal distribution.

Furthermore, to identify differences between three groups (ex-students, no students and adults), we used the Kruskal–Wallis ANOVA. This test compares the variation between data sets among different groups, and lets us know when the differences of the study variables are significant.

10.3 Results and Discussion

To study the existence of differences between the general environmental and geological knowledge in the three groups of the study (25–35, 35–45, and 45–55), Fig. 10.6 shows a box and whisker plot. A significant difference was found between the three

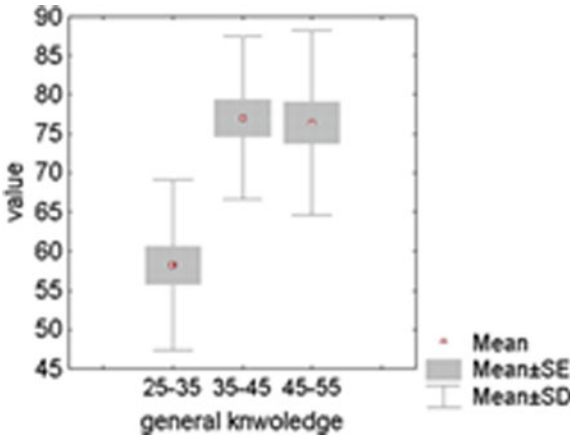

Fig. 10.6 Box and whisker plot for adults' geological and environmental knowledge. Adults of different ages showed the following data: 25–35 (58.27 ± 10.63, mean ± SD); 35–45(77.02 ± 10.16, mean ± SD) and 45–55 (76.44 ± 11.53, mean ± SD)

groups of adults ($H_{2,60} = 22.44$; $p < 0.01$), in which a lower knowledge was found in adults aged 25–35 (58.27 ± 10.63, mean ± SD). It must be underlined that we found significant differences between these two other of adults aged 35–45 and 45–55 (77.02 ± 10.16, mean ± SD and 76.44 ± 11.53, mean ± SD, respectively). So, there were common answers in adults aged >35 years, independently of their social condition and careers. These results endorse the idea of reduction of contents on Geology in Spanish schools, a reduction which is having implications in the present professionals, due to the fact that territorial management is dealing with people who have a minor geological and environmental knowledge than the previous generations.

Likewise, a minor knowledge involves a minor conscience of the implications of the actions. This way of acting was demonstrated when they were asked about the consequences of different territorial projects. This fact leaves the population defenseless and less critical facing decision making at territorial level (Macedo 1997).

Furthermore, it must be highlighted the fact that all the adults—without exception—would like to participate in courses on geology and nature to expand their knowledge, regardless of the age stratum and their professional career (85% have university degrees).

In order to compare the differences in the environmental knowledge between children and adults, Fig. 10.7 shows a box and whisker plot of three groups: children––ex-students and no students, and adults (>25).

This study reveals that there are significant differences between the three groups ($H_{2,180} = 115.07$ $p < 0.001$), and every group was different from the others. Children who had been attended to the summer course in Aliaga had a higher general knowledge on geology and nature than the rest of the population (85.57 ± 11.07, mean ± SD), being even higher than adults' knowledge (70.58 ± 13.86, mean ± SD). On the other hand, students who did not attend the summer course had a much lower general knowledge (46.59 ± 10.09, mean ± SD). This low level of knowledge—even in young people aged 17 years—coincides with the assertions of the authors as Pedrinaci (said in the introduction) who affirms that most of the population that ends up with secondary

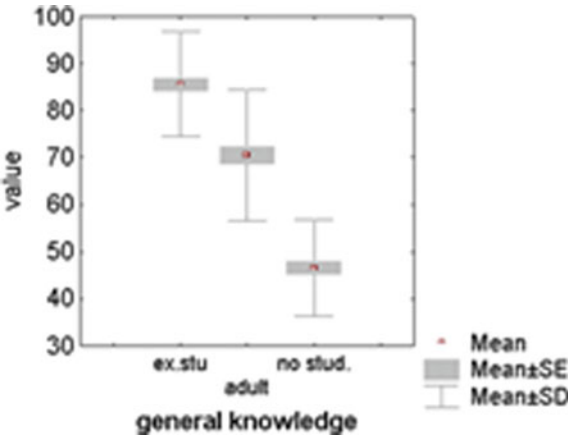

Fig. 10.7 Box and whisker plot for children's geological and environmental knowledge. Children (ex-students-no-students) and adults showed the following data: ex-students (85.57 ± 11.07, mean ± SD); adults (70.58 ± 13.86, mean ± SD) and no students (46.59 ± 10.09, mean ± SD)

education lack basic knowledge in Earth Sciences. This lower value, lower than people aged 25–35, could be showing a reductionist trend for decades, which means that we must put the spotlight on a generational problem of ignorance, that will worsen over time if no measures are taken to correct it.

However, not only was a higher degree of knowledge on ex-student proved but also this fact demonstrates the important educational work in geosciences that can be done in the geosites with a teaching infrastructure (such as geological parks and geoparks and geological–paleontological museums). Such work is being claimed from the *Red Ibérica de Espacios Geomineros*, recently created by Spain, Portugal, and Andorra (https://patrimonigeominer.eu/). This network has been founded by members such as the Geological Park of Aliaga, which highlight the recognition of the responsible role that geologists have in sustainable development, forcing them to carefully evaluate the existing educational structures to ensure more effective contributions to the population.

In this context, these children who have shown a higher knowledge, also have become more involved in territory, due to the fact that they have been taught notions on Geoethics in the summer courses. It is not possible to have a good notion of nature without basic geological notions, and geologists also have an important function in the world of ethics (Martínez-Frías et al. 2011) not only to protect the geosites from the geo-depredation, but also to achieve the sustainable development of the area.

Established educational courses on Earth Sciences can build good foundations, however, extracurricular initiatives can achieve the same goal (Gill 2016), like those which can be offered in geological sites with an adequate educational framework.

Tomorrow's land managers are the children of today, and they could start to understand the environment if an earlier acquisition of Geosciences knowledge is provided. This fact will contribute to giving children qualified skills to interpret the geosphere and biosphere and their diversity since earlier ages, contributing to create a more critical and combative society.

The satisfactory results in this earlier teaching in children make possible this initiation of early ages in geosciences concepts and issues.

10.3.1 The Geoethics' Role on the Education by Geotourism in Geological Sites

Natural hazards and anthropogenic activities have led to the rapid destruction of several geosites; what is putting emphasis on the need for geoconservation and Geoethics. The scientific community dedicated to Geoethics is strongly linked to the Geotourism activity, since it is one of the key tools to promote values of Geoethics among stakeholders and participants (Gill 2017). Moreover, the teacher community thinks that learning Geoethics contribute to successfully consider the ethical quandaries of Earth Sciences, and so students could develop sustainability approaches to face environmental issues (Vasconcelos and Almeida 2014).

Understanding Geoethics as "… research and reflection on the values which underpin appropriate behaviors and practices, wherever human activities interact with the geosphere" (Peppoloni and Di Capua 2015), teaching Geoethics provides an added-created value for a societal resilience for environmental justness defying the technological society (Bellaubi 2018). This way, this critical pedagogy becomes a useful tool to teach how to think in a conscious way.

Characteristics of the environment and school spaces have a decisive influence on the activities and behaviors of children and young people. The contact with nature minimizes the stress factors that today's childhood supports, this contact also increases their well-being, stimulates cognitive processes, facilitates emotional regimentation, and promote resilience. In addition, natural spaces offer opportunities for motivation and learning in all areas of knowledge, creating ecological awareness. Direct experience of natural processes is provided by this approach (Barberá and Valdés 1996), which develops a practical way of thinking, and general interpretation patterns of the planet Earth in the pupils' brains (Kirschner 1992). This outdoor experience is unique due to the fact that the geological processes complicatedness is re-established.

10.3.2 Implications of a Sustainable and Quality Tourism for the Sustainable Development of the Area

Due to the low geological knowledge showed on population, the scientific community is promoting the reintroduction of geosciences based on field activities, as well as ensuring the conservation of geological and geomorphological sites, which would be through Geotourism. The development that is being done from Europe, shows an

effort to expand the physical interpretation of landscapes to tourists, promoting their conservation (Hose 1997).

Geotourism teaches tourists to better understand and appreciate cultural aspects, encouraging an effective geological understanding through education, which in turn provides tourist satisfaction (Dowling and Newsome 2006). Thus a geotourist can have a holistic experience that brings together knowledge, appreciation and ethical considerations. In addition, Geotourism is considered as an activity that adds significant economic value to the geological heritage, because of the fact that an infrastructure must be created and adapted to the exhibition and access to points of geological interest, as well as the establishment of jobs and personnel training for the maintenance of facilities and explanatory disclosure (Nieto et al. 2006).

In contrast to the new model of mass tourism that is being reported recently among the population of the cities—which goes to the rural environment to enjoy outdoor activities, and which is threatening the sustainability of host areas—the Geotourism is shown as a sustainable way to develop these areas of special geological and natural richness, using tourism as a vertebrate economic activity. Within this geotouristic activity, we highlight two main axes of action that are essential for the sustainability of the resource.

Firstly, in order to know the quantity of visitors who does not damage the environment of a place; touristic planning requires the implementation of the concept called "host capacity". Therefore, in sensible natural areas, a necessity to distinguish between touristic activities and good environmental quality appears as a key factor to protection, particularly if natural assets are the main pole of attraction (Edwards and Priestley 1996). Secondly, touristic guides related to the environment are essential to evaluate the natural resources of a place. In addition, geotouristic guides or geological guide-interpreters are the main factors of valorization and protection for special sites with a higher number of geological diversity elements. Moreover, Geoethics concept should be applied by these professionals, by teaching the commitment required to the correct protection of the environment. By means of these under-control tours, the touristic recreation based on a responsible satisfaction will be guaranteed, and so as the future viability of the activity itself.

Furthermore, stakeholders and touristic decision takers must equate geological heritage with cultural, archaeological and ethnographic heritage in the social and economic strategies of development in the special areas with high geological values (Hose 2013).

All the above mentioned about the need for Geoethics and geological knowledge, has a greater relevance if the focus of interest is the children's audience; because this experience would be part of a non-regulated education that will strengthen their background integrated by a balanced, respectful and realistic knowledge.

10.4 Conclusions

Children no students and young people have shown lower geological and environmental knowledge than adults, and therefore, they are falling behind in basic education. The children of today are the future managers of tomorrow, this minor knowledge—without basic notions of geology—is inadmissible, due to the fact that they will become a predatory society incapable of judging the repercussions of our actions in the territory. And, at the same time, defenseless against projects which can damage the environment in an irreversible way.

On the other hand, the entire population interviewed agreed that they would like to attend a course on geology and nature if they had the opportunity. The fact that the entire population demands this type of learning, highlights the need for public authorities to act in response to a unanimous social demand that is not being provided.

The higher knowledge of the ex-students of the intensive courses provided by the manager of Geological Park of Aliaga, shows not only a positive effect that these courses can have in the education of our future professionals, but also shows this type of courses as suitable for school and extracurricular activities. These activities are necessary to reintroduce the basic notions of Earth Sciences that have been lost in Spain for decades.

The scientific and geological community is reacting, calling for a more active and responsible action in the sustainability of the environment of the professionals of Earth Sciences through Geoethics. Promoting educational plans and didactic activities for the general population is being requested by means of Geotourism.

All the above mentioned knowledge and measures will not be effective, if society does not equate the geological and natural heritage with the cultural one. Public institutions should become aware of the need for education of the population, who are responsible for the preservation and the effective sustainable development of their own environment.

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