DISCUSSION ON HOW BEST TO INTEGRATE THE USE OF GENAI AND GEOAI IN HIGHER EDUCATION

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Abstract: In this article we present the current situation of the use of GenAI and GeoAI in higher education and exemplify some possibilities for recognizing the use of AI through proper citation. Currently there is the AI Regulation developed at the level of the European Commission in the framework of the Digital Agenda. This is the first legal framework on AI that addresses the risks of AI and positions Europe to play a leading role globally. Starting from this context, we want to highlight the advantages and disadvantages that this way of working brings, but also to realistically identify some possibilities for properly citing the contribution of AI in scientific work at the academic level. It is necessary to implement such citation systems starting from the bachelor and master levels. At the doctoral level students should already know and apply the elements that are to be included in the Guide for the elaboration of doctoral theses, by the National Commission for the Certification of University Degrees, Diplomas and Certificates.

Keywords: AI, GenAI; GeoAI; artificial intelligence; higher education; APA; MLA; Chicago; citing; authorship

1. Introduction

The current state of the research shows that artificial intelligence is becoming more integrated, with its role transformed from an invisible assistant to a more visible collaborator [1]

This is why the need has arisen to regulate the basis for the current elements of GenAI and GeoAI, especially given the context created by Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonized rules on artificial intelligence. [2].

In this legislative provision (Art. 6, paragraph (2)) it is stated that high-risk AI systems in education and professional training are the following: those for access or placement in the education or training system; those for the assessment of learning outcomes, including those for guiding the learning process of individuals in education at all levels; those for the assessment of the educational level to be received; those for monitoring and detecting prohibited behavior of pupils and students during testing, in education and training institutions at all levels.

In this context, the issue of how higher education institutions will manage the use of AI and especially how to recognize the use of AI is also raised, as investigated in the paper "Acknowledging the new invisible colleague: Addressing the recognition of Open AI contributions in scientific publishing" [1]

The Commission has released a pilot for GPT@EC, a secure general-purpose corporate tool using generative artificial intelligence (AI). [3]

The AI rising in popularity impacted academia in a strong way, becoming a standard research tool in very little time. [4]

A survey conducted in 2022 shows that students rated the accuracy of AI for homework studies 7.2 out of 10. [5] This shows the importance of AI results that students use for their work. The confidence and the way students rely on AI reveals the opportunity to provide them with support in the writing process to ensure they have access to factual information. It was highlighted that 41% of students stated that they always edit on AI-generated content, while only 3% stated that they never do. [5]

Figure 1 highlights the main purposes for which students use AI. It is important to know these aspects before considering how AI tools can be integrated into the educational process.
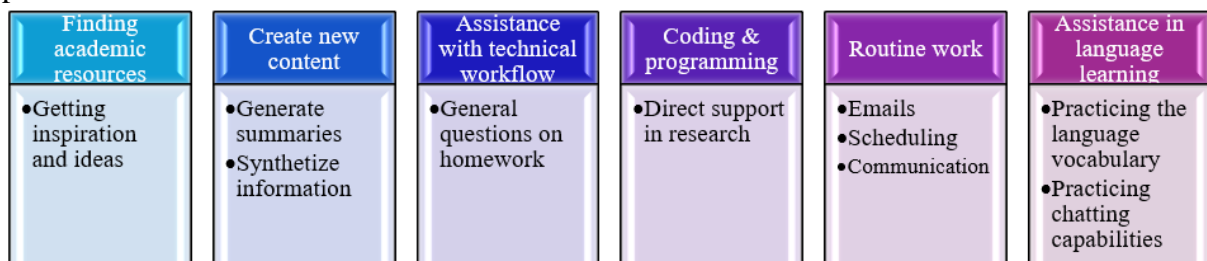
Finding academic resources	Create new content	Assistance with technical workflow	Coding & programming	Routine work	Assistance in language learning
•Getting inspiration and ideas	•Generate summaries •Synthetize information	•General questions on homework	•Direct support in research	•Emails •Scheduling •Communication	•Practicing the language vocabulary •Practicing chatting capabilities

Figure 1 - AI Use Cases

2. GenAI and GeoAI

GenAI (Generative AI) is used to develop new content (text or images) based on patterns in data. Large Language Models (LLMs) are a powerful form of this AI, generating human-like text, while Small Language Models (SLMs) focus on specialized tasks with less data. Retrieval-Augmented Generation (RAG) enhances these models by pulling in external information for more accurate results. AI Agents use generative AI to autonomously perform tasks such as writing or research. Together, they represent cutting-edge advancements in automation and creativity. [6]

AI methods and techniques have been applied to solving geospatial problems for a long time, GeoAI being in fact the use of AI methods, including ML and DL, to produce knowledge through the analysis of spatial data and imagery, so geospatial artificial intelligence is known as GeoAI. In fact, in GeoAI are mixed AI methods, data mining, and fast computations within a GIS platform to produce results based on the use of geospatial data [7], [8]

Actually, the use of AI is applied in many geospatial usecases because methods of analysis are becoming more empirical and exploratory and AI tools offer the possibility to process and integrate complex data. GeoAI is rapidly replacing or working alongside older analogical methods. [9] Similar to other areas of artificial intelligence, geospatial data processing faces transparency and explainability issues that come with the use of machine learning methods, which sometimes represent a true black box. As an advantage, these methods together with a varied data set allow to approach much more complex problems than was previously possible. [10] GeoAI can be used in modern reconnaissance missions, AI for real-time information transmission, automatic map updating by integrating satellite or aerial images, GNSS data, terrestrial LiDAR and other data from various sensors, monitoring vehicles, equipment, buildings, traffic flow management, crime, sustainable development and

natural resource management. As far as geospatial data is concerned, there are mentions on how it can be cited. [11]

In present the development and use of artificial intelligence (AI) and artificial intelligence applied in geo-information technologies (GeoAI) raise a number of similar concerns. [12]

3. Current situation - roles of AI in research

In the following we will refer to artificial intelligence (AI) in all the forms in which it can be used (GeoAI, GenAI, etc)

At present, the situation found from the study of specialized articles is as shown in figure 2, which reveals the need for a degree of transparency, but also the existence of restrictions on the use of AI, ethical provisions, the way of citing the AI tools used, the issue of authorship when using AI.

Some authors have identified different roles that AI can play in research work, such as cited as source, cited in quotation marks, cited as acknowledgment, or as co-author. [13]

As approaches that stand out in terms of how to mention AI, some authors emphasize that they prohibit the use of AI in text generation for school papers. This approach can lead to non-enforcement, clandestine use of AI, and thus discourage fairness in science and research. The difficulty of establishing authorship credit and transparency are used as justifications. [14] Another case is the policy that allows the AI to be listed as the author, which is justified by transparency and preventing giving credit to a human author for the analysis performed by the AI. This leads to the problem that the AI can be neither legally nor morally responsible. AI systems are proficient in generating language, however one major limitation of AI systems is their struggle to grasp context. By comparison, human writers possess a profound understanding of the world, emotions, and cultural subtleties, which greatly enhance the quality and complexity of their work. Although AI systems are skilled at identifying patterns, they often fail to interpret contextual cues and create content that resonates intellectually and emotionally. [15]

Another case is mentioning AI in the acknowledgements section, approach that may be justified on the grounds of transparency, but AI cannot be morally or legally responsible.

Disclosure
- mention the AI tools used in research
- show the extent in which AI tools were used in research

Rules/restrictions
- AI is not an author
- AI can be cited
- AI is prohibited in some cases (see AI Regulation)

Ethics perspective
- AI in research
- AI in writing

Citing
- Guidelines
- As a software developed by a company (eg. APA)
- Showing the role in the research process (eg. MLA)
- As footnote, highlighting the prompt used (eg. Chicago)

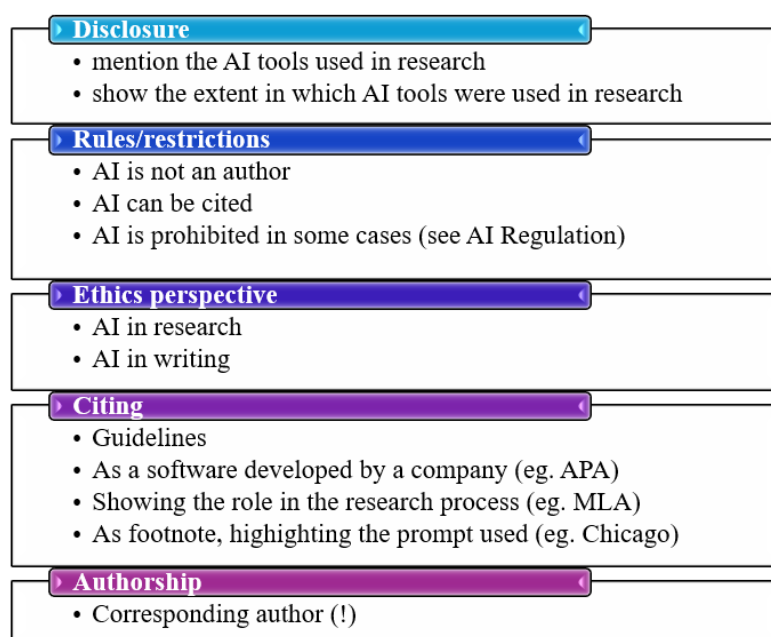**Authorship**
- Corresponding author (!)

Figure 2 - Specific perspectives for AI in research

In terms of the level of disclosure of the acknowledgment of the use of AI, the scientific journals require that authors clearly show both how AI tools were used in their research and writing processes and the extent to which they were used. This sort of disclosure is important to clarify the confusion about authorship and to address ethical concerns about plagiarism and misrepresentation of intellectual effort.

In terms of the rules and restrictions that exist, AI cannot be involved as an author because it cannot fulfill the criteria of intellectual contribution and responsibility, but AI can be mentioned in citations. At the same time, the rules regarding the use of AI must be respected, and they foresee that there are cases in which this is prohibited. [7], [16], [17]

In relation to this, from an ethical point of view, it is the obligation of the author(s) to recognize whether and what part of the content of a scientific paper was generated using AI, both in the writing process and in the process of research and conducting experiments or processes.

The growing functionalities of the AI have led to mentioning the possibility of the AI being considered as a corresponding author, if it manages the correspondence, handling such logistical and administrative duties with the publisher. However, we consider this approach not fully justified, since the requested changes and improvements to the paper are related to human intellectual design, not to AI.

4. The main ways to cite AI tools

Journals require authors to clearly indicate how AI tools were employed in their research and writing processes. [1] However ChatGPT has been asked who owns as autorship the content generated by ChatGPT, and they replied "I do not own the content I generate. I am a machine learning model developed and owned by OpenAI, and the content generated by me is subject to OpenAI's license and terms of use". [18]

Guidelines mentions that the AI tools can be used in a limitative way. However, it is better to be transparent regarding the use and investigate their output in a responsible way. In research and higher education the AI tools can be used as advanced search tools, in order to create new content, generate summaries or synthetize information. An appropriate way for using AI is to acknowledge and describe in deep how the tool has been used, mentioning the model, prompts and the generated answers. Students must be aware that AI-generated material should not be referenced as a primary source and chatbots should not be listed as authors.
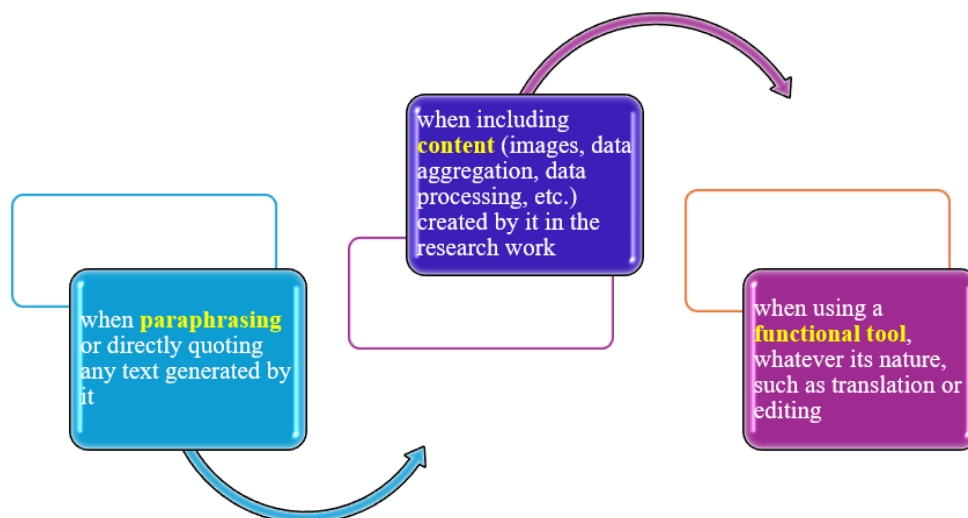

Figure 3 - Main cases where AI Chatbots need to be cited

In present, some well known examples of Generative AI (GenAI) models are ChatGPT(OpenAI) https://www.chat.openai.com, Gemini (formerly Bard) (Google DeepMind) https://www.gemini.google.com, Copilot (Microsoft) https://copilot.microsoft.com

There are studies regarding how AI tools are currently cited, exploring whether citation practices are evolving and how different citation styles approach AI contributions.

There are rules for citing AI tools and this practice, imposed due to the need for transparency in research from an ethical perspective. Three of the main styles of citation rules are APA, MLA and Chicago. All of them are providing guidelines for citing AI tools. [19]

APA style recommends to cite AI like other software. In this case the authorship is attributed to the organization in charge with software developing. (eg. ChatGPT is cited as a software developed by OpenAI, Copilot is cited as a software developed by Microsoft) [20], [21]

- *OpenAI. (2023). ChatGPT (Mar 14 version) [Large language model]. https://chat.openai.com/chat*
- *Microsoft. (2025). Copilot (Preview) [Large Language Model]. https://copilot.microsoft.com*

MLA style recommends describing the tool's role in the research process. [4] Full citations in MLA follow a standardized formula. In case of using AI, not all citation fields are required to be filled in. The core elements in an MLA citation and how they apply to AI specifically, are the following:

- Author: blank
- Title of source: the prompt you used to generate the text or a short description if the prompt itself is too long
- Title of container: the name of the AI tool (eg. ChatGPT)
- Version: the tool's version (eg. GPT-4)
- Publisher: AI developer company
- Date: AI accessed date (day-month-year format)
- Location: tool URL
- "Example of an MLA citation" prompt. ChatGPT, GPT-4, OpenAI, 20 Mar. 2025, chat.openai.com/chat.

Eg. Full citation in works cited page:
"Summarize the book XYZ" prompt. ChatGPT, GPT-4, OpenAI, 20 Mar. 2025, chat.openai.com/chat.
Parenthetical citation in text: ("Summarize the book")

The current recommendation in Chicago Style Citations for AI is not to include a citation in a formal bibliography or reference list. However it must be included a numbered footnote or endnote. [22], [23]

Eg.footnote: ChatGPT, response to "Explain the events of the lead up to the Civil War in 200 words," OpenAI, June 20, 2024.

In fact, even on platforms that include AI (e.g. the "Literature review" option on https://scispace.com/, the "Briefing doc" or "Chat" option on Google's NotebookLM platform https://notebooklm.google.com/), searches can be performed which can sometimes be useful in the documentation process, but also these should be mentioned as resources. [24]

In Romania it was developed https://olimpiada-ai.ro/ which seems an interesting initiative, through which students can train themselves in the good sense to have a healthy approach to AI.

One direction in which students should be trained is towards the creation of AI solutions, using for example https://www.kaggle.com/ or https://www.aicrowd.com. [24]

5. Conclusions

AI-based tools can greatly help those who are experts in a domain, because they know the correct answer and what it should look like. If one gets this answer using the AI tool, this saves time and can tackle the next problem. If the correct answer is not received, the expert knows how to adapt the received answer.

However, if a person does not know much about the domain in question, the prompt refinement process can take a very long time, and sometimes it can exceed the time needed to solve the problem at hand without AI-based tools. Therefore, for learners, it is more efficient to solve problems without AI until they become an expert, and only then turn to AI.

AI can function effectively as a supplementary tool for writing research. It offers substantial assistance by automating tasks, allowing human writers to concentrate on creative endeavors, analytical work, and critical thought processes.

The authors remain responsible for the content, not the AI instruments, so it is recommended to check the accuracy of responses; it is important to note about the model, version number, dates, and export conversations with the AI tool; to protect institutional data, PII (personally identifiable information), and intellectual property; to check with prospective journals before including AI in research.

The AI industry and academia must collaborate to drive progress, taking into account the real-world impact of AI technology.

The impact can be seen in personalized learning by enhancing learning outcomes and providing personalized feedback as specific exercises. This collaboration ensures that these technologies are effectively integrated into educational settings. These AI tools also offer support from a different perspective: learning a foreign language.

AI tools offer the advantage of new teaching methods, helping students to be creative, to innovate and to gain real-world experience.

A main advantage could be that the students are prepared for an AI-driven future for future job markets perspective, by aligning curricula with industry demands and providing work-based learning opportunities. AI technologies should be implemented in an ethical and equitable way for all of the students.

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