

Article

UNESCO Global Geoparks vs. Generative AI: Challenges for Best Practices in Sustainability and Education

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Abstract: Artificial intelligence (AI) has become one of the most controversial tools of recent times. Offering an extremely simple operating system, users can generate texts, images, videos and even human voices. The possibility of using such a powerful tool creates new paths and challenges in the field of environmental education: How does it influence natural heritage protection? Is it considered positive within sustainability and quality education? The reality is very different, showing algorithms trained with information of dubious quality and, on many occasions, obtained without permission from authors and artists around the world. UNESCO Global Geoparks (UGGps) are international references in education at all levels, related to territorial development and geoscience education. This article discusses if generative AI is, nowadays, an effective and applicable educational tool for the strategies developed and promoted by UGGps. This designation exists for people's opportunities. The use of these tools in their current state could make the UGGp figure change its values and fundamental pillars in the future.

Keywords: education; geosciences; geoparks; sustainability; AI



Citation: Martínez-Martín, J.E.; Rosado-González, E.M.; Martínez-Martín, B.; Sá, A.A. UNESCO Global Geoparks vs. Generative AI: Challenges for Best Practices in Sustainability and Education. *Geosciences* **2024**, *14*, 275. <https://doi.org/10.3390/geosciences14100275>

Academic Editors: Karoly Nemeth and Deodato Tapete

Received: 22 August 2024

Revised: 8 October 2024

Accepted: 9 October 2024

Published: 17 October 2024



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1. Introduction

Artificial Intelligence (AI) has been introduced to society as a complex algorithm of possibilities. In theory, these would facilitate daily tasks, helping society to progress socially [1–4]. AI companies have not stopped growing exponentially, and the uses of this new technology have shifted from supporting roles on existing tasks to having the ability to “replace” people in their usual jobs at some point. Moreover, texts, audio and videos have now been developed to evoke simulated emotions based on what is understood as the human soul [5].

All of this has been achieved with years of research, and feeding algorithms through material that resides in databases, information centers and the Internet in its wide spectrum. The access of AI to unfiltered material has caused that, even if in the primary states of the algorithm the information were truthful, it would show a muddy set of information from all kinds of sources [6,7]. An example of this would be that, right now, anyone with an internet connection can write anything online, just as anyone can write a book and self-publish it. This situation contributes to generating a negative view of AI. To step out of this, in most cases, it is necessary to consult experts and specialized organizations to

contrast the information that these programs receive and to monitor the correct operation and results of the system [8].

Along with this problem, a much larger one coexists. Ethics. Has permission been sought to collect and use the data these programs use to train themselves? Is it positive for people that AI, and more specifically the generative variant, ends up overshadowing professions that they have been performing and perfecting for years? Is it acceptable to call AI a sustainable tool? These are just minimal examples of issues that arise when something that promises to be a very positive tool for society can have harmful implications if not performed properly [9].

AI, as such, has been used for years as a resource to perform calculations, evaluate variables and even make decisions, always supervised by qualified personnel prepared for this responsibility, but this new scenario presents us with some relevant elements to consider that can be crucial in its implementation and development in society [10,11].

UNESCO Global Geoparks (UGGps) are territories with a regional development strategy, focused on the science–society nexus found between natural heritage (abiotic and biotic) and the culture (tangible and intangible) of the people who reside there. Thanks to this synergy, the UGGps contribute to global sustainability through the advantages of the didactic framework, promoting quality education for natural and cultural heritage protection and preservation and, at the same time, promoting employment and professional opportunities, and the correct functioning of Nature–Society–Economy gear [12,13]. All of this together, results in a sustainable development engine, considering the 5Ps of the 2030 Agenda [14]. Within this definition, a crucial element stands out that cannot be ignored and that is immersed in the fundamental pillars of the values of the UGGps: the social component [12,15,16]. In this context, the question of whether the use of generative AI for audiovisuals, voiceovers, posters, brochures or even advertising is ethical or not, represents something relevant and necessary to be addressed regarding the UGGps, given that these territories, which seek constant innovation in communication and education, need to know and evaluate the advantages and disadvantages of these technologies before their implementation.

This paper portrays a reality in which educational environments, in this case, UGGps, may be tempted to use generative AI for multiple uses in the development of their activity. With the theoretical background in education and sustainability ethics, the aim of this work is to ensure that UGGps have a clear idea of how to use AI without going against its fundamental values. To carry out this project, ethical aspects collected in literature aimed at education, sustainability and UGGps were compiled and taken into consideration, being theoretically applied directly to the pillars that underpin these territories.

With this, it is possible to assess whether the use of generative AI in its current state would be positive or negative and observe new paths or possibilities that allow its use in an ethical way in the future.

2. Methodology

This study is based on a bibliographic compilation that includes aspects related to the advancement of AI, its application in UGGps and similar educational environments, as well as works published in scientific journals with a geological and multidisciplinary focus.

To facilitate the understanding of this documentation, a general framework for AI was developed from an educational perspective, as well as from the viewpoints of sustainability and UGGps, as these are key pillars around which the concept revolves. To achieve this, official documents and scientific studies addressing these specific topics were considered.

For the discussion and conclusions, all the factors outlined in the general framework were considered and conceptually applied to the core pillars of UGGps, addressing geoscience education, the social and economic sectors, sustainability, and key elements such as art and culture, which are symbolic within these regions. Additionally, a query was posed to one of the most widely used AIs today to explore potential search results in a real-world

scenario, allowing for a discussion of new directions, challenges, and possibilities for the future (Figure 1).

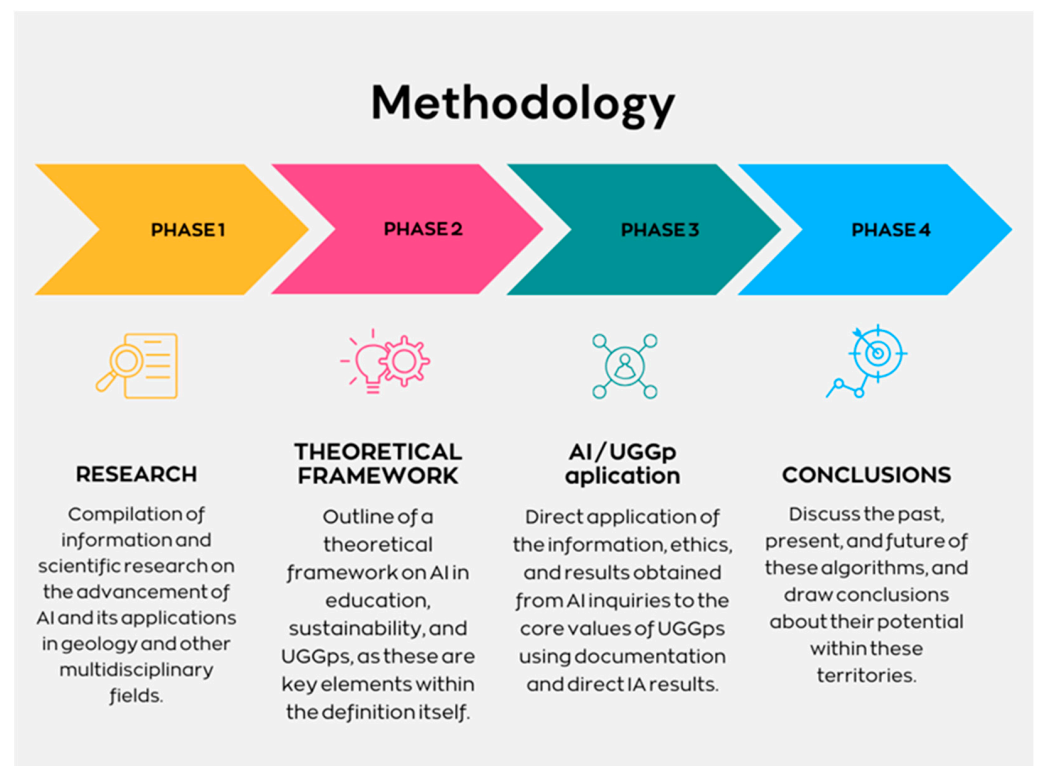


Figure 1. Graphic summary of the methodology steps used for this study development.

3. AI in Education

European Commission defined in their 2022 guidelines for ethical AI use in education as “Computer programs or machines that are programmed to carry out tasks that normally require human intelligence, for example, learning or reasoning. Using data, certain AI systems can be “trained” to make predictions, make recommendations or make decisions, sometimes without human intervention” [17].

All these statements refer mainly to what is currently known as generative AI. It differs from previously existing algorithms in being able to simulate human intelligence and provide answers according to their training, design specialized educational plans, prepare conclusive results or even draw pictures and emulate human voices and features [5].

In the current didactic landscape, a multitude of factors must be considered to allude to the correct use of AI in the educational framework [18]. To understand how we could consider whether AI complies with the ethical framework established on education, it is essential to assess some essential aspects:

- Social behavior: more specifically, lifestyle. The possibility and capacity of action of people;
- Social equality: considered from opportunities for inclusion and non-discriminatory behavior toward others;
- Dignity, respect, rights, obligations and connections between the human beings that make up our society;
- Human capacity with the right to choose and make decisions in addition to being responsible for the results and consequences thereof [17].

Another term relevant to mention is the topic of transparency. This is defined as “transparency with personal data, privacy and origin of information”. It is essential to know what type of data is used for algorithm training to assure their informative reliability. At the same time, the assurance of that information is necessary to guarantee their protection and thus preserve their right to privacy [19].

These elements are basic for the ethical considerations that are applied in educational terms to AI, since they are based mainly on humanity, respect and the progress of people above all [20]. Without them, AI development would be unpredictable and chaotic, and would go against society [21]. Among the permitted uses of AI in the educational aspect, there are those called “high-risk” interactions. It is not possible to compare an algorithm that facilitates a calculation to one that clearly develops and imitates human competence without leaving a possible trace detectable and identifiable by education and training center staff. Therefore, there are requirements applicable to this type of tool that allow their use if, as previously indicated, it does not affect the educational development of students and teachers and thus guarantees their reliability and ethical and responsible use. All requirements relate primarily to ethical considerations and these elements mentioned, such as humanity, transparency, fairness, technical soundness, and the security and reliability of the data used [17].

These considerations are extremely important for the correct use of these technologies (Figure 2). The use of generative AI in education is perhaps a source of new opportunities and functionalities applicable both in the field and in the classroom but, at the same time, it is a dangerous element that, used incorrectly, can attack values as fundamental as data protection, equity or the capacity and possibility of human progress [17].



Figure 2. Ethical requirements from the educational framework for the reliable use of AI [17].

4. AI in Sustainability

Sustainability is understood as everything that ensures a perfect circle that encompasses society, economy and nature protection, or, as defined in the United Nations Brundtland Commission in 1987: “meeting the needs of the present without compromising the ability of future generations to meet their own needs” [22]. It is a multidisciplinary concept supported by the Sustainable Development Goals (SDGs) of the United Nations Agenda 2030, which set the guidelines to bring us ever closer to a prosperous future, accessible to all and respectful of the natural environment [14].

The SDG4 “Quality Education” is defined as “Ensure inclusive, equitable and quality education and promote lifelong learning opportunities for all”. Implications of these new technologies collide directly with crucial concepts of this definition, such as inclusivity, equity, opportunity and society in general. This can be reflected in the targets and indicators of SDG4 4.1 and 4.5 specifically since they relate the concept to accessibility and inclusivity [14]. AI can be a powerful tool for generating employment and opportunities and developing ideas in a time that was previously thought unthinkable. Nevertheless, if

not used properly, it can also be the origin of a social gap, benefiting a certain part of the population that can access this type of technology creating new forms of discrimination [23].

Furthermore, information collection for training these tools was carried out on many occasions without real permission of the original authors, or with abusive clauses that violate the clauses of confidentiality and authorship. Corporations hide behind the premise that the data collected are found free on the Internet, going around the copyright associated with some of the content collected [24]. In this framework, Meta Platforms Inc. recently announced that multimedia files published on its different social networks would be used to power its own generative AI but allow users to fill out a passage to refuse to lend their material for such use. These plans are currently paused due to regulatory pressure. Transparency in these types of actions is important, especially now, since it can lead to negative future consequences, both for companies and for users [25].

From the natural protection panorama, AI is also a powerful tool for understanding climate change and the environmental processes that everyday occur on Earth and other planets [26]. It could help monitor weather forecasting, natural disasters and many different situations with high efficiency and effectiveness [27,28].

But, focusing on the environmental impact of AI, and more specifically on the models that are responsible for large-scale information collection and automatic learning, indirect energy consumption shows important values to be considered [29]. One of those is the processes that require the development and assembly of graphic cards with immense computing capacity, in addition to the software related to their activity. The calculated emissions approximations approach quantities of more than 284,000 kg of carbon dioxide. These consumptions are close to the average life of an American car multiplied by five [30]. As algorithms become more powerful, energy consumption in the phase of construction is crucial for their correct functioning. However, in terms of climate care on their indirect processes, they are far from being efficient and sustainable in the long term.

Connecting the environmental component with the social component, it can be observed that AI is drastically moving away from the actual concept of sustainability itself. The environmental tear it produced in its indirect production is something to consider rather than just focusing on the benefits it currently provides. Currently, technology is progressing at an unprecedented pace, and it is likely that soon, we will see significant enhancements that will lead to the development of a tool that is effective, inclusive, equitable, and environmentally sustainable [31].

5. UGGps and Possible Uses of AI in the Educational Framework

UGGps perform as territories for sustainability through educational strategies that promote awareness and conservation of natural and cultural heritage, applying innovative methodologies from different perspectives and sources; sites of geological interest, interpretation centers, museums and even educational core places such as schools, high schools or universities [32]. Thanks to their didactic work, they advance on a territorial level in their development strategy to draw tourism and to promote important values, for instance, the personal identity of each territory, healthy lifestyles and climate and natural protection. Within this system, AI might provide endless opportunities to support this work, which would facilitate certain tasks and expand their educational offer, thus enhancing their capabilities. Nevertheless, several considerations collide with the very foundations of the definition of UGGps. These considerations should be taken into account in order to carry out specific analyses on whether the use of this type of technology is positive or negative for them.

Analyzing the specifics of support from scientific and technical research, calculation algorithms and specialized AI are currently being utilized to enhance and streamline the analysis process for experts and professionals. In this sense and always being supervised, these are extremely interesting and positive elements for the development of research activities, such as Ph.D. thesis or studies of any kind that are helping the UGGps themselves to be more accessible and adapted to all types of people [33]. As it is said, technology

supports humans and does not replace them. Like computers, it promotes the progress and development of territories and society.

In the case of generative AI, a different type of panorama is found [34]. This type of AI is dedicated to tasks that would normally be performed by people, imitating human logic and problem-solving abilities [5]. In this sense, the idea that tasks performed by generative AI can provide not only job support but also economic relief for UGGps in the educational framework can be very conflicting. Moreover, it would also mean dehumanizing the results and contributing to the decline in social development. Some of these future scenarios, of those tasks, would have an important ethical component and should be considered relevant:

1. Educational planning: designing teaching plans focused on a specific target audience;
2. Content selection: choosing what content to teach according to the visitors and their educational level;
3. Localization of UGGp information: support for the information available in the territory to be found in all possible languages;
4. Marketing campaigns: preparation of representative designs, posters, audiovisuals and brochures in which the territory's "essence" is represented;
5. Multimedia content: simulating illustrations, music, voices, figuration or any audiovisual resource for its proper usage;
6. Augmented reality: the ability to unite all these resources to simulate and teach the past, present and future of the territory from science, nature and culture.

All these actions represent a fundamental part of the didactic and daily promotional work of the UGGps as many other educational centers [18,35]. However, due to the current state of generative AI and considering all its development and workflow, they neither provide reliability nor can they be aligned with the UGGp core values. That is why the presence of at least one professional to analyze the results obtained is essential. However, the problem goes much further. Since their work cannot be traced, it is not possible to know the origin, rights or permissions of the data used for each generated result [17]. But, most important of all, is that they lack personality. When educational planning and selection of UGGp content is carried out, the territory, the public and their culture must be acknowledged in the process entirety: most accessible areas, which Site of Geological Interest is better for each lesson or even how a visit should be adapted for a specific multi-level audience.

Each didactic action carried out in the UGGps has personnel associated who know what to do and how to adapt themselves to each situation [36–38]. If the visit is only based on a series of parameters and simulating an interaction, it is going to be at a great cost of human rights, for the UGGp personnel and visitors. Furthermore, if there were any problem or compromised situation, there would be no one to take responsibility for what happened. Something similar happens with the generation of texts in other languages, voices, images and audiovisual resources. International artist unions are in a constant fight against generative AI and its abusive practices [39]. This is because to offer the current results they are trained with art, portfolios and even personal accounts of countless people on the internet and social networks. In this case, its use would greatly reduce the costs for the UGGps, but it would leave aside voices, faces, music, colors and, ultimately, culture itself that identifies people in the territory. This is something extremely important in the fundamental pillars of the UGGps [40–43].

6. Discussion

If we ask ChatGPT v1 [44], one of the most used AIs currently available, "How can AI be useful in education in UGGps, considering the ethical aspects in field and laboratory activities?", it answers with the following text:

"AI can significantly enhance education in UNESCO Global Geoparks by leveraging its capabilities to improve learning experiences, research, and conservation efforts while adhering to ethical standards. Here are several ways AI can be useful in this context:

6.1. Educational Enhancements

1. Personalized Learning

- *Adaptive Learning Systems:* AI can create personalized learning experiences for students based on their individual needs and learning styles. This can include interactive modules, quizzes, and feedback mechanisms that adapt to the student's progress.
- *Language Translation:* AI-powered translation tools can make educational materials accessible to a broader audience, breaking down language barriers and promoting inclusivity.

2. Virtual and Augmented Reality

- *Virtual Field Trips:* AI can facilitate virtual field trips to geoparks, allowing students to explore and learn about geological features and biodiversity without being physically present. This can be particularly beneficial for those unable to travel due to financial or geographical constraints.
- *Augmented Reality (AR) Applications:* AR can be used to superimpose geological information over real-world views, enhancing on-site learning by providing real-time data and interactive content about the features being observed.

6.2. Research and Conservation

1. Data Collection and Analysis

- *Automated Monitoring Systems:* AI can power drones and sensor networks to monitor environmental conditions, track changes in biodiversity, and gather data on geological formations. This can provide researchers with up-to-date information and help in early detection of ecological issues.
- *Big Data Analytics:* AI can analyze large datasets collected from field activities to identify patterns, predict trends, and provide insights into geological and ecological processes.

2. Citizen Science and Public Engagement

- *Crowdsourced Data Collection:* AI can support citizen science projects by processing data submitted by the public, such as photographs or environmental readings. AI algorithms can classify, validate, and analyze this data, making it useful for scientific research while engaging the community.
- *Interactive Educational Tools:* AI-driven apps and platforms can engage visitors by providing interactive learning experiences, such as quizzes, guided tours, and real-time feedback on their contributions to citizen science projects.

6.3. Ethical Considerations

1. Privacy and Data Security

- *Data Anonymization:* AI systems must ensure that personal data collected from participants (e.g., location data from mobile apps) is anonymized and securely stored to protect privacy.
- *Informed Consent:* Participants in AI-driven projects, especially those involving data collection, must provide informed consent, understanding how their data will be used and protected.

2. Bias and Fairness

- *Algorithmic Transparency:* AI algorithms should be transparent, with clear documentation on how they work and what data they use, to ensure they do not perpetuate biases or discrimination.
- *Inclusive Design:* AI tools should be designed to be inclusive, ensuring they are accessible to people with diverse abilities and from different socio-economic backgrounds.

3. Environmental Impact

- *Sustainable Practices:* AI technologies used in geoparks should minimize environmental impact, such as using energy-efficient sensors and ensuring that drone flights do not disturb wildlife.

- o *Ethical Data Use: Data collected from natural environments should be used responsibly, with a focus on conservation and education rather than exploitation.*

By integrating AI into educational and research activities in UNESCO Global Geoparks, we can enhance learning experiences, improve research outcomes, and engage the public in meaningful ways. However, it is crucial to address ethical considerations to ensure that AI applications are fair, inclusive, and environmentally sustainable”.

Indeed, the AI response provides us with technical information that, in the form of an algorithm, can help UGGps as a support tool in various sectors, studies and practices in the educational field. Furthermore, the results obtained show a clear deficiency of knowledge of the internal system of the UGGps, mentioning, as an example, the use of drones and other unusable elements by the vast majority of these territories due to a lack of economic resources. Despite being a fast and efficient system, it lacks reliability, as it is trained with unfiltered information from every accessible database. A redirection strategy would be necessary so that the use of these tools was purely ethical and sustainable from the social framework that we understand today. It has already been proven that these algorithms work at stellar speed and with excellent performance but, as mentioned above, the information has no trustworthiness in many cases, being used in most cases without official permission and basic filtering. These results show a clear example that, indeed, thanks to AI it is possible to obtain texts on any topic, but the lack of in-depth knowledge about them can lead to crucial errors and possible consequences in the future.

To use these tools in a sustainable way, a new policy framework would be necessary, in which, having already tested their operation, algorithms would be retrained with all legal agreements, and copyrights and following the national and international guidelines and regulations on data protection, equity, transparency and humanity. Furthermore, technologies used for its process must continue to advance to reduce its consumption directly and indirectly, and thus operating on a legal, reliable, accessible and respectful algorithm for people and nature. In short, in a sustainable way. In fact, there are references of UGGps that have proposed and implemented AI and machine learning systems for various activities already, such as monitoring changes in the landscape, pollution, research or the digitalization of territories, but always as support and never as a replacement [45–48].

Therefore, its use as support material will always require the presence of one or more experts who carefully select the information to provide maximum usefulness to what the algorithm can provide. Here is at the heart of the discussion. AI tells us in the generated text that it would be a positive tool for these territories, but it forgets to mention the human factor, which is the hallmark of the UGGps. They represent, above all, sustainable development strategies by and for people. Communication is a genuinely human skill, so trying to communicate an idea using only a machine drastically reduces its personality and impact.

Without its inhabitants, UGGps could not exist. The Moon presents a fascinating opportunity for geological tourism, given its unique features and the significance of its landscape in comprehending planetary geology and our existence in the cosmos. However, without a civilization that prioritizes educational initiatives centered on natural heritage for advancement and growth, the establishment of a UNESCO Global Geopark on the Moon remains unfeasible.

UGGps survive thanks to traditions, culture, stories and, ultimately, the legacy of people who have adapted themselves to a natural environment. Using AI in any of these aspects would be on a different path from that outlined by UNESCO’s key values, since it would directly threaten the designation of the origin, culture and personality of each territory.

In addition, the involvement of people in UGGp projects would be diminished and undervalued using a quick and economical tool. UGGps stand for “Single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development” [49]. This means that the UGGps exist with the basic idea of creating opportunities and pro-

moting the development of people [49]. If these tools are used in their current state, they would directly threaten the territory's cultural identity and UGGps would cease to have meaning, so they could disappear or be transformed into different denominations in the future (Figure 3).

AI vs. UGGps - SWOT ANALYSIS



Figure 3. Strengths, weaknesses, opportunities and threats (SWOT) analysis of AI implementation in its current state in UGGps.

7. Conclusions

The review and subsequent evaluation of the scientific research studied provide us with the possibilities that the use of AI could offer to UGGps. Currently, many AI algorithms are full of misinformation and use data without permission from their main authors and social networks. This aspect, together with the indirect energy expenditure involved in its correct functionality from very high-power equipment, makes them unsustainable tools nowadays, threatening humanity and the environment. There is much room for improvement, but in its current state, its utilization must be narrowed to certain controlled spaces. In the case of UGGps, there is no doubt that their application would be useful as a supporting role in a multitude of procedures, but there are several disadvantages to contemplate behind these algorithms. From even greater efficiency in educational designs to the lower economic cost of certain proposals and activities, different types of algorithms would present endless new opportunities within UGGps.

However, there is something that has not been reflected in the studies and represents the basis of the existence of the UGGps: People. Without people, the UGGps would be a non-existent denomination, and all educational actions in pursuit of the development of the local socio-economy would be lost. Furthermore, the very definition of UGGps indicates that it is a sustainable development strategy, so the use of generative AI would go against every basic value of the territories. Colors, voices, faces, music or sensations provide designation of origin and human value to these.

The digitalization of everything is clearly advancing at a rapid stride, and soon, we are likely to see AI-powered tools being used in UGGps for activities such as geological risk assessment, climate monitoring, mathematical calculations, and even educational activities. The key issue is not what these tools will be used for, but how they will be implemented. How can we encourage the use of these tools in an ethical and beneficial way for the region, rather than merely speeding up results at the expense of human involvement and the reliability of the data obtained? This study raises new questions, such as how to measure the actual effectiveness of AI in the educational background, the potential impact

of implementing this tool on the teaching–learning process or the examination of both the positive and negative consequences that may arise from its use.

In short, the use of algorithms to support research and always supervised by specialists has been used for years and will continue to be used to accelerate processes and promote scientific progress, but the use of generative AI, in the current situation of the algorithms, would clearly go against the fundamental pillars of the UGGps illustrated the UNESCO definition, since it threatens its most basic element.

Author Contributions: Writing—original draft, J.E.M.-M.; Supervision, E.M.R.-G., B.M.-M. and A.A.S. All authors have read and agreed to the published version of the manuscript.

Funding: This study was supported by Portuguese funds from Fundação para a Ciência e a Tecnologia, I.P. (Portugal) in the frame of UIDB/00073/2020 (<https://doi.org/10.54499/UIDB/00073/2020>; accessed on 8 October 2024) and the UIDP/00073/2020 (<https://doi.org/10.54499/UIDP/00073/2020>; accessed on 8 October 2024) projects of the I & D unit of Geosciences Center (CGEO).

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

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

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