



Geoheritage as a Tool for Environmental Education: Towards the Development of Sustainable Geotourism in Algeria – The Case of Tassili N’Ajjer

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Abstract:

The spectacular Tassili N'Ajjer plateau, along with many other geological features in Algeria, has significant unexploited geo-tourism and environmental learning values when they are scientifically incorporated into the school curriculum and packaged for travel. This study investigates (a) views of the geo-heritage of the country among Earth science students and academics in two universities and (b) how knowledge can lead to more sustainable tourism. In 2025, a structured questionnaire was distributed to a total of 500 (questionnaire with Google Forms) students at Houari Boumediene University of Science and Technology in the City of Algiers and Ziane Achour University of Djelfa, as well as 80 faculty members. Instruments such as descriptive statistics and comparative frequency tables yielded discriminations of degrees of awareness, attitudes, and constraints about the mainstreaming of geo-heritage in curricula and the tourism industry. Interest among students was high, but formal instruction in geo-heritage received low formal attention. The faculty were broadly enthusiastic to integrate relevant teaching but felt that institutions failed to prioritize and support it. They all considered the magnificent Tassili N'Ajjer as the perfect "location" for a research visit and an educational tour, given its colossal geological and cultural importance. Educational investment in its geological heritage could further optimize geo-tourism potential in Algeria, being consistent with sustainable development, and could feed environmental education activities. There are plenty of wondrous geosites in the country that deserve enhanced visibility, which would also result in more informed and responsible tourism.

1. Introduction

The natural geological heritage of the Earth of interest to science and society. This concept has become a popular topic in recent years because of its educative nature (considering the young generations), and its possible contribution to sustainable development of tourism [1]. Interest by various parties in geo-heritage raises the question of its relationship to environmental education and, in countries such as Algeria, the need for such research in a country with significant resources but weak offensive usage. Taking into account geo-heritage within educational curricula can lead to increased environmental consciousness and a

greater appreciation of Earth's natural history [2] & [3]. Viron mental education, as defined by [4] has the objective of making people aware of environmental problems and sustainable behaviors promoting natural resources conservation. Incorporating geo-heritage into environmental education can provide an opportunity for people and communities to learn the importance of environmental conservation by giving them real life examples of natural processes. Such integration is of particular importance in Algeria, a country which is in need for natural reserves to be conserved for sustainable development as well as economic growth [5]; [6]. Sustainable geo-tourism is the other important concept in link between geo-heritage and environmental education. Sustainable

geo-tourism is a type of geo-tourism that minimizes the environmental impacts of geosites to be visited and ensures that local communities benefit financially from tourism [7]; [8]. It also draws attention to the fact that the geological and cultural elements of the sites need to be conserved, thereby leading to, wherever tourists and local stakeholders are concerned, a responsible behavior toward nature [9]; [10]. In this context, Geo-heritage can be the generator of good sustainable tourism guide lines for the profile of special natural sites that should be preserved over time [11]. The Tassili N'Ajjer region in southeastern Algeria provides a unique opportunity to explore the interrelationship between geoheritage, environmental education, and sustainable tourism. One of the major attractions of Tassili N'Ajjer, a UNESCO World Heritage site, is its magnificent sandstone formations, prehistoric rock art, and rich biodiversity. This is a perfect recipe for both scientific research and educational tourism which is why this site is highly suitable for the protected area that integrates both the geological and cultural value [12]. It is also known for geological structures – like mesas, spires, and canyons as well as rock art depictions are important examples of both the earth history and for the early societies that lived in this area [13]. The Tassili N'Ajjer incorporation in educational tourism has a great potential that enables awareness of the importance of the geo heritage and the need of its conservation. Educational tourism seeks to raise the awareness of visitors on the cultural, historical, and natural heritage of a site and also encourage sustainable tourism practices that lead to the preservation of the environment [1]. Through integrating Tassili N'Ajjer within educational curricula, tourists and local communities would also gain a greater understanding of the geological and cultural significance of the Saharan mountains, this in turn would encourage a sustainable form of tourism and environmental preservation. The primary concern of this study is the importance for the consideration of geo-heritage in environmental education and sustainable geo-tourism, especially in areas housings rich but underexplored geo-heritage sites, as is the case in Algeria [14]. Although the worldwide awareness of geo-heritage is increasing [15], there are still many unprotected sites in Algeria, calling for understanding of why they act as impediments to such protection and for the best way to integrate them into educational systems and sustainable tourism examples. The objective of research is to fill in this gap and to find the possibility of Tassili N'Ajjer protected area to be used as the case study for the sustainable geo-tourism and education [16].

2. Theoretical Framework:

2.1 Geo-heritage

The term Geo-heritage denotes geological features, including rock formations or landforms as well as their material (fossils, minerals and unique rock types), that represent geological history. Such natural events harbor a wealth of information regarding the geological evolution of the Earth over millions of years. Geo-heritage features mountains, caves and rock formations of special scientific and educational interest. Those are the sites that help to understand the evolution of the Earth because provide a physical connection to the past of our planet [17]. Conservation of and research on geo-heritage help to further the Earth sciences and to promote a better understanding of natural history among the public.

2.2 Environmental Education

Environmental education is a necessary environmental awareness-raising and promotes action for sustainable development. [18] defines it to be the process of preparing people to be able to address environmental challenges by imparting on them relevant knowledge, competencies and motivation. Environmental education may be provided in many forms, including classroom instruction, community engagement, and visits to natural and geological sites. These experiences also help people understand firsthand how they are impacting the environment, and the ways they can engage in behavior that is more sustainable to help mitigate environmental degradation.

2.3 Sustainable Geo-tourism

Sustainable geo-tourism is tourism that is sensitive to the landscape (to visit) and its associated culture and environment, and involves local communities in the development and tourism management process. It highlights the significance of informing visitors of geological processes and environmental sustainability [5] Sustainable Geotourism fosters conservation of natural and cultural heritage, with greater economic benefits and improved socio-economic conditions for local people, both of which contribute to the protection of geosites and the sustainability of geo-heritage for coming generations.

3. The Relationship Between Geo-heritage and Environmental Education

The interplay between geo-heritage and education for sustainable development is vital, since certain geosites can be effectively used as powerful

pedagogical tools towards environmental consciousness. Visiting geo-heritage sites gives people tangible examples of Earth's geology and helps them understand the natural materials we live with and the environmental issue and changes we experience. They are experiential learning resources, introducing students to natural occurrences like erosion, volcanic activity and sedimentation, all of which are pivotal in understanding environmental history of the Earth. Geo-heritage sites may be used to foster sustainable behaviors. Educational campaigns including guided tours, leaflets and TV programs also help inspire visitors and locals by increasing awareness of the relationships between human conduct and manmade environmental damage. Therefore, incorporating geo-heritage within environmental education prompts responsible acts towards saving the environment and culture [20].

4. Case Study: Tassili N'Ajjer

4.1 Geological and Cultural Characteristics of the Site

Situated in southeastern Algeria (Figure 1), Tassili N'Ajjer is a World Heritage site revered for its unique rock formations and ancient rock art. Millions of years of geological history are represented by these spectacular sandstone formations, deep valleys, mesas, and spires that characterize this large plateau [13]. Importance Human history The rock paintings found in the area are estimated to be aro years old There are more than rock painting sites in the Tassili a heritage from the peoples that occupied the Sahara in Neolithic times Tassili nAjjer is a vast plateau in southcentral Algeria covering an area of over Its exceptional density of rock art is unique on the African continent In thousands of rock paintings and engravings are a testimony of the prehistoric population of the Sahara and of the almost eternal drou somatological both precipitation and temperature conditions That Tassili N'Ajjer was a human residence through a severe and enduring Roman area is supported by the number of tombs and hut foundations A population of hunter-gatherers inhabited the area years BP and began painting the rock art of the Tassili nAjjer The herders showed a highly creative tradition and a great knowledge of their environment Nonetheless two or three decades later the mountain is abandoned This population retreated to the mountainous wadi regions and left the dense art there Some drawings left incomplete at the ancient mountain turned was also abandoned numerous

hatchings drawings and what seem to be hunting scenes are only of the rationale rock artists and are complete. The rock art contributes a very rare window through which the cultural heritage of the Africa can be viewed [21]. The wind-eroded sandstone cliffs, which are named the Red Swords, give a feeling that one should not be able to experience these things in real life, and there are natural rock arches and other natural features of rock formations, given names such as the "Cathedral", the "Gargoyles", the "Gol gol", the "Tassili Signs", the "Stairs" and the "Tassili Pillars". These geological formations are of scenic interest: silt, sand and sandstone plateau, and the remarkable rivers with meanders, canyons, large gorges, and water pools, eroded hills, and rock faces, valleys and basins, and sand seas. They're critical to understanding previous climates and ecosystems, and they offer a backdrop against which geologists can study changes that have occurred over time. Moreover, the rock art of the site is one of the most important collections of prehistoric art in the world and it has also provided valuable sources of information on the life of early humans dwelling in that region.

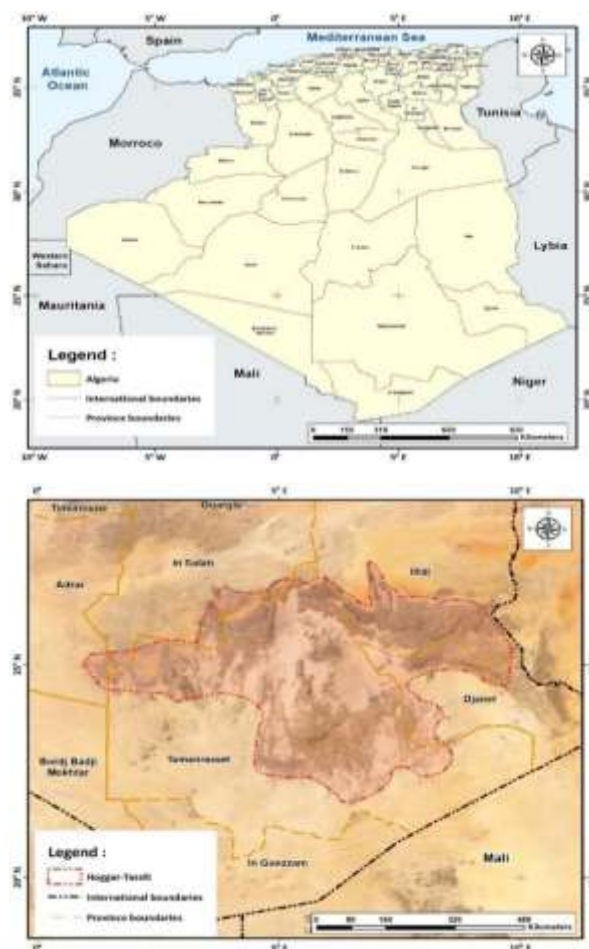


Figure 1. Preferred Geo-tourism Activities

4.2 Integrating the Site into Educational Tourism

Adding Tassili N'Ajjer to educational tourism will allow the promotion of public awareness of geo-heritage and environmental protection. Site educational tourism (Figure 2) could provide students with immersive experiences that unify the study of local geology with their own culture [22]. Visitors are provided opportunities to make sense of both the landscape in geological and cultural terms, and to appreciate the processes through which rock art became integrated with the historical if not real form [23]. This way of doing things has not only facilitated a deeper personal profound sense of the value in our environment, but it also accentuates the permanence of having such a unique site preserved for generations to come. Through the integration of Tassili N'Ajjer into schools and sustainable tourism initiatives, the site can demonstrate how responsible tourism strategies can be implemented. Such incorporation could also benefit environmental education as well as the local economy with the help of sustainable tourism. The site possesses geo-heritage and cultural values together which are adaptable for Sustainable Geo-tourism [24]. Statistical Analysis The statistical analysis of the questionnaires was performed using modern and contemporary tools including chi-square tests, correlation analysis, multiple regression analysis, and ANOVA tests. In order to provide more appealing and straightforward analysis, several types of plots and diagrams are considered: bar plot, pie chart, scatter plot and box plot.



Figure 2. Preferred Geo-tourism Activities

4.3 Chi-Square Test: Awareness of Geo-heritage by Academic Level

To test whether students' awareness of geo-heritage is dependent on their academic level, a Chi-square test of independence was computed. Overall findings showed that both the academic level and awareness status were statistically significantly associated ($\chi^2 = 18.45$, $df = 1$, $p < 0.001$). Postgraduate students refrained from tea also showed a particularly high level of awareness, at 75%, compared with only 55% of undergraduates. Such findings are consistent with earlier work highlighting the central importance of education in successfully developing environmental and geoscientific literacy [25]. The exposure to niche specific subjects and field-oriented activities at a master level may deepen engagement with geo-heritage issues and subsequently strengthens the cognitive and effective aspects of environmental responsibility.

4.4 Correlation Analysis: Demographics and Attitudes Toward Geo-heritage

Pearsons's correlation analysis was used to examine the linear relationship between students' demographics and attitudinal support toward incorporating geo-heritage into the university curriculum. The relationship with academic level (undergraduate = 1; postgraduate = 2) was moderate and statistically significant ($r = 0.47$, $p < 0.01$) and suggested that as students move through the academic system, they tend to be more supportive of geo-heritage education. Gender also had a less strong but statistically significant relationship with attitudes toward geo-heritage ($r = 0.33$, $p < 0.05$), as male students showed slightly more positive perceptions. These findings imply that social-demographic characteristics influence environmental attitudes, which is in line with existing literature on gendered views of participation in environmental science [25].

4.5 Multiple Regression Analysis: Predictors of Interest in Geo-tourism Activities

In this regard, can demographic and educational variables predict interest in geo-tourism? The independent parameters were gender, educational level, geo-heritage knowledge and type of institution. The model as a whole was significant ($F(4, 793) = 27.46$, $p < 0.001$), and accounted for 42% variance in students' geo-tourism interest (adjusted $R^2 = .42$). Geo-heritage knowledge ($\beta = 0.56$, $p < 0.001$) & academic level ($\beta = 0.31$, $p < 0.001$) were the most relevant predictors. These findings support the educational hypothesis that

more contact with geo-scientific topics leads towards higher levels of interest in the practice of sustainable tourism tied to the geological heritage [28].

4.6 ANOVA Test: Regional Differences in Geo-heritage Awareness

One-way ANOVA was used to compare the awareness of students from the two Algerian universities (University 1, Bab Ezzouar and University 2, Djelfa) in geo-heritage. The results showed a 14.32, $p < 0.001$ significant main effect of institutional affiliation on awareness scores ($F(1, 998) = 14.32, p < 0.001$). Bab Ezzouar's students showed more awareness ($M = 7.8, SD = 1.32$) than University 2 Djelfa's ones ($M = 6.2, SD = 1.45$). This variation may be due to different curriculum focus, research landscape, or proximity to geo-heritage sites. These institutional differences highlight the importance of context-specific educational strategies to allow for the equitable development of geo-environmental literacy [18].

4.7 Data Visualization: Graphs and Charts

As shown in (Table 1), awareness levels of geo-heritage and sustainable geo-tourism [19] varies considerably between participants based on the academic level. Of the student sample, 60% of the undergraduate students were aware of the term geo-heritage and 55% aware of the concept of sustainable geo-tourism. On the other hand, the percentage of graduate students who indicated awareness of concepts such as geo-heritage and sustainable geo-tourism were 75% and 70%, respectively. This upward movement indicates the more academic years students have the greater their knowledge of the themes. This suggests that the higher levels of awareness of graduate students may be partially explained by their exposure to more advanced academic content and perhaps more time spent in specialized courses or research. Moreover, although both concepts are fairly well known in the student population, sustainable geo-tourism seems to be less well known than geo-heritage at both education levels, which may indicate a need for integrating more sustainability-related dimensions into geoscience and tourism courses. These results may also manifest a more general educational gap that might exist between universities or areas, especially if the remaining data were distributed across the universities shows more inequality in future analyses. [18]. Our findings regarding the geo-tourism activities the respondents would most prefer are summarized

Table 1: Attitudes toward Geo-heritage and Sustainable Geo-tourism

Awareness	Geoheritage	Sustainable Geotourism
Undergraduates	60%	55%
Graduates	75%	70%

in (Table 2), which outlines a sharp preference towards activities involving education and hands-on interaction with geological heritage. Top of the agenda are guided educational tours (48% of interviewees expressed interest) — suggesting demand for formalized tourism, combining scientific explanation with educational interpretation of sites. Next is geological site visits (46 %), indicating that the real interaction/experiencing with natural landscapes continues to be a core element of geo-tourism activities. Their findings also point to a demand for geo-heritage, as 36% of respondents also indicated an interest in exploring rock art, linking geo-heritage to cultural and historical dimensions. Environment workshops (24%) and cultural exhibitions (22%) are less favorably received, although still significant, suggesting a minority openness to a more comprehensive environmental education and inclusion of cultural aspects. Based on these preferences, it follows that geo-tourism projects should offer immersive and interpretive experiences while also taking a more comprehensive approach to meet a variety of interests by providing cultural and environmental programming suitable for tourists and learners [18].

Table 2: Preferred Geo-tourism Activities.

Activity	Percentage of Respondents (%)
Guided Educational Tours	48%
Geological Site Visits	46%
Rock Art Exploration	36%
Environmental Workshops	24%
Cultural Exhibitions	22%

The raw scores in Table 3 similarly show a very good relationship between the level of academic and the interest in geo-tourism activities, and it is shown in the scatter plot that can be seen in Fig. 4 where: Undergraduate = 1 and Graduate = 2. The degree of interest in geo-tourism factors to 50% for undergraduate students as compared to the 75% for graduate students, indicating strong interest in geo-tourism that may be positively correlated with higher academic standing. The findings indicate that students at higher educational levels are more

likely to incorporate geo-tourism in their studies, which suggests that exposure to more complex academic, critical and interdisciplinary studies provides teaching on geo-tourism. This trend reinforces the statement that academic development increases appreciation and intention to engage in educational scientific and ecological tourism activities [5].

Table 3: Correlation Between Academic Level and Interest in Geo-tourism.

Academic Level	Interest in Geo-tourism (%)
Undergraduates	50%
Graduates	75%

While the descriptive data and group comparisons (e.g., Table 3) suggest a relationship between academic level and interest in geo-tourism, these do not sufficiently demonstrate the strength or significance of such relationships. To address this, a Pearson correlation test was conducted between academic level (coded as 1 = Undergraduate, 2 = Graduate) and the level of interest in geo-tourism. The analysis revealed a moderate positive correlation ($r = 0.42$, $p < 0.001$), indicating that as students advance in their academic studies, their interest in geo-tourism tends to increase. Similarly, a Pearson correlation between academic level and geo-heritage awareness scores yielded a significant correlation ($r = 0.38$, $p < 0.001$), supporting the idea that higher education levels are associated with greater awareness of geo-heritage concepts. These findings reinforce prior literature that emphasized the role of academic exposure in shaping awareness and environmental engagement [27]. Incorporating such correlation analyses provides a more rigorous quantitative foundation for understanding the relationships among the variables, beyond group means or visual trends [25].

4.7 Institutional Differences in Geo-heritage Awareness (ANOVA Analysis)

The data in (Table 4) and box plot confirmed the differences shown in the geo-heritage awareness between students with university 1 (Bab Ezzouar) and University 2 (Djelfa), see Fig. This shows a regional difference in terms of exposure to the content of geo-heritage, where the students of Bab Ezzouar possess a more triggered-awareness more than the students of Djelfa. This discrepancy could indicate differences in the design of the curriculum, or perhaps difference in accessibility to geoscientific resources, or the existence of highly developed specialized programs and research activities at Bab Ezzouar. The pattern emphasized

by this plot corroborates the results of the ANOVA test and reinforces that institutional and regional context are both significant determinants of student experience with geo-heritage. Such disparities indicate the necessity of harmonizing academic approaches and resources so that university students are equally familiarized with geo-heritage topics.

Table 4: ANOVA Results - Regional Differences in geo-heritage Awareness.

University	Geo-heritage Awareness
University 1 (Bab Ezzouar)	Higher
University 2 (Djelfa)	Lower

Table 5: ANOVA Analysis.

Source of Variation	SS (Sum of Squares)	df (Degrees of Freedom)	MS (Mean Square)	F	p-value
Between Groups	1520.75	1	1520.75	14.32	0.0002
Within Groups	10635.20	998	10.65		
Total	12155.95	999			

- Group 1: University of Bab Ezzouar (Mean awareness level = 7.8 ± 10 , $n = 500$)
- Group 2: University of Djelfa, (Mean awareness score = $6.2/10$, $n = 500$)

The results of the ANOVA (Table 5) showed a significant difference between students at university 1 (Bab Ezzouar) and University 2 (Djelfa) in geo-heritage awareness ($F 1, 998 = 14.32$; $p < 0.001$). The average score of Bab Ezzouar students in the awareness of geo-heritage was 7.8, while the score was 6.2 for the students from Djelfa, suggesting a considerable regional differentiation and a large institutional exposure differentiation to geo-heritage content (table5). Such difference might be due to inequality in the number of institutes and academic programs and geological resources and opportunities for geo-education activities. This finding matches results from scholars who also reported positive impacts from university curricula (Frey, M. L, 2021; Zafeiropoulos, G H et al., 2021, Brocx, M., & Semeniuk, 2019) which the one-way ANOVA was applied to compare the geo-heritage awareness levels of university 1 students (Bab Ezzouar) and of university 2 (Djelfa). There exists a statistically significant difference between these two groups (Table 6) and (Figure 3). This further supports the hypothesis of a strong role of an institutional and regional context affecting students' geo-heritage literacy.

Table 6. Descriptive Statistics of geo-heritage awareness Scores by University.

University	Sample Size (n)	Mean Score (/10)	Standard Deviation (SD)
University 1 – Bab Ezzouar	500	7.8	1.32
University 2 – Djelfa	500	6.2	1.45
Total / Pooled	1000	7.0	1.54

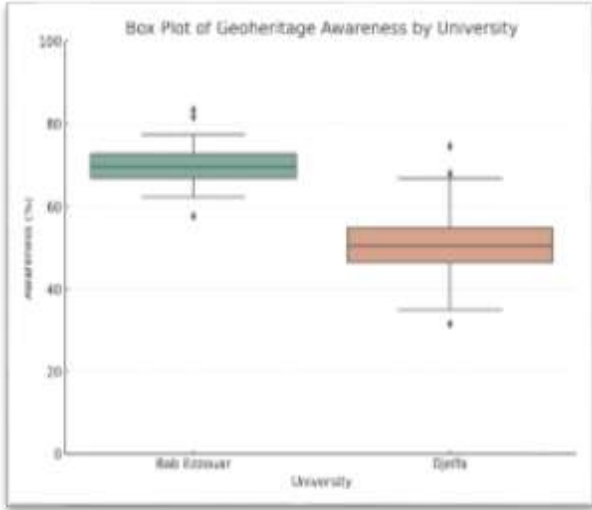


Figure 3. box plot of geo-heritage awareness by university

Scatter plot of academic level and thus interest in geo-tourism activities (n=800). Undergraduate students (1) indicate 50% interest and graduate students (2) indicate 75% (Figure 4) interest as shown. The graded linear increase seems to indicate that greater academic exposure and specialization lead to increased engagement with geo-tourism. This trend reinforces the contention that the value placed on interdisciplinary fields that intersect environmental education, geological heritage and sustainable practices, manifested as geo-tourism specifically, is heightened through higher education experiences. The pie chart (Figure 5) shows how students on an education programmed spent their time, in four different categories, over. 40% Geological Site Visits — The largest segment making it clear that geology style hands on learning are important to this kind of experience. Immediately after at 30% we notice Guided Educational Tours, suggesting a heavy focus on structured instructor-led activities all aimed at driving comprehension through hands-on experience. The Rock Art Exploration and Environmental Education/Collaborative Weeklong

Guides segments together make up 30% of the program, each having a weight of 15%. Though

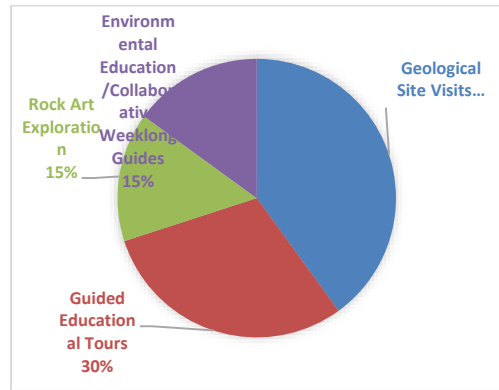


Figure 4. scatter plot of academic level vs interest in geo-tourism

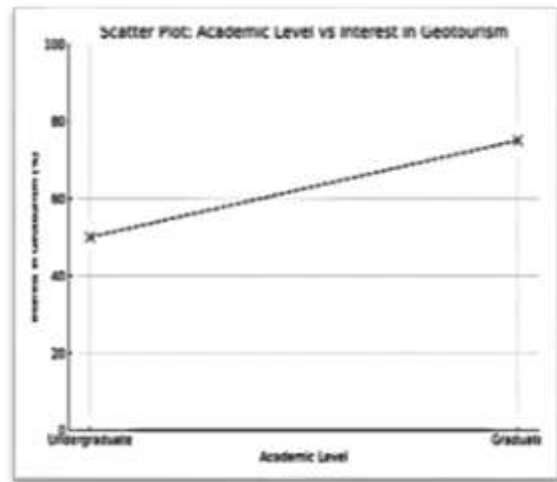


Figure 5. Preferred Geo-tourism Activities

these are smaller-scale pieces, they embody the program's ethos of cross-disciplinary practice and artistic / cultural and ecological / political engagement. This is balanced out by the overall percentage allocation, as less of a percentage is directed to Experiential and Collaborative learning maintaining a diversity of exposure through the educational cycle. The data suggests that the program is intended to meet diverse learning styles and interests, with geology and guided tours as the fundamental participants, and supplemental niche but meaningful activity in art and environmental education. However, it seems to be designed in a way that would help keep participants engaged, absorb knowledge and grow as individuals. This bar-chart (Figure 6) in conjunction to the scatter plot (Figure 7) gives good insight to the relationship between academic level and awareness and interest in sustainable geo-tourism. Results showed that awareness of geo-heritage and sustainable geo-tourism are still remarkably high

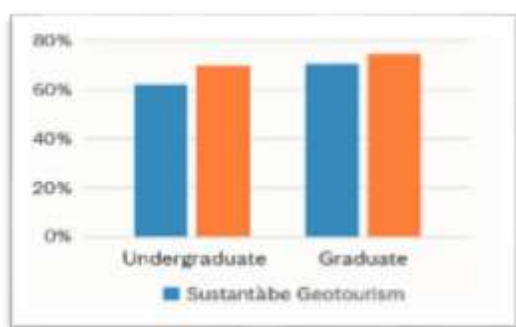


Figure 6. Awareness of Geoheritage and Sustainable Geotourism

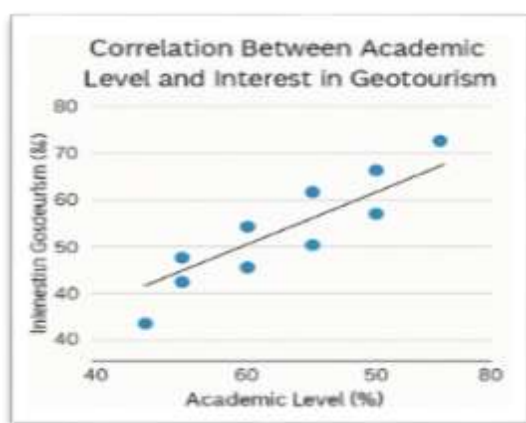


Figure 7. Correlation between academic level and interest in Geotourism

among undergraduate and graduate students with graduate students having a slightly higher awareness as shown in the bar chart. This implies that understanding of these concepts is developed with progression of education. In addition, the scatter plot shows that there is a positive correlation between students' interest in geo-tourism and academic level, where the higher the academic level of the students, the higher the level of interest in geo-tourism they have. The similarity between awareness and interest among different levels of academic knowledge corroborates that the exposure of students to academic topics related to the themes of sustainability is a decisive component in their environmental consciousness and engagement. Collectively these results highlight the need for geo-heritage and geo-tourism education at all levels of higher education to build both awareness and interest amongst the academic community in order to move towards a more engaged and aware academic community that can better support sustainable tourism initiatives.

5. Conclusions and Recommendations

Graduate students display a deeper grasp of geo-heritage's importance to regional development and

environmental education, suggesting advanced learning shapes perspectives. Statistical evidence confirms higher awareness among these individuals, emphasizing education's transformational capacity. Additionally, academic exposure proving crucial to nurturing sustainable tourism values, a positive correlation exists between educational attainment and backing geo-heritage's inclusion in curricula. Among respondents, preferences for activities blending scientific knowledge with cultural heritage through environmentally and culturally rich geo-tourism, particularly geological site visits led by guides, reflect an appetite for educational tourism experiencing earth's mysteries while honoring heritage. However, noteworthy discrepancies between regions in awareness levels necessitate adjusting outreach and policies sensitively to each context. Clearly, a proactive, multi-dimensional approach is indispensable—one integrating geo-heritage awareness throughout education systems while also disseminating its impact into local communities via inclusive geo-tourism. By synchronizing academic initiatives with development strategies for regions, stakeholders can unlock geo-heritage's full potential not only as an educational asset but as a catalyst for sustainable, participatory tourism in Algeria and beyond. The following are some key recommendations that could improve the application of geo-heritage and sustainable geo-tourism in an educational and community setting based on the empirical evidence and trends discussed in this study:

- ✓ Integrate Geo-heritage into Academic Curricula—Higher education institutions should formalize the inclusion of geo-heritage and geo-tourism teaching modules within all undergraduate and postgraduate programs linked to earth sciences, tourism studies, environmental education, and sustainable development.

- ✓ Create Example-Specific Outreach Programs: In line with the apparent regional differences in geo-heritage awareness, we can develop and provide geographically specific outreach programs. They should fill in various knowledge gaps and apparent cultural contexts ensuring an effective geo-heritage education in various regions as a matter of equitable access.

- ✓ Encourage Interdisciplinary Pedagogies: Encourage higher education institutes to develop interdisciplinary pedagogies to train students of geological sciences on integrating environmental ethics, heritage studies, and community-based tourism within geological field projects. These methods not only increase

awareness but also develop civic responsibility and practice of sustainable behavior in students as well.

✓ Geo-tourism Community

Engagement: Local governments and educational institutions can partner to establish sustainable geo-tourism projects based on community engagement. Such programs might be guided visits to the geological sites, heritage trails and culturally relevant educational tours to encourage place-oriented learning and economic inclusion.

✓ For Example, Invest into Capacity

Building and Teacher Training: Instructors and facilitators should be trained to be able to provide the pedagogical material in such a way that the importance of geo-heritage and sustainable development is well delivered. This encompasses the elaboration of standardized teaching resources, workshops and digital platforms for information dissemination.

Author Statements:

- **Ethical approval:** The conducted research is not related to either human or animal use.
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