CREATIVITY AND GENERATIVE AI IN EDUCATIONAL CONTEXTS: CHALLENGES AND FUTURE SCENARIOS. SURVEY ON THE PERCEPTIONS OF STUDENTS AND TEACHERS

CREATIVITÀ ED INTELLIGENZA ARTIFICIALE NEI CONTESTI EDUCATIVI: SFIDE E SCENARI FUTURI. INDAGINE SULLE PERCEZIONI DI DOCENTI E STUDENTI

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ABSTRACT

Creativity is considered a crucial 21st-century competency in many different fields, including education (Treglia, 2020; Patston et al., 2021). Recent advancements in generative Artificial Intelligence (AI), are challenging the notion of creativity as an exclusively human attribute. This article discusses the results of a survey conducted on a sample of secondary school teachers and university students of educational sciences about the opportunities and challenges represented by the development and implementation of AI systems in educational settings and the interaction between human creativity and AI.

La creatività è considerata una competenza cruciale del 21° secolo in molti campi diversi, compresa l'istruzione (Treglia, 2020; Patston et al., 2021). I recenti progressi nell'intelligenza artificiale generativa (AI) stanno mettendo in discussione la nozione di creatività come attributo esclusivamente umano. L' articolo discute i risultati di un'indagine condotta su un campione di insegnanti di scuola secondaria e studenti universitari di scienze dell'educazione sulle opportunità e le sfide rappresentate dallo sviluppo e dall'implementazione dei sistemi di intelligenza artificiale in contesti educativi e l'interazione tra creatività umana e intelligenza artificiale.

1. Introduction

Creativity is considered a crucial 21st-century competency in many different fields, including education (Treglia, 2020; Patston et al. 2021). Authors have defined creativity as the generation of new, useful ideas that can be implemented in problem solving, procedures, processes, and products (Amabile, 1983; Frare & Beuren, 2021; Verganti et al., 2020). Recent advancements in Artificial Intelligence (AI), are challenging the notion of creativity as an exclusively human attribute. AI is currently defined as all computer systems capable of engaging in human-like processes, such as learning, adapting, synthesizing, self-correcting, and using data for complex computing tasks (Popenici, Kerr., 2017). In the broadest sense, actually AI is defined as information processing models developed to perform tasks initially performed by humans (Skilton & Hovsepian, 2017) or as the totality of algorithms and computer software systems used to perform processes that require cognition (Cross & Lucas, 2019). The World Bank (2018) defines it as computer systems collecting, analyzing, and processing big data in real time and ultimately recognizing patterns, making decisions, and learning from data and experience. Generative models of AI, in particular, has exhibited the ability to produce new and original elements by combining pre-existing data. Specifically, generative algorithms can be used to automatically generate creative artifacts like music (Dong et al., 2018), digital artworks (Tan et al., 2017; Elgammal et al., 2017), code, and stories (Brown et al., 2020). When interacting with humans, AI becomes an influential factor in the creative process with possible consequences on the generated outcomes and the individuals participating in the creative task (Vinchon, Lubart et al 2023). This scenario calls for a critical and extensive examination of the underlying mechanisms that drive both human and artificial creativity (Campione et al. 2023). International scientific literature highlights how AI in the education field is a particularly emerging sector capable of making a significant impact, presenting innovative solutions to improve the learning process of students and increase the effectiveness of teachers. Possible applications concern, for example, the development of personalized learning systems, designed to encourage the growth of students' skills; the use of automatic assessment systems to assist teachers in analyzing student knowledge, simplifying the assessment process; developing facial recognition algorithms to gain insights into student behaviors, enabling a deeper understanding of classroom dynamics (Remian, 2019). AI can also provide support for special needs students, for instance by teaching autistic children to identify facial expressions. In the educational field in particular, Machine learning ML algorithms are applied to profiling to predict the risk of drop-out in schools and universities (Del Bonifro, Gabbrielli, Lisanti, & Zingaro, 2020). Intelligent Tutoring

Systems (ITS) are instead used to simulate one-to-one personal tutoring by containing representations of the student's knowledge; Natural language processing (NLP) methods have also been explored to facilitate access to online lesson content by students (Glass, Hazen, Cyphers, Malioutov, Huynh, & Barzilay, 2007) and to create courses through automated generation of e-learning contents (Wang & Okamura, 2020). The complex interaction between AI technologies and educational methodologies is therefore redefining pedagogical strategies, learning environments and the overall educational experience. Whilst the importance of both creativity and AI are well established in educational system (Gabriel et al. 2022), less is know about how university students and teachers perceive and value GenAI and its connection with creativity. In a learning environment, the way students and teachers perceive a technological innovation such as GenAI, their views, concerns, and experiences of the technology can have impact on their willingness to utilise the tool and consequently the extent to which the tool is integrated in the learning process (Chan, & Hu,2023). In view of the unprecedented interest in GenAI at present, there is a need to examine teachers and university students' attitude towards GenAI and their experience of using GenAI in order to gain insights into how it can be integrated in higher education to enhance teaching and learning. After examining some crucial aspects of human creativity in connection with generative AI in learning environments, this article discusses the results of a survey conducted on a sample of secondary school teachers and university students of educational sciences about the opportunities and challenges represented by the development and implementation of AI systems in educational settings and the interaction between human creativity and AI.

2. Human creativity and GenAI

The advent of the internet and new digital technologies had already raised a series of questions, still not entirely resolved, regarding the impact of new technologies on the higher functions of the mind and, in particular, on divergent thinking. According to several authors (Maffei, 2014; Greenfield, 2009) technologies are contributing to modifying the neuronal structure of the human brain and to the emergence of a new cognitive profile. This is dictated by the fact that the brain is a slow organ that is forced to compete with the super speed of digital media. The result is that divergent thinking, that which is suited to adaptation, reflection and the development of new ideas and solutions, would gradually deteriorate, in favor of a reactivity necessary to support the rhythms of today's society, but very little suitable for stimulating creativity. Some cognitive functions such as memory,

strongly implicated in creative processes, could undergo changes. Being comfortably assisted by technology that shields us in our daily lives and remembers for us could lead to a reduction in the need to remember. With one click we can have information archived and stored in the large internet database which is larger and more easily accessible than biological memory. However, the latter does not only coincide with the accumulation of data and knowledge, but is a dynamic system that implies the continuous processing and re-signification of stored data (Treglia, 2020). Creative processes require the recombination of pre-existing elements in memory so it is of vital importance that the information "captured" through openness and focusing towards the external and internal environment is stored and is available; the possibility that an individual produces creative associations also depends on the repertoire of information available to the subject. This same repertoire can be provided and expanded by AI which finds and recombines data for us. Today's AI systems excel at producing a large number of proposals in record time. We can obtain a list of 20–40 ideas, a text on a specific topic, a poem, or a personalized computer image with just a few clicks. AI systems should consider themselves as a tool that will be used throughout the various phases of the human creative process which in general start in any domain by a phase of exploration and documentation. For example, in the case of creative writing, scriptwriters collect a massive and usually disproportionate amount of information, reading books, magazines, newspapers, consulting archives and photos, watching movies, etc (Bourgeois-Bougrine et al., 2014). To understand the complex interactions between human creativity and AI, it is appropriate to analyze the contribution of Boden (2016), one of the most influential thinkers on AI and creativity, who first of all explains the difference between creative ideas: there may be creations that are new only for the single individual who produced them and which are the result of what you call P-creativity (psychological creativity), and creations which are instead completely new for the entire society, born from H-creativity (historical creativity), which is equivalent to Beghetto and Kaufman's (2007) mini-c creativity or big-c creativity. The first are those on which we focus when we talk about creativity in relation to AI systems, since it seems interesting to see how algorithms are able to discover, understand and rework something that we might take for granted but which for them is a total novelty. Next, she identifies three different forms of creativity: creativity that happens when fresh connections are made between familiar ideas (forms, genres, approaches, expressions, etc.) (combinational creativity); when existing ideas are further explored (exploratory creativity); or when the existing ideas are transformed (transformational creativity). So far, we have seen examples of AI programmes which are apparently

creative in the sense of Boden's psychological and historical creativity, producing new artistic works that did not exist before, for example, in the field of visual art or music composition (Anantrasirichai and Bull, 2021; European Parliament Think Tank, 2020). AI can even be programmed to produce something unexpected and surprising: its programme can have rules to change the rules themselves to possibly generate a transformative effect,though in reality only few have created artworks that have such an effect. Scientists, artists and musicians live on exploratory creativity: they inherit a certain way of thinking from their culture, they study it, explore its contents and then attempt to transform it, modifying, removing or adding some dimensions. It is no coincidence that history shows that the most innovative ideas derive from a total overturning of certain structures taken for granted by the majority of those belonging to that sector, thanks to the intuition of a single individual. Current computational models are able to reproduce all three forms of creativity mentioned above to varying degrees, although exploratory creativity is the most successful, since the richness and complexity of human associative memory are difficult to replicate and represent in a computational form. A study conducted by Mollick (2023) examines several experiments in which ChatGPT is compared with students in crowdsurcing processes and creative writing processes. The results show that the human creative ideation process can easily be supported by generative AI tools, drawing many benefits, even if the human component still plays a crucial role as a key factor in generating the output is how the request (or prompt) is formulated and with how much detail it is described.

The use of AI in the field of creative ideation could also help in overcoming experience bias. For example, the atypical inputs created by Generative AI can inspire people (especially if they are experts in a given domain) to think beyond their preconceptions about what is possible or desirable in a product both in terms of form/content and in function terms; they can help them overcome the Einstellung effect (Eapen et al., 2023) according to which previous experiences prevent them from considering new ways to solve problems. A further positive contribution that Generative AI can provide is support for the evaluation and refinement of ideas. To conclude, it is important to point out that the creative process does not begin or end with the generation of ideas. Creativity scholars have long identified other crucial aspects of the creative process. Fundamental to creativity is problem finding—exploring, identifying, and defining the objects of creativity (what should be asked and addressed; Csikszentmihalyi, 1988; Reiter-Palmon & Robinson, 2009) and estimating the potential originality and effectiveness of the generated ideas (Corazza & Agnoli, 2022). We are in a new era of "assisted creativity," namely AI is not an independent creator in this sense, but rather a

collaborative creative agent. In this collaboration, the human keeps a central role at two key moments of the creative process: at the beginning and at the end. Indeed, at the beginning, the human must engage in problem finding—identifying and exploring questions and fine-tuning them to get a desired output (Glaveanu et al., 2013). AI systems would be a very helpful and powerful tool that would save time and expand the field of possibilities. However, the legal responsibility and the credit of the final output or product should remain human prerogative. Thus, AI would assist in the problem development phase of a creative process (Csikszentmihalyi, 1988; Mace & Ward, 2002). Additionally, as mentioned before, the human takes on the role of the estimator who evaluates rated productions and then refines, modifies, and ultimately validates them.

3. Methodology

Our work aims to reflect on the complex interactions between GenAI and creativity and examine teachers and university students' attitude towards GenAI and creativity in learning environment. To this end, our research questions are:

1.How familiar are university students in Educational Science and secondary school teachers with GenAI technologies?

2.What are the potential benefits and challenges associated with using GenAI in teaching and learning, as perceived by university students and teachers?

3.Can GenAI be effectively integrated into higher education to enhance teaching and learning outcomes?

4. Does the adoption of generative AI affect humans' creative production?

To answer the research questions, a survey was conducted starting from October 2023 during which a questionnaire was administered to a group of 544 subjects made up of upper secondary school teachers in Rome (n=270) and university students (n=274) enrolled in the Educational Sciences course at the University of Cassino. With a focus to obtain different perspectives on Artificial Intelligence in education, both teachers and students are selected. The student participants are selected using convenience sampling and snowball sampling. An e-mail was sent to student list that was already present in the database, as a means of convenience sampling. Students were invited to be a part of the study with an introduction of the study and its importance. Teachers were also recruited through chain sampling starting from personal and professional contacts of the research team. A link to the

online questionnaire was generated and shared with known teachers and students, with a request for further dissemination among their respective contacts. When completing the online questionnaire, participants were informed of the purpose of the research and the methods and purposes of data processing. The participation was completely voluntary, and the responses were anonymous. The questionnaire was developed by drawing upon similar studies and existing questionnaires on teachers' and students' perceptions of educational technologies in higher education (see in particular the study of Chan & Hu, 2023). The instrument comprises a pool of 21 closed-ended questions, employing a 5-point Likert scale ranging from "Strongly agree " to "Strongly disagree which asked participants to rate the tools of AI: 1) knowledge of generative AI technologies; 2) willingness to use generative AI technologies ; 3) concerns about generative AI technologies; 4) impact of integration of AI technologies in education; 5) impact of integration of AI technologies on creativity. Participants were also given a short questionnaire to collect personal data (age, gender, educational level, occupation, teaching experience, technological proficiency). After being entered into the data sheet, the scores obtained from the subjects of the entire sample were analyzed through descriptive statistics such as mean and variance. To evaluate the differences between the means of the two groups in the expected dimensions, a one-way analysis of variance was then conducted.

4. Results

Table 1 summarizes the results relating to demographic information.

TABLE 1. DEMOGRAPHIC INFORMATIONS

DEMOGRAPHIC INFORMATIONS			
PARTICULARS		FREQUENCY	PERCENTAGE
AGE	Under 18	0	0,0%
	18-20	92	16,9%
	21-25	127	23,3%
	26-30	55	10,1%
	31 and above	270	49,6%
	TOTAL	544	100,0%
GENDER	Male	246	45,2%

	Female	298	54,8%
	Prefer not to say	0	0,0%
	TOTAL	544	100,0%
EDUCATIONAL LEVEL	High School	219	40,3%
	Some College/Associate Degree	0	0,0%
	Bachelor's Degree	55	10,1%
	Master's Degree	264	48,5%
	Doctorate/Ph.D.	6	1,1%
	Others (Diploma)	0	0,0%
	TOTAL	544	100,0%
OCCUPATION	University students	274	50,4%
	Teachers	270	49,6%
	TOTAL	544	100,0%
TEACHING EXPERIENCE	none	0	0,0%
	1-5 years	89	33,0%
	6-10 years	143	53,0%
	11-15 years	36	13,3%
	16-20 years	2	0,7%
	20 years and above	0	0,0%
	TOTAL	270	100,0%
TECHNOLOGICAL PROFICIENCY	Novice	26	4,8%
	intermediate	280	51,5%
	advanced	182	33,5%
	expert	56	10,3%
	TOTAL	544	100,0%

The results relating to the various dimensions investigated by the questionnaire are presented below

TABLE 2. Knowledge of generative AI technologies

STATEMENT	MEAN	SD
generative AI technologies have limitations in their ability to handle complex tasks	4.10	0.85
generative AI technologies can generate output that is factually inaccurate	4.08	0.84
generative AI technologies can generate output that is out of context or inappropriate	4.03	0.83
generative AI technologies can exhibit biases and unfairness in their output	3.89	0.97

As illustrated in table 2, the finding suggests that participants overall have a good understanding of the limits of artificial intelligence. In particular, it is identified that AI has limitations in managing complex tasks (mean=4.10; SD 0.85), which can generate inaccurate outputs (mean 4.08; SD 0.84), as well as outputs that are out of context and inappropriate (mean 4.03; SD 0.83), while there is less awareness of biases and unfairness in the outputs.

TABLE 3. Willingness to use generative AI technologies

STATEMENT	MEAN	SD
I envision integrating generative AI technologies into my teaching and learning practices in the future	4.00	0.96
I believe generative AI technologies can help me save time	3.72	0,94
I think AI technology is a great tool as it is always available	3.85	0.88
I believe AI technologies can provide me with unique insights and perspectives that I may not have thought of myself	4.05	0.92

The subjects interviewed appear overall to be well disposed towards AI and the possibility of integrating it into their learning and teaching practices. In particular, the potential of AI to be always available (mean 3.85; SD 0.88) and to be able to help save time (mean 3.72; SD 0.94), as well as to be able to provide new insights and perspectives (mean 4.05; SD 0.92) (tab. 3).

TABLE 4. Concerns about generative AI technologies

STATEMENT	MEAN	SD

Using generative AI technologies to complete assignments undermines the value of the education	4.21	1.12
Generative AI technologies will hinder my development of generic or transferable skills such as teamwork, problem-solving and leadership skills	3.19	1.16
Generative AI technologies will limit my opportunities to interact and socialize with others	4.05	0.98

As results from table 4, participants generally perceived GenAI as a valuable and useful tool and did not have a high perception of possible risks regarding limitations in social interactions (mean 4.05; SD 0.98), the development of personal skills (mean 3.19; SD 1.16).

TABLE 5. Impact of integration of AI technologies in education

STATEMENT	MEAN	SD
The use of AI technologies positively influence student's engagement in educational activities	2.84	1.13
AI technologies make complex concepts more understandable for learners	3.06	1.20
Incorporating AI technology in education is essential for preparing students for the future	4.20	0.82
AI Technologies enhance communication and collaboration among students and teachers	4.05	0.96
AI technologies allows for more personalized and adaptive learning experiences.	2.85	1.12
AI technologies provide writing and brainstorming support	2.75	1.10

As illustrated in table 5, partecipants have a positive attitude toward GenAI and its integration in education. In particular they recognized the potential of generative AI for personalized learning support, writing and brainstorming assistance, and student's engagement in educational activities.

TABLE 6. Impact of integration of AI technologies in education on creativity

STATEMENT	MEAN	SD
AI Technology fosters a more creative and innovative learning environment	2.87	1.12
AI Technology enabling students to produce more creative content	3.08	0.99
AI Technology enabling student to solve problems in different ways	2.77	0.97

AI poses problems on transparency and plagiarism of the creative product	2.85	1.10

With regards to the last research question about AI technology and creativity in education, table 6 shows as partecipants seem to be optimistic about AI's integration in education and about its impact on creativity. They consider GenAI as a tool that can fosters a more creative and innovative learning environment (mean 2.87; SD 1.12), enabling students to produce more creative content (mean 3.08; SD 0.99) and to solve problems in different ways (mean 2.77; SD 0.97). Also interesting is their perception regarding the issue of transparency and plagiarism of the creative product, which remains a problematic issue as it implies the importance of intellectual property rights and the attribution of credit for creative works.

The analysis of variance reveals that there are no statistically significant differences between the mean scores of the two groups of university students and teachers in all dimensions considered.

5. Discussion and conclusion

The objective of this contribution was to propose reflections on the integration of GenAi in educational contexts and on the delicate issue of the relationship between GenAI and human creativity. It also aimed to investigate the perceptions of secondary school teachers and university students of educational sciences regarding the possible impact of GenAI in learning contexts and on creative processes, starting from the assumption that such perceptions influence the willingness to use the tool of AI and integrate it into teaching and learning practices. For this purpose, a sample of 544 subjects completed a questionnaire aimed at evaluating their knowledge and consideration of GenAI, their willingness to use it in educational contexts and its possible impact on creativity. The data obtained showed that the participants generally have a positive perceptions about AI, considering it mostly a useful tool for personalized learning support, writing and brainstorming assistance, and student's engagement in educational activities. Findings also show that participants are generally willing to use GenAI for their studies and future work, recognizing its resource aspects but also some limitations and possible risks, such as in providing inaccurate and context-inappropriate outputs. Regarding the impact of GenAI on creative processes, the results highlight an optimistic perception of the participants, who seem to consider AI as a useful tool to stimulate the production of new ideas, solve problems and create an innovative learning environment.

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