sustainability

MDPI

Article

Increasing Geoheritage Awareness through Non-Formal Learning

Paola Coratza [1,2], Vittoria Vandelli [2,3,*] and Alessandro Ghinoi [1]

[1] Department of Chemical and Geological Sciences, University of Modena and Reggio Emilia, 41125 Modena, Italy
[2] CRICT—Inter-Departmental Research and Innovation Centre on Constructions and Environmental Services, University of Modena and Reggio Emilia, 41125 Modena, Italy
[3] Department of Economics Marco Biagi, University of Modena and Reggio Emilia, 41121 Modena, Italy
* Correspondence: vittoria.vandelli@unimore.it

Abstract: Non-formal learning can have a crucial role in increasing citizens' literacy to geoscience providing the opportunity to raise the public profile of geology and geomorphology. Starting from these remarks, the project presented here is one of the first attempts, at national level, aimed at achieving the territorial upgrading based on geoheritage enhancement. The project started thanks to a bottom-up input and involved the collaboration between scholars and local administrations and stakeholders for the valorization of a fluvial area within the Municipality of Castellarano (Emilia Apennines, Northern Italy). To achieve this aim of non-formal learning activities, based on the interpretation of the geoheritage, have been implemented. In fact, the investigated area includes valuable geological and geomorphological features which have been used, in the frame of the project here presented, to promote local geodiversity and geotourism. In particular, three geosites of regional significance were considered for the creation of EarthCaches, interpretative panels and guided excursions. Interpretative contents were designed to be educational, providing accurate but non-technical explanations. Attention was given in including illustrations playing an important role in the learning process. The results revealed that the implemented activities positively contribute to raising public awareness on the value of geoheritage.

Keywords: geosites; geotourism; geoeducation; geointerpretation

Citation: Coratza, P.; Vandelli, V.; Ghinoi, A. Increasing Geoheritage Awareness through Non-Formal Learning. *Sustainability* **2023**, *15*, 868. https://doi.org/10.3390/su15010868

Academic Editor: Antonio Miguel Martínez-Graña

Received: 6 December 2022
Revised: 26 December 2022
Accepted: 29 December 2022
Published: 3 January 2023

1. Introduction

Geology and geomorphology can play a role in the education for sustainability and sustainable development and in the achievement of the goals of the 2030 Agenda [1–4]. Earth scientists must identify broad and multidisciplinary strategies to meet the increasing global demand for resources and to predict and mitigate the anthropic impact on Earth [5].

In fact, geotourism (sensu [6]), as a form of sustainable tourism, promotes the conservation of geodiversity (sensu [7,8]) by ensuring geoscientific education [9,10], spreading understanding and appreciation of geological features to tourists and those communities living and working around sites of geological and geomorphological interest, beyond mere aesthetic enjoyment.

In this context, fostering the geological and geomorphological education is crucial to increase the awareness regarding the importance of geoheritage. In fact, if people understand the value of geoheritage and geodiversity they are more prone to preserve them [11,12]. Given the scant literacy on Earth Sciences [13], interpretation, as well as education, are fundamental tools to raise awareness about the need for geoheritage management and conservation [14]. Regarding interpretation, it can be defined as a form of communication that presents information and educational activities in a way that could arouse interest/curiosity, entertain and inspire visitors and provide an intentional/deliberate learning experience [15,16]. Effective interpretation plays a key role in promoting and

fostering geoheritage conservation [17,18]. In fact, through geointerpretation—that is understood as the interpretation concerning a geological or geomorphological process, event, or feature—visitors can understand the importance of preserving geoheritage and adopt self-regulating behaviors more in line with geoheritage conservation purposes [12]. The supply of interpretive means enables visitors to acquire knowledge and understanding of the geology and geomorphology of a site (cf. [17]) and their importance in providing essential ecosystem services for living beings including humans. Interpretation can also be used by planning authorities to better manage tourism, to preserve natural resources and to increase visitors' satisfaction (c.f. [13,19] and references therein). Regarding visitors, it is necessary to underline that the interpretation means must be tailored to a target public. In most of the cases, it is not possible to address an interpretative material at the same time to the general public, hobbyists, teachers and experts. To engage different types of target audience, a solution could be to design an interpretative plan including different interpretative levels according to the different types of target audience [20,21].

In this framework, interpretative contents can be conveyed through non-formal learning activities. In fact, these latter are outside the boundaries of formal education, since unlike education in formal settings they do not merely include lists of facts or information, but they use illustrative media, authentic experiences, and original objects to provide lessons. Non-formal learning has been defined by Colardyn and Bjornavold [22] as: "learning embedded in planned activities that are not explicitly designated as learning, but which contain an important learning element". A recommendation of the Parliamentary Assembly of the Council of Europe (Recommendation N° 1437) [23] states the importance of non-formal educational practices to foster formal educational systems to respond to rapid and constant technological, social, and economic change in society.

Starting from these premises, the aim of the paper is to present the implementation of a project aimed at enhancing the geological heritage and geodiversity of a fluvial area within the Municipality of Castellarano (Emilia Apennines, Northern Italy). Although the area is characterized by valuable natural assets (including geological and geomorphological ones), since the 1950s, its economic development has been strongly based on the exploitation of the geological landscape features exclusively understood as raw materials (e.g., clay, sand, gravel) to serve local construction and tile industries. Since then, the geodiversity of the area has not yet acquired any value as a cultural asset exploitable in a sustainable way through geotourism. Considering this context, the current study proposes new ways and strategies to awaken the interest of the general public on the geological features or peculiarities as key elements to develop tourism in less popular areas, as the one considered in this study is. In particular, the area object of interest corresponds to a fluvial cycle-pedestrian path where three geosites of regional significance are located. Apart from their unquestionable scenic value, their scientific and cultural interest though recognized by the scientific community remains generally obscure to the visitors of the area. Starting from these considerations, in last few years, the need of the territorial upgrading of the area rose even among the local population. In order to encounter this need, a synergy among scholars, local administrations and stakeholders was built leading to the implementation of non-formal learning activities based on the three geosites located in the considered area. In countertrend with the past vocation of the area, thanks to this synergy applied to the work here presented, the cultural value of the geological heritage became a means for the valorization of the area through the creation of interpretative panels, EarthCaches, and guided excursions. Not least, this paper further intends to present guidelines and procedures, inspired by the existent literature which were followed by the authors for the implementation of such non-formal learning activities, and which can also be applied in other areas.

2. Study Area

The Municipality of Castellarano (Emilia Apennines, Northern Italy) (Figure 1) has a rich and diverse geological and geomorphological heritage [24]. For many years the local

administrations have been devoted to the conservation and valorization of the natural assets within its territory, including geodiversity. The study area corresponds to a fluvial stretch of the Secchia River, bordered by a cycle-pedestrian path. The landscape of this fluvial stretch is influenced by (i) anthropic activity, that has deeply modified the river course, (ii) structural geological factors, i.e., the bedding of rock layers and contrasting lithology, and of course, (iii) river dynamics which strongly changed through time.

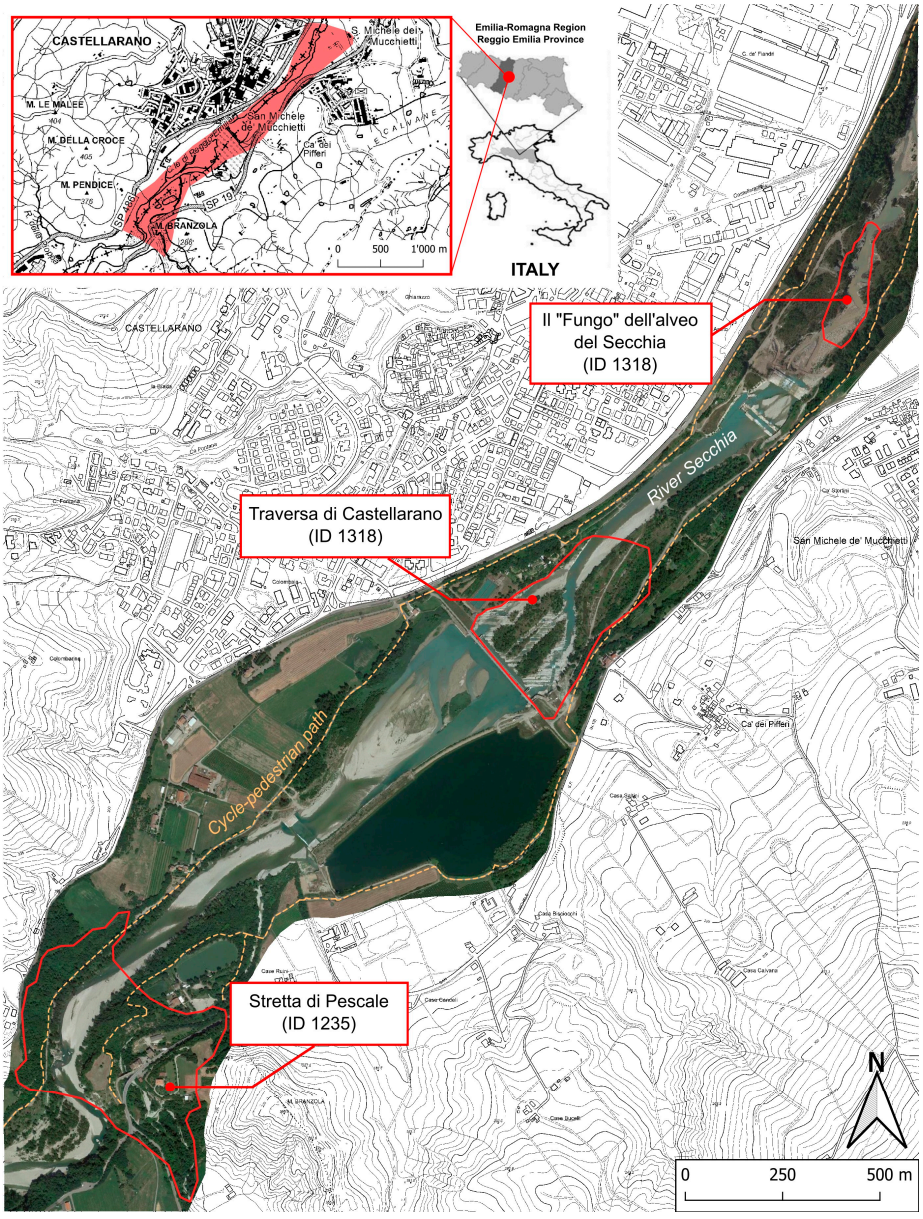

Figure 1. Geographic location of the three geosites which were object of attention for the implementation of non-formal learning activities. The spatial limit (outlined with a red line), the name and the ID (the latter reported in the brackets) are the ones assigned to each geosite in the regional inventory.

The rocks that crop out in the investigated fluvial stretch date back to millions of years ago (ranging ca. from 70 to 20 million years ago). Formed on the sea floor, they underwent strong deformations during Apennine orogeny, and some of them were permanently brought out of the sea. Now their strata appear anything but horizontal, some are inclined towards the south, some are even vertical. Tectonic uplift—which is still undergoing—and erosion by the river have been sculpting the rocky outcrops, although man has favored a strong acceleration of erosion by constructing a river dam in the eighties. If on one hand,

the deep erosion is creating hazardous conditions such as instability of the river sides, on the other hand, the constant deepening of the rocky riverbed is creating a system of gorges of great scenic beauty. The rocks that form the vertical strata down the valley from the river dam are turbidites belonging to local geological formations dating back to 70 million years ago: they formed after large underwater-landslide-deposits piled up in layers on the sea floor [25,26]. The rocky outcrops that form the Pescale gorge (*Stretta di Pescale* locality) are bordered by high vertical cliffs made of white carbonate rocks which were formed about 20 million years ago in an environment very similar to that of the current coral reefs [27]. The presence of a fault has favored the incision of the hard rocks by the river, forming a deep winding canyon [28,29]. At the top of the Pescale cliff, on the right bank of the Secchia River, there is a fluvial terrace which has been a human settlement since the Neolithic. Once one has crossed this "bottleneck", the riverbed widens again towards the artificial river basin. Downstream with respect to the river dam the selective erosion acting on the outcropping sandstone and conglomerate layers (dating back to some 30 million years ago) has created peculiar landforms among which is a curious mushroom-shaped structure. Regarding the latter, the river erosion has been more effective on the weaker sandstones, thus leaving a flat "hat" of harder conglomerate sustained by a round-shaped pillar of sandstone.

In this geological context, three geosites included in both the national and regional inventories can be found. They are located along the cycle-pedestrian path (Figures 1 and 2) that eases their reachability by pedestrians and cyclists. Considering their good accessibility, visibility, and exemplarity, these geosites were chosen as the centerpiece of non-formal learning activities:

1. *Stretta di Pescale* is a narrow stretch of the Secchia River, bordered by subvertical cliffs of carbonate rocks. Despite its scenic value, the geosite also has archaeological importance since it hosts the remnants of a Neolithic human settlement.
2. *Traversa di Castellarano* is a fluvial dam, the construction of which caused a strong increase of the downstream erosive power of the Secchia River and the consequent exposure of turbidites. The geosite is important from a scientific point of view since it includes exceptionally well exposed turbidite layers part of a rock fold of regional extensions.
3. *Il "Fungo" dell'alveo del Secchia* is a mushroom-shaped structure modelled by river erosion and located along a deeply carved stretch of the Secchia River. Apart from the spectacularity of the resulting gorge, the mushroom-shaped structure has been used as a landmark to estimate riverbed erosion rate.

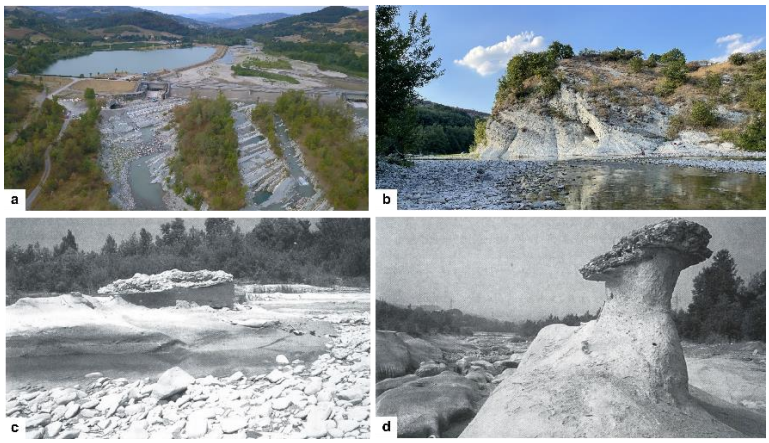

Figure 2. The three geosites, located along the Secchia River (cf. Figure 2 for their location): (**a**) the Castellarano dam and the very well exposed subvertical turbidites outcrops (photo courtesy of Claudia Milioli); (**b**) the narrow stretch of the Secchia River in correspondence of Pescale locality with its subvertical carbonate cliff; (**c**,**d**) ten-year evolution of the mushroom shaped structure from 1986 (**c**) to 1996 (**d**). Reprinted with permission from Ref. [28]. the Societaà dei Naturalisti e Matematici di Modena APS.

3. Materials and Methods

The project for the valorization of the study area started thanks to a bottom-up input. In fact, the request for the implementation of activities aimed at the enhancement of the rich and diverse geological heritage of the investigated fluvial stretch was supported by the local population (as ecological volunteers, hiking groups, sport associations . . .). Then, in order to satisfy this request, the Municipality of Castellarano, thanks to the support of the Emilia-Romagna Region and the Emilia Centrale Parks Managing Authority, have stipulated an agreement with the University of Modena and Reggio Emilia, for the implementation of non-formal learning activities for the valorization of the area. Three geosites located along the investigated cycle-pedestrian path were the object of attention for the implementation of such activities. In fact, due to their good accessibility and/or visibility they offered a learning opportunity to understand how anthropic activity, structural geological factors and river dynamics have influenced the landscape evolution of the site. The non-formal learning activities were based on the interpretation of the geological and geomorphological features of the study area, and they have implied the rearrangement of scientific and technical contents in more intellectually accessible ways. This was achieved by making semantic and conceptual simplifications without losing scientific integrity and still providing accurate information/explanations [20,30].

In order to develop coherent interpretive themes and select the best interpretive means, an interpretative plan was designed in collaboration with the Municipality of Castellarano, the Emilia Centrale Parks Managing Authority and the Emilia-Romagna Region with the involvement of local stakeholders. Regarding the design of the interpretative plan, different methods have been presented in literature (cf. [31,32]). In particular, Hughes and Ballantyne [15] identified three steps that most of these methods have in common:

- Definition of the objectives of the interpretation;
- Turn of the objectives into themes;
- Selection of the best interpretative means.

Inspired by these steps, the procedures followed in this paper, for the implementation of the interpretative means, are summarized in Figure 3 and a synthetic description of each step is reported in the following lines.

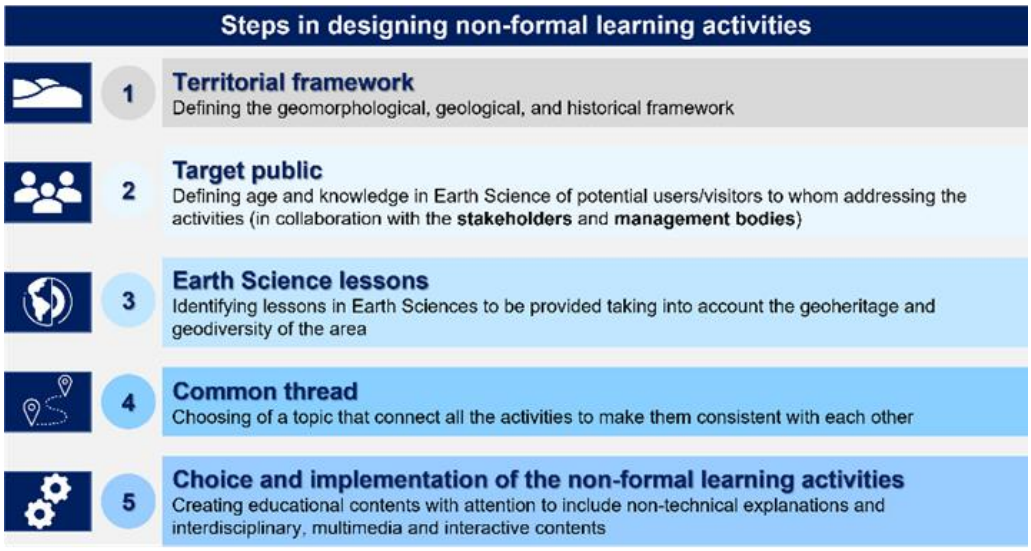

Figure 3. Steps followed in the design and implementation of the interpretative plan for the valorization of the cycle-pedestrian path located along the Secchia River (Municipality of Castellarano, Northern Italy) through non-formal learning activities.

First of all, the geological and geomorphological framework of the study area was defined on the basis of data from literature and on the authors' knowledge of the area (see

Section 2). Particular attention was devoted to the characterization of the three geosites. Historical maps from the early 19th century, historical photographs, old urban plans, and projects, retrieved from the Historical Archive of the Municipality, were also considered. This with the purpose of integrating geological and cultural heritage information.

Secondly, the definition of the target audience was crucial to select the best interpretative means. To this aim some reflections on this topic in the field of geotourism have been considered [21,32–36]. In particular, one of the earliest reflections on the topic is included in the manual by Ham et al. [32] where the need of implementing interpretation plans from the point of view of the audience is stressed. The authors also suggested to outline simple audience categories as the best way to work in interpretive planning. On the same note, Dowling [34] remarked the importance to achieve the satisfaction of geotourists (also taking care of visitor safety during the site visit) in order to guarantee the success of geotourism activities, including interpretation. Regarding the identification of visitor's types, Gorman [33] proposed a classification based on market requirements. The author associated visitor's types with an increasing value according to their potential contribution to the economy of the visited area. In the same paper, the following types of tourists were identified: accidental and general visitors (from low to medium value), and interested and Scholarly visitors (from medium to high value).

More recently, Božić and Tomić [35] and Vasiljević et al. [36], based on the results of visitors' surveys, outlined different geotourists' profiles. In detail, Božić and Tomić [35] focused their analysis on the geotourists' classification proposed by Grant [37] which takes into account geotourists' interest and previous knowledge in Earth Sciences (see Section 4 for more details). The authors compared the appreciation of the different values of geosites (e.g., Scientific/Educational, Scenic/Aesthetic values) between general geotourists (understood as visitors motivated by a general interest in nature and in activities based on geosites) and pure geotourists (greatly interested with knowledge in geology). The authors found that the first type gives more importance to human-induced values (e.g., promotion, good quality of interpretative panels and tour guide services) while the second type appreciates natural values of a geosite (e.g., rarity, presence of viewpoints). Similarly, Vasiljević et al. [36] distinguished different types of potential geotourists' profiles which were outlined based on the different geotourists' attitudes. The authors found that the major characteristics of geotourists were their interests for local communities and their appreciation in the involvement of such communities in tourism development.

Inspired by these remarks, in the present study, the target public was selected with the collaboration of the local administrations and the Emilia Centrale Parks Managing Authority (see Section 4).

Based on the outlined territorial framework, the third step was aimed at identifying the features that make the investigated area attractive for visitors and important for providing them with lessons in Earth Sciences. The term "lessons" should not be considered in the canonical/formal way, but it is more like take-at-home messages and basic geoscientific information concerning the geology (mainly structural geology and stratigraphy) and geomorphology of the area. The considered features were relevant not only to the geological and geomorphological aspects, but also to the location of point of views, the presence of human artifacts, historical events or stories and traditions (as suggested by Hughes and Ballantyne [15] and references therein).

In order to create a consistent itinerary among the three geosites, a theme, a common thread, was identified. The topic was chosen considering the storytelling opportunities provided by the investigated area including natural, territorial, and historical aspects.

Lastly, three main non-formal learning activities, i.e., interpretative panels, Earth-Caching and guided excursions were chosen as suitable interpretative means. In the following subsection, guidelines and procedures applied for the implementation of these activities are presented.

3.1. Interpretative Panels Guidelines and Procedures

According to literature (e.g., [16,19,38]) and authors' experience, attractive panels should include the features summarized in Figure 4. In particular, contents should be understandable, to help the reader to recognize and assimilate information. Photographs and diagrams may help in visualization and conceptualization of the scientific information. In fact, they are useful to schematize the landscape of a certain area visible from the visitor's position [20], as well as visible and non-visible geological and geomorphological processes/features [39]. Pictures and drawings may be inserted as well, with instructional and decorative purposes. In fact, they are demonstrated to be beneficial in the learning process [40], but it is important to define a common drawing style to make possible the association between all the panels implemented. Moreover, according to Migoń and Pijet-Migoń [18] it would be preferable to follow a common thread and to develop a theme creating a story that visitors can follow consulting panel after panel. The authors propose the storytelling approach in designing interpretative panel contents rather than simply providing information unrelated to each other. In order to create a story, the progressive idea of geologic time, for instance, can be followed [19]. Regarding the panel installation, their location should be effective and the relationship between durability, cost, and aesthetics should be evaluated to identify the best compromise. To encounter all these requirements, panels should be developed in partnership with experts in visual communication.

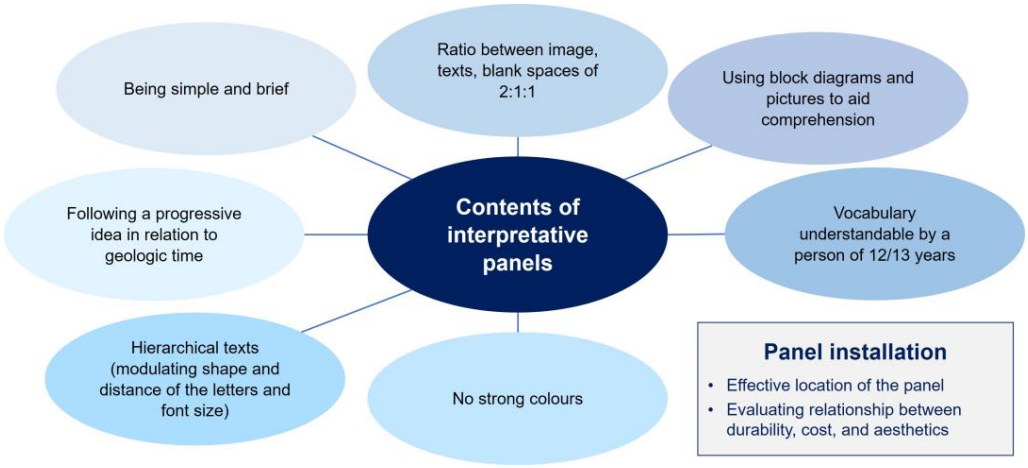

Figure 4. Tips on the implementation of the interpretative panels' content based on literature related to the topic (see references in the text).

3.2. EarthCache Guidelines and Procedures

GeoCaching is a GPS-based treasure hunt that has been practiced since May 2000, that is when the access to GPS positional accuracy was made available by the United States Government to every GPS device. GeoCaching consists of hiding a container in a particular location, then publishing the latitude and longitude of the location on the Geocaching web/mobile application for other "geocachers", to be found using a GPS device [41–43]. This activity is very popular, in fact in 2017 the worldwide hidden GeoCaches reached 3 million. There are different styles of cache with some demanding an online or field puzzle to be solved before the final coordinates are revealed or others that do not have a physical container, e.g., virtual GeoCaches and EarthCaches. These latter are special types of GeoCaches for which there is not a container but Earth itself provides the treasure. EarthCaches: (i) provide a lesson in Earth Sciences; (ii) are educational; (iii) highlight a unique feature providing a unique experience to the visitors as well as a unique lesson about the feature at the site. Moreover, logging an EarthCache demands GeoCachers to deal with site-specific tasks that provide a learning opportunity related to the topic. GeoCachers use the information from the EarthCache web page as well as their on-site observations to solve the task. Their task/solution logs prove that GeoCachers have visited the site.

EarthCaching promotes outdoor sustainability and sustainable tourism since it adheres to the principle of "Leave no Trace" that refers to the enjoyment of the environment without damaging natural assets or ecosystems.

For the creation of a new EarthCache, it is necessary to follow specific guidelines available on the dedicated web page at the Geological Society of America (GSA) web site [44]. In fact, EarthCaching is a program developed and coordinated by GSA and when a new EarthCache is submitted, it undergoes revisions by geoaware members of the EarthCache Team. The new EarthCache is published only after reviewers' approval. The steps for the creation of EarthCaches are summarized in Figure 5.

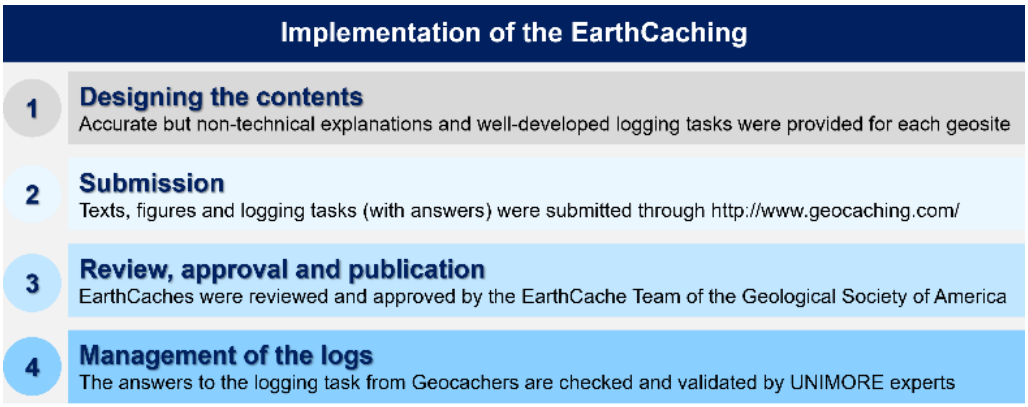

Figure 5. Steps followed in this study for the creation of a new EarthCache.

EarthCaching is not only a game, in fact it adheres to the four attributes defined by Jonassen [45] for a meaningful learning experience mediated by technology (cf. [11,46,47]). EarthCaching is: (i) active, since the EarthCacher searches for the place and wants to solve the tasks at the location; (ii) intentional, since the EarthCacher has the intention of discovering, solving, and logging tasks; (iii) authentic, since the challenges/tasks required for EarthCache log are carried out in nature; (iv) cooperative, since EarthCache visitors can interact with the Geocaching Community.

3.3. Guided Excursions

As reported by Moreira [19], the interpretative resources can be classified into non-personalized and personalized. The first are those that do not directly use people as interpreters (e.g., interpretative panels, signs, publications); the second include interaction between the public and a person with the role of interpreter (e.g., guided tours, lectures, games, simulations). The personalized resources offer the opportunity to establish empathy between visitors and experts making the Earth Science lesson provided more effective. With the aim of providing personalized interpretative resources aimed at the discovery of the valuable features of the study area, guided excursions were organized by local administrations with the involvement of the geomorphologists of the University of Modena and Reggio Emilia, in quality of experts, together with a specialized environmental guide.

4. Results and Discussion

The outputs of the implementation of the interpretative plan are presented in this paragraph and related subsections.

The territorial framework outlined earlier in this study identifies the interpretative potential of the area. Regarding the definition of the target audience, different types of audience were identified according to the classification provided by Grant [37], i.e.,

- General 'visitors' who are either unaware, aware, or interested in geological tourism;
- 'Geo' tourists who range from geo-amateurs (amateur but their visit is driven by an interest in the subject), to geo-specialists (geo-degree or similar driven by technical interests), to geo-experts (highly informed and interested in specific site or features).

Considering the geological and geomorphological features and processes characterizing each of the three geosites, lessons in Earth Sciences were selected (cf. Table 1). In order to create a consistent itinerary among the three geosites a common theme/thread was chosen, namely "The River and the Human Being". This topic was developed in different ways among the activities, i.e., the Castellarano dam geosite offered the opportunity to provide information about the anthropic modifications to the riverbed, while the Pescale geosite was suitable to discuss the geological and geomorphological features which make fluvial terraces favorable places for human settlements since the Prehistoric period (cf. Table 1).

Table 1. Earth Science lessons and common thread (theme) chosen to be associated to the related geosite.

Geosite Name	Description	Lessons in Earth Sciences	Common Thread Development
Stretta di Pescale	Narrow stretch of the Secchia River at Pescale locality	Processes leading to the formation of fluvial terraces	The fluvial terraces as a favorable place for human settlements
		Rock displacement due to faulting	
Traversa di Castellarano	Castellarano dam	Sedimentary processes for the formation of turbidite rocks	Riverbed modifications induced by anthropic interventions
		Rock folding due to Apennine orogeny	
Il "Fungo" dell'alveo del Secchia	Mushroom-shaped structure along Secchia River	Fluvial erosion	The response of the river to the anthropic interventions
		Selective erosion processes	

To meet the needs of these different types of target public, an interpretative plan with multiple interpretative strata (cf. [20,21]) was designed:

(1) Base level: Corresponds to interpretative panels, which resulted in static installations presenting basic information regarding the area. They were designed to be addressed to general visitors with the purpose of attracting readers' attention;
(2) Second level: Corresponds to material with more complex content, which is not only intended to motivate the visitor, but also to provide specific knowledge. They are addressed to "interested" visitors and geo-amateurs who have already a certain motivation, but not necessarily the knowledge in geology and geomorphology. GeoCaching activities were designed to engage this type of audience;
(3) Third level: Corresponds to material with contents of a certain complexity, for people with a specific motivation to learn about certain aspects (geo-specialists and geo-experts). The contents include a list of references, maps, and other technical sources. A web page in the web site of the Castellarano Municipality was designed to address this type of audience. The web page is accessible also by scanning a QR code that can be found on the interpretative panels.

Guided excursions can be tailored to the target audience, thus they can be either attributed to the second and/or the third level of interpretation. They also provide an opportunity to test the effectiveness of the designed materials. In the following subsections the implemented non-formal learning activities (interpretative panels, EarthCaching, guided excursions) are presented.

4.1. Interpretative Panels

According to the interpretative plan four panels located along the investigated cycle-pedestrian path were designed and installed (Figure 6). The first panel was dedicated to the description of the itinerary through the three geosites, while the other three panels were dedicated to one of the three geosites each. The order of these three panels followed the direction of the Secchia River flow. The first panel introducing the itinerary was installed at the entrance of the cycle-pedestrian path, while the other panels were located not far from the respective geosite, in correspondence of a viewpoint from which the reader is able to clearly see the geosite. The place of panel installation was decided by the local Department of the Environment not only considering the view of the geosites but also to avoid dangers for the visitors.

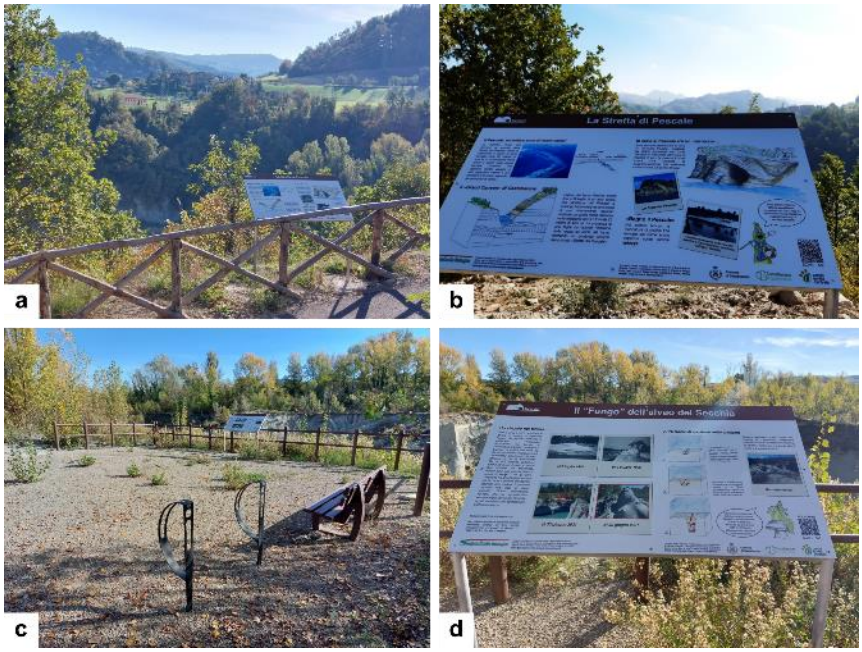

Figure 6. Two examples of the interpretative panels installed along the investigated fluvial stretch: (**a**,**b**) distant and closer view of the panel implemented for *Stretta di Pescale* geosite; (**c**,**d**) distant and closer view of the panel implemented for *Il "Fungo" dell'alveo del Secchia* geosite.

Panels include informative non-technical contents based on scientific information while schematic and simplified sketches were used to illustrate processes and features. In order to make the panels more attractive comics were inserted, in particular a mascot in the form of a caterpillar provides visitors with curious information regarding the geological and historical aspects of the site.

As mentioned above, a QR code to access a dedicated page of the web site of the Castellarano Municipality was included on the lower right corner of each interpretative panel [48]. In particular, the web page includes supplementary information on each of the three geosites, as well as animations, videos, maps and links to external resources (e.g., reference literature). The web page includes an English translation in order to make the interpretative contents accessible to a foreign audience.

4.2. EarthCaching

Three EarthCaches were implemented for each geosite object of interest. The position of the EarthCaches correspond to the positions of the panels providing visitors with a clear and safe view of the geosite. The texts of the EarthCaches include accurate but non-technical explanations related to the features that the visitors will find at the site. Explanations are brief, ranging between 300 and 400 words. The cache page includes a description of the site and site-specific logging tasks, related to the geology and geomorphology, written in

both Italian and English. For every EarthCache four logging tasks are provided assuming a basic knowledge of geology and a certain interest and motivation in accomplishing the tasks. Interpretative panels may also provide some help for the task completion. The Cache page also includes pictures of the site and diagrams to better explain geological and geomorphological features and processes.

The answers to the logging tasks are managed by the EarthCache owners, namely the geomorphologists' team of the University of Modena and Reggio Emilia.

In Table 2 the topics of the site-specific tasks are shown. The tasks were categorized based on the classifications of the subject-specific competences in Geography by Wall and Donert [49] and to the Geographical Standards used as a guideline in German high school teaching [50] (cf. [46,51]). These two classifications were generalized and adapted extending them to the Earth Science subject.

Table 2. Main topics of the tasks required to log the implemented EarthCaches in relation to the subject-specific competences/performances involved (see references in the text).

Geosite	Topic of the Task	Main Competences/Performances
Stretta di Pescale	Explaining what a fault is	Appropriately using subject-specific terminology
	Estimating the height of the fluvial terrace	Using subject-specific methods
	Describing the outcropping rocks	Collecting, comparing, analyzing, and presenting subject-specific information
	Arguing why human beings have chosen fluvial terraces as places for settlements since the Prehistoric period	Comprehending the reciprocal relationships between physical and human environments
Traversa di Castellarano	Definition of anticline and syncline	Appropriately using subject-specific terminology
	Describing the outcropping rocks	Collecting, comparing, analyzing, and presenting subject-specific information
	Arguing about the selective erosion processes	Interpreting landscapes
	Estimating the height of the river dam	Using subject-specific methods
Il "Fungo" dell'alveo del Secchia	Meaning of erosion rate	Comprehending the nature of change
	Describing the present-day appearance of the mushroom-shaped structure	Interpreting landscapes
	Estimating the depth of the Secchia River gorge	Using subject-specific methods
	Taking a picture of the riverbed for future comparisons	Using subject-specific methods

4.3. Guided Excursions

Guided excursions were organized along the cycle-pedestrian path by the Municipality of Castellarano in collaboration with the Emilia Centrale Parks Managing Authority for the Week of the Planet Earth.

Geomorphologists of the University of Modena and Reggio Emilia were involved in accompanying visitors along the tours together with a specialized environmental guide who provided visitors with notions regarding the biotic aspects and some curious historical facts.

Every guided excursion was attended by ca. 20 people, approximately 10% of the participants were teenagers, 25% were children and the rest were adults, the latter were mainly amateurs with an interest in the subject (geo-amateurs).

5. Conclusions

This paper presented the implementation of a project aimed at enhancing the geological heritage and geodiversity of a fluvial area in the Municipality of Castellarano (Northern

Apennine, Italy) through non-formal learning activities. Although the investigated area is characterized by a rich and diverse geological and geomorphological heritage, it was not a common tourist destination and not very well-known even by local people. The request for the implementation of activities aimed at the valorization of the area was supported by local administrations as well as by local stakeholders who encourage its renaturation. In this context, non-formal learning activities (i.e., interpretative panels, EarthCaches and guided excursions) were implemented focusing on three geosites located within the investigated fluvial area. Local cultural and historical aspects were also considered.

The activities were designed considering different interpretative levels addressed to different types of target audiences (general visitors and geotourists) based on their interests and background in Earth Sciences.

In this context, the paper has presented one of the first studies in Italy on geoheritage enhancement supported by a bottom-up input which experienced the collaboration between the University and the local administrations and stakeholders. This is particularly new especially if one considers that the area is not included in a National Park or Reserve where generally the natural features (including geology and geomorphology) attract more the attention of administrations and stakeholders. At the international level, this work has presented one of the few attempts to combine more traditional interpretative means, namely, interpretative panels and guided excursions, with the less familiar EarthCaching. This resulted in the creation of a consistent itinerary among all these activities. The effectiveness of the non-formal learning activities was tested in different ways. In the case of interpretative panels, guided excursions were used to retrieve feedback from the public in the form of oral comments of appreciation or critics or requests for clarification made during the visit. To date, the visits aroused certain interest, but for a systematic study of the appreciation of the activities a more extensive sample of visitors is necessary. In the near future, to understand the effectiveness of these activities, feedback from visitors and local communities will be systematically collected through comment cards or questionnaires.

In the case of EarthCaching, an idea of its efficacy and appreciation is given by the answers and comments included in the GeoCachers' log. Moreover, after an initial stop in school field trips imposed by the COVID-19 pandemic, EarthCaches are currently used by the Emilia Centrale Parks Managing Authority to carry out dissemination activities addressed to school children, providing an opportunity to test the efficacy of such activities on a young public. From a Citizen science perspective, through EarthCache, visitors can play a role in the monitoring of the state of maintenance of the place and of the interpretative panels, in fact who posts comments and images will effectively monitor the site (see also [30]).

In conclusion, to face the new challenges that global climate and societal changes are imposing, it stands to reason that one of the crucial aspects is the valorization of territories based on their environmental and natural resources, including geoheritage [24,52,53]. From this thought, this paper was also intended to contribute in the challenge to raise awareness of geoconservation starting from the engagement of local communities involving local administrations and stakeholders, schools, and associations (e.g., see [54]). To face this challenge and to build these local networks, in this paper an extra effort has been put into geoheritage interpretation.

Author Contributions: Conceptualization, P.C., V.V. and A.G.; methodology, P.C. and V.V.; investigation, V.V. and A.G.; data curation, P.C. and V.V.; writing—original draft preparation, P.C., V.V. and A.G.; writing—review and editing, P.C., V.V. and A.G.; visualization, V.V.; supervision, P.C. and A.G.; project administration, P.C.; funding acquisition, P.C. All authors have read and agreed to the published version of the manuscript.

Funding: The research was carried out in the frame of the following projects: (i) "Conservation and enhancement of the geodiversity of Castellarano Municipality" funded by the Municipality of Castellarano, the Emilia Centrale Parks Managing Authority and the Emilia-Romagna Region—Scientific responsible: Paola Coratza (Unimore); (ii) "Training new generations on geomorphology, geohazards and geoheritage through Virtual Reality Technologies" (GeoVT) under the Erasmus+

Programme, Key Action 2: Partnerships for Cooperation (Agreement number: 2021-1-SE01-KA220-HED-000032142)—Coordinator: Georgia Destouni (University of Stockholm); Partner organization leader: Mauro Soldati (Unimore); (iii) "Analysis of the interaction between fluvial dynamics and slope processes aiming at the recognition of geomorphological risk situations" within the framework of the collaboration between the Inter-Departmental Research and Innovation Centre on Constructions and Environmental Services (CRICT) of the University of Modena and Reggio Emilia and the Regional Agency for Territorial Safety and Civil Protection of Emilia-Romagna—Scientific responsible: Mauro Soldati (Unimore).

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: The authors are thankful to the three anonymous reviewers for their useful suggestions.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Georgousis, E.; Savelidi, M.; Savelides, S.; Holokolos, M.-V.; Drinia, H. Teaching Geoheritage Values: Implementation and Thematic Analysis Evaluation of a Synchronous Online Educational Approach. *Heritage* **2021**, *4*, 3523–3542. [CrossRef]
2. Gerbaudo, A.; Lozar, F.; Lasagna, M.; Tonon, M.D.; Egidio, E. Are We Ready for a Sustainable Development? A Survey among Young Geoscientists in Italy. *Sustainability* **2022**, *14*, 7621. [CrossRef]
3. Gill, J.C. Geology and the Sustainable Development Goals. *Epis. J. Int. Geosci.* **2017**, *40*, 70–76. [CrossRef]
4. Stewart, I.S.; Gill, J.C. Social Geology—Integrating Sustainability Concepts into Earth Sciences. *Proc. Geol. Assoc.* **2017**, *128*, 165–172. [CrossRef]
5. Bruschi, V.M.; Coratza, P. Geoheritage and Environmental Impact Assessment (EIA). In *Geoheritage*; Elsevier: Chennai, India, 2018; pp. 251–264, ISBN 978-0-12-809531-7.
6. Hose, T.A. Selling the Story of Britain's Stone. *Environ. Interpret.* **1995**, *10*, 16–17.
7. Gray, M. *Geodiversity: Valuing and Conserving Abiotic Nature*, 1st ed.; John Wiley & Sons: Hoboken, NJ, USA, 2004; ISBN 0-470-09081-2.
8. Gray, J.M. *Geodiversity: Valuing and Conserving Abiotic Nature*, 2nd ed.; John Wiley & Sons Inc.: Chichester, UK, 2014; ISBN 978-1-118-52509-8.
9. Joyce, B. Australias Geological Heritage a National Inventory for Future Geoparks and Geotourism. In *Geotourism: The Tourism of Geology and Landscape*; Newsome, D., Dowling, R.K., Eds.; Goodfellow Publishers: Oxford, UK, 2010; ISBN 978-1-906884-09-3.
10. Newsome, D.; Dowling, R.K. (Eds.) *Geotourism: The Tourism of Geology and Landscape*, 1st ed.; Goodfellow Publishers: Oxford, UK, 2010; ISBN 978-1-906884-09-3.
11. Zecha, S.; Regelous, A. Promoting Geodiversity Education by Using EarthCaching in National Geoparks. *Geoheritage* **2018**, *10*, 637–643. [CrossRef]
12. Selmi, L.; Canesin, T.S.; Gauci, R.; Pereira, P.; Coratza, P. Degradation Risk Assessment: Understanding the Impacts of Climate Change on Geoheritage. *Sustainability* **2022**, *14*, 4262. [CrossRef]
13. Began, M.; Višnić, T.; Djokić, M.; Vasiljevic, D.A. Interpretation Possibilites of Geoheritage in Southeastern Serbia—Gorge and Canyon Study. *Geoheritage* **2017**, *9*, 237–249. [CrossRef]
14. Brilha, J.; Reynard, E. Geoheritage and Geoconservation: The Challenges. In *Geoheritage*; Elsevier: Chennai, India, 2018; pp. 433–438, ISBN 978-0-12-809531-7.
15. Hughes, K.; Ballantyne, R. Interpretation Rocks Designing Signs for Geotourism Sites. In *Geotourism: The Tourism of Geology and Landscape*; Goodfellow Publishers: Oxford, UK, 2010; pp. 184–199, ISBN 1906884099.
16. De Oliveira Vasconcelos, J.M. Interpretação Ambiental. In *Manual de Ecoturismo de Base Comunitária: Ferramentas Para um Planejamento Responsável*; WWF Brasil: Brasília, Brazil, 2003; pp. 261–294.
17. Hose, T.A. 3G's for Modern Geotourism. *Geoheritage* **2012**, *4*, 7–24. [CrossRef]
18. Migoń, P.; Pijet-Migoń, E. Interpreting Geoheritage at New Zealand's Geothermal Tourist Sites—Systematic Explanation Versus Storytelling. *Geoheritage* **2017**, *9*, 83–95. [CrossRef]
19. Moreira, J.C. Interpretative Panels about the Geological Heritage—A Case Study at the Iguassu Falls National Park (Brazil). *Geoheritage* **2012**, *4*, 127–137. [CrossRef]
20. Carcavilla, L.; Berrio, M.P.; Belmonte, A.; Durán, J.J.; López-Martínez, J. Geological Diffusion among the General Public: Principles, Techniques and Methods for the Design of Written Information. *Boletín de la Real Soc. Española de Hist. Nat. Sección Geológica* **2010**, *104*, 93–110.
21. Prendivoj, S.M. Tailoring Signs to Engage Two Distinct Types of Geotourists to Geological Sites. *Geosciences* **2018**, *8*, 329. [CrossRef]

22. Colardyn, D.; Bjornavold, J. Validation of Formal, Non-Formal and Informal Learning: Policy and Practices in EU Member States. *Eur. J. Educ.* **2004**, *39*, 69–89. [CrossRef]
23. Parliamentary Assembly of the Council of Europe Recommendation N 1437 on Non-Formal Education, Access to Information, Young Person, Adopted by the Committee on Culture, Science and Education on 24 January 2000 at the Assembly Debate (1st Sitting) 2000. Available online: https://assembly.coe.int/nw/xml/XRef/Xref-XML2HTML-EN.asp?fileid=16762 (accessed on 1 September 2022).
24. Coratza, P.; Vandelli, V.; Soldati, M. Environmental Rehabilitation Linking Natural and Industrial Heritage: A Master Plan for Dismissed Quarry Areas in the Emilia Apennines (Italy). *Environ. Earth Sci.* **2018**, *77*, 455. [CrossRef]
25. Bettelli, G.; Panini, F. Introduzione Alla Geologia Del Settore Sud-Orientale Dell'Appennino Emiliano. In *L'Appennino Settentrionale*; Centro Duplicazione Offset Srl: Florence, Italy, 1992; Volume 76, pp. 207–240.
26. Gasperi, G.; Preti, G.; Bettelli, G.; Panini, F.; Pizziolo, M.; Bonazzi, U.; Fioroni, C.; Fregni, P.; Vaiani, S.C. *Note Illustrative Della Carta Geologica d'Italia Alla Scala 1: 50.000. Foglio 219" Sassuolo"*; APAT: Rome, Italy, 2006.
27. Balocchi, P.; Little, W.W. Influence of the Canossa-San Romano Fault System on the Development of the River Secchia Fluvial Terraces (Northern Apennines, Italy). *Atti Soc. Nat. Mat. Modena* **2020**, *2020*, 31–51.
28. Bonazzi, U. Una Forma d'erosione Differenziale Nell'alveo Del Fiume Secchia (Pedeappennino Modenese). *Nat. E Mat. Di Modena* **1995**, *126*, 19–27.
29. Bonazzi, U. Modificazioni d'alveo Del Fiume Secchia Avvenute Negli Ultimi Cento Anni Nei Dintorni Di Sassuolo (Modena). Atti Soc. *Nat. E Mat. Di Modena* **1996**, *127*, 67–99.
30. Macadam, J. Geoheritage. In *Geoheritage*; Elsevier: Chennai, India, 2018; pp. 267–288, ISBN 978-0-12-809531-7.
31. Brochu, L. *Interpretive Planning: The 5-M Model for Successful Planning Projects*; National Association for Interpretation: Fort Collins, CO, USA, 2003; ISBN 978-1-879931-12-1.
32. Ham, S.H.; Housego, A.; Weiler, B. *Tasmanian Thematic Interpretation Planning Manual*; Tourism Tasmania: Hobart, TAS, Australia, 2005.
33. Gorman, C.E. Landscape and Geotourism: Market Typologies and Visitor Needs. In Proceedings of the Promotion and Protection, Achieving the Balance, Dublin, Ireland, 18–19 October 2007; pp. 1–12.
34. Dowling, R.K. Geotourism's Global Growth. *Geoheritage* **2011**, *3*, 1–13. [CrossRef]
35. Božić, S.; Tomić, N. Canyons and Gorges as Potential Geotourism Destinations InSerbia: Comparative Analysis from Two Perspectives—Generalgeotourists' and Pure Geotourists'. *Open Geosci.* **2015**, *7*, 20150040. [CrossRef]
36. Vasiljević, Đ.A.; Vujičić, M.D.; Božić, S.; Jovanović, T.; Marković, S.B.; Basarin, B.; Lukić, T.; Čarkadžić, J. Trying to Underline Geotourist Profile of National Park Visitors: Case Study of NP Fruška Gora, Serbia (Typology of Potential Geotourists at NP Fruška Gora). *Open Geosci.* **2018**, *10*, 222–233. [CrossRef]
37. Grant, C. Towards a Typology of Visitors to Geosites. In Proceedings of the Second Global Geotourism Conference, Making Unique Landforms Understandable, Mulu, Sarawak, Malaysia, 16–20 April 2010; pp. 17–20.
38. Hose, T.A. European Geotourism–Geological Interpretation and Geoconservation Promotion for Tourists. In *Geological Heritage: Its Conservation and Management*; Instituto Tecnologico Geominero de Espana: Madrid, Spain, 2000; pp. 127–146.
39. Sanz, J.; Zamalloa, T.; Maguregi, G.; Fernandez, L.; Echevarria, I. Educational Potential Assessment of Geodiversity Sites: A Proposal and a Case Study in the Basque Country (Spain). *Geoheritage* **2020**, *12*, 23. [CrossRef]
40. Lenzner, A.; Schnotz, W.; Müller, A. The Role of Decorative Pictures i:n Learning. *Instr. Sci.* **2013**, *41*, 811–831. [CrossRef]
41. O'Hara, K. Understanding Geocaching Practices and Motivations. In Proceedings of the Twenty-Sixth Annual CHI Conference on Human Factors in Computing Systems—CHI '08, Florence, Italy, 5–10 April 2008; ACM Press: Florence, Italy, 2008; p. 1177.
42. Clough, G. Geolearners: Location-Based Informal Learning with Mobile and Social Technologies. *IEEE Trans. Learn. Technol.* **2010**, *3*, 33–44. [CrossRef]
43. Clough, G. Mobile Informal Learning through Geocaching. In *Mob. Learning: The Next Generation*; Taylor and Francis: New York, NY, USA, 2016; pp. 43–66, ISBN 978-113512365-9.
44. EarthCache Guidelines. Available online: https://www.geosociety.org/GSA/Education_Careers/Field_Experiences/EarthCache/GSA/fieldexp/EarthCache/guidelines/home.aspx (accessed on 20 October 2022).
45. Jonassen, D.H. *Learning to Solve Problems with Technology: A Constructivist Perspective*; Prentice Hall: Hoboken, NJ, USA, 2003; ISBN 978-0-13-048403-1.
46. Zecha, S.; Hilger, L. EarthCaches: An Opportunity for Learning Geoscience; a Pilot Study for Glaciomorphologically Themed EarthCaches. *J. Geogr. Inf. Sci.* **2015**, *1*, 324–334. [CrossRef]
47. Zecha, S. EarthCaching as a Possible Way to Raise Environmental Awareness? In *Geospatial Technologies in Geography Education*; de Miguel González, R., Donert, K., Koutsopoulos, K., Eds.; Key Challenges in Geography; Springer International Publishing: Cham, Switzerland, 2019; pp. 127–140, ISBN 978-3-030-17783-6.
48. Castellarano, Il Secchia e i Geositi. Available online: https://www.comune.castellarano.re.it/castellarano-il-secchia-e-i-geositi/ (accessed on 5 December 2022).
49. Wall, G.; Donert, K. HERODOT Thematic Network and the Tuning of Geography Education in Europe. *Planet* **2004**, *12*, 19–22. [CrossRef]

50. Educational Standards in Geography for the Intermediate School Certificate with sample assignments 3. Edition (2014). Available online: https://geographiedidaktik.org/download/educational-standards-in-geography-for-the-intermediate-school-certificate-with-sample-assignments-3-edition-2014/ (accessed on 7 November 2022).
51. Wall, G.P.; Speake, J. European Geography Higher Education Fieldwork and the Skills Agenda. *J. Geogr. High. Educ.* **2012**, *36*, 421–435. [CrossRef]
52. Coratza, P.; Vandelli, V.; Fiorentini, L.; Paliaga, G.; Faccini, F. Bridging Terrestrial and Marine Geoheritage: Assessing Geosites in Portofino Natural Park (Italy). *Water* **2019**, *11*, 2112. [CrossRef]
53. Cappadonia, C.; Coratza, P.; Agnesi, V.; Soldati, M. Malta and Sicily Joined by Geoheritage Enhancement and Geotourism within the Framework of Land Management and Development. *Geosciences* **2018**, *8*, 253. [CrossRef]
54. Van Vlack, K. Dancing with Lava: Indigenous Interactions with an Active Volcano in Arizona. In *Anthropological Perspectives on Environmental Communication*; Sjölander-Lindqvist, A., Murin, I., Dove, M.E., Eds.; Palgrave Studies in Anthropology of Sustainability; Springer International Publishing: Cham, Switzerland, 2022; pp. 29–53, ISBN 978-3-030-78040-1.