ChatGPT's Role in the Education System: Insights from the Future Secondary Teachers

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***Abstract*—Nowadays, the fast evolution of educational technology boosted by AI tools like ChatGPT urges to understand how future educators perceive its use in the education system. This study evaluates the knowledge and attitudes towards ChatGPT of future teachers enrolled in science (Biology, Physics, Chemistry) and humanities (Spanish Language and Literature) modules at the University of León (Spain). To achieve this goal, a non-experimental, descriptive, cross sectional, and quantitative research design has been carried out. A sample of 70 Master of Secondary Education students completed a validated questionnaire. The aim was to gauge the level of their prior knowledge about ChatGPT and to analyze their double perception as both students and future educators. Our findings indicate that prospective secondary educators generally perceive ChatGPT as a beneficial tool for students. As future teachers, they identify certain advantages in using tools like ChatGPT to enhance teaching performance. However, they are concerned about the difficulty of detecting plagiarism and the potential decrease in students' critical thinking skills. These two aspects are viewed as threats to the quality of the educational system. This study highlights differences between future science and humanities teachers. Notably, educators with a humanities background are more worried about information quality, creativity, and academic integrity compared to their science counterparts. This work highlights the need to address customized strategies for incorporating AI into the educational system through specific training that takes into account the prior education of students and teachers.**

***Keywords*—ChatGPT, secondary education, artificial intelligence, teacher training, educational perceptions, technology in education**

I. Introduction

The advent of new technologies often sparks conflicting emotions and divides the population. People oscillate between their benefits and their dangers. Since the early days of human-like processing in the 1950s, led by Turing [1, 2], Artificial Intelligence (AI) has experienced exponential growth. This trend has significantly accelerated with the advent of chatbots, particularly following the global release of ChatGPT-3.5 in November 2022 and its advanced version, ChatGPT-4, developed by OpenAI. This AI tool, based on the Generative Pretrained Transformer (GPT) language model, is designed to produce responses that mimic human interaction (OpenAI). AI's recent advances have been rapidly embraced in a variety of scientific fields, leading to a multitude of applications that have positively and directly impacted on several sectors, including healthcare [3–6] and sustainable industrial development [7]. Significantly, AI's impact has been profound in the educational sector [8], where the focus has been more on the risks and challenges. For instance, in this sector professionals are specially concerned about authorship issues [9–12], rather than on the expansive possibilities it presents. At the same time, there is a growing ethical concern addressing themes like responsibility, inclusion, social cohesion, autonomy, safety, bias, academic integrity, and environmental impact [13, 14].

Thus, there is an urgent need for a paradigm towards a holistic approach, that enables a conscious and informed engagement of educators with emerging technologies. This approach fundamentally requires high-quality training for educators to effectively navigate digital literacy [15]. It also needs legislative frameworks to regulate the use of such technologies within ethical boundaries and reinterpret the concept of plagiarism in the context of technological advancements [13, 16]. In fact, in situations where significant political interventions are absent (as in Spain, where the most recent document addressing these issues is from 2020 [17], various universities have started to implement ethical codes to regulate the use of AI in research [18]. Some institutions have even returned to more traditional methods of examination, like written or oral tests [19], or have implemented complete bans on the use of these technologies [20]. This preemptive action took place even before the European University Association published its guidelines on responsible technology use in university teaching in February 2023 [21]. However, Spain's adoption of these guidelines through the Crue Universidades Españolas and the Ministry of Universities represents a relatively modest advancement in this area. While these measures are noteworthy, they do not completely meet the pressing demands to continue legislating in alignment with UNESCO's directives [22]. UNESCO has committed to maximize the potential of AI technologies, with the unwavering objective of ensuring inclusive, equitable, and quality education, and promoting lifelong learning opportunities, all within the scope of the 2030 Agenda (SDG4). The treaty represents a comprehensive effort to address both the opportunities and challenges posed by AI in education. This document is structured around 44 meticulously categorized recommendations. These include integrating AI into education policy strategies, deploying it for education administration and facilitation. and enhancing AI use in pedagogical practices and among the teaching community. These recommendations also focus on implementing AI in learning processes and their evaluation, fostering essential skills and values for life and work in the AI era [22, 23].

The directives set forth by UNESCO could mark the

beginning of a journey towards effective regulation in education. It may, potentially enhance teacher training quality [24], and develop effective strategies to promote digital literacy. The OECD [25] underscores the need for research that examines the transformations effected by intelligent technologies and their direct impact on classroom education, as well as on the management of educational organizations and systems.

Several classroom-level interventions and recent empirical studies have begun to produce intriguing results [26, 27]. Research has been focusing on aspects such as the potential of these technologies to facilitate communication between educators and students. Originating decades ago within in the field of Computational Linguistics, this research now extends to areas like Natural Language Processing (NLP) in communicative interactions [28], and the generation of contextually appropriate responses within an education setting [29, 30]. Several studies analyzed its role in various writing tasks [31]. The authors have identified ChatGPT's use in writing tasks in the following three categories: ChatGPT as a co-author [32, 33], ChatGPT as a writing assistant [34–36] and the future of writing with ChatGPT [37, 38].

The benefits of these technologies also extend to teaching native and second languages from early ages, particularly in enhancing written expression [39]. Furthermore, they provide tailored responses and resources that align with each student individual learning level, pace, and style, (i.e. personalized learning experiences [40]). Moreover, their use as tools introduces innovative methodologies, enhances the teaching-learning process, affects both superficial and profound motivation, and has the potential to improve student performance [41–43]. Other applications include (i) AI's role in addressing real-time individual differences , as part of Universal Design for Learning (UDL) [44]; (ii) the creation of education materials, including texts, images, videos, 3D objects, audios, and source codes [45, 46]; (iii) its ability to understand context, which, in turn, enhances interaction with tools, enables self-directed responses, and creates a richer information environment [47]; and (iv) the development of intelligent tutoring systems [36, 48]. These are just some of the notable benefits highlighted by studies. Additionally, AI is recognized as an effective tool for enhancing teacher productivity, reducing the time spent on asynchronous tutoring routine evaluation tasks using scales or rubrics [49]. It has also been proved its ability to automate exam grading and forum monitoring [50]. Last, it also provides insights into student progress through continuous and formative assessment, thereby fostering self-regulation [51].

This comprehensive review of the literature [26] predicts a radical transformation in the education sector in the coming years. This transformation is expected to affect didactic approaches and classroom methodologies. It may also, influence the search, acquisition, and processing of information, redefine essential education competencies for lifelong learning, and the tools and instruments for evaluation. The education community must engage in this debate; It cannot afford to remain indifferent. Actively acquiring and implementing AI knowledge in the classroom is essential to maximize the learning potential for all involved parties. Direct intervention in university degree curricula, integrating the use of these tools across various disciplines, is imperative. This is a challenge for educators as learning modalities are poised to change and subsequently, teaching methods will be required to evolve [51].

Considering that this trajectory in education affects all levels and stakeholders, one particular sector stands out as especially vulnerable: teachers in training. The greatest responsibility for training falls on these teachers in training, Teachers in training are poised to become the standard-bearers of digital literacy for the youth. This aligns with the goals outlined in Strategic Axis 2 of the National Artificial Intelligence Strategy (ENIA), which focuses on promoting the development of digital capabilities, enhancing national talent, and attracting global talent in the field of artificial intelligence [17].

There are already studies that examine the impact of AI and the perception held by teachers in training in primary education [3, 52, 53]. However, there is a gap in research focusing on future secondary school teachers, and specifically on teacher training master's programs. Additionally, insights from students with diverse academic backgrounds could be particularly valuable. The juxtaposition of two distinct groups, such as students in experimental sciences and humanities, with their varying expectations, uses, and perceptions of artificial intelligence, provides a unique opportunity for analyzing both the perception and application of ChatGPT. While the sciences seem, at first glance, more inclined to embrace technology, advanced studies in Linguistics argue that creativity remains a unique stronghold for humans. Despite the advancements in AI, still shows significant limitations in transformational creativity and inductive reasoning. The essence of creativity lies in divergent thinking, characterized by illogical and chaotic reasoning [54, 55]. Humanities students are often taught to value human intelligence and emotional depth, shaping their perception of art through the cultivation of aesthetic sensibility.

Therefore, it becomes imperative to understand how future educators, perceive these emerging AI-based technologies, especially considering their diverse academic backgrounds. Understanding their perceptions will enable an analysis of their potential impact on the future structure of the education system. This study is important for guiding future research on ChatGPT's use in education. It proposes involving current teachers and their students, especially in secondary schools across different subjects, to understand how ChatGPT affects teaching methods. Additionally, comparing its use among secondary students and university professors will provide a clearer picture of its impact across a wide range of education levels.

The main goal of this work is to evaluate how the students enrolled in the science (Biology and Physics and Chemistry) and humanities (Spanish Language and Literature) modules of the Master in Teacher Training program at the University of León perceive the use of ChatGPT in education. So far, this evaluation is unique as it considers the dual perspective of these individuals as both current students and future educators. To achieve this goal, the study has outlined the following specific objectives:

- Objective 1: Assess the level of prior knowledge on ChatGPT among future secondary education teachers.
- Objective 2: Analyze perceptions of using the tool as students.
- Objective 3: Evaluate the perceptions on ChatGPT´s application as future teachers.
- Objective 4: Contrast these perceptions between future humanities and sciences teachers.

II. Materials and Methods

A. Participants and Sample

The population under study consisted of 101 Master Degree in Secondary Education Teacher Training students at the University of León. Specifically, we used the 2022/2023 and 2023/2024 academic years in the specialties of Physics and Chemistry, Biology and Geology, and Spanish Language and Literature. We selected these students because they provide information from a dual perspective: current students and imminent teachers.

We conducted this study in October 2023. A sample of 70 students from the Master Degree in Teacher Training participated (70% of the study population): 33 students were sciences students (19 from the modules of Physics and Chemistry and 14 from Biology and Geology), while 36 were humanities students from Spanish Language and Literature module. The average age of the sample was 26.5 years (SD = 4.74), 78.6% were women, 20.0% men, and the remaining 1.4% identified as nonbinary gender (refers to a gender identity that doesn't fit strictly within the traditional categories of male or female).

Before implementing a practical classroom session on the use of ChatGPT for specific teaching applications, students were asked to complete a questionnaire via Google Forms. The purpose of this questionnaire was to gauge their prior knowledge of the tool (details of which are further elaborated in Block 2 of the subsequent section). Following the questionnaire, study participants engaged in a one-hour hands-on session utilizing ChatGPT for educational purposes. This session included creating educational materials and developing assessment tools relevant to their field.

B. Study Instrument: Characteristics and Application

In order to carry out this study, we designed a nonexperimental, descriptive, cross-sectional, and quantitative research. We carried it out through the application of a questionnaire already published and validated by Lozano and Blanco Fontao for primary teachers in training [52] with small adaptations. Students answered the questionnaire after informing them and obtaining their consent for the use of the data for the present work.

It was divided into 4 blocks. The first block was composed of demographic questions, with the 3 first questions, identifying the gender, age and specialty of the Master. Block 2 consisted of three questions to study the participants´ previous knowledge on the use of the application. Block 3 dealt with the study of the students´perceptions of ChatGPT access and use, as well as the identification of possible advantages and disadvantages for its use as students. Finally, Block 4 dealt with ChatGPT student perceptions as future teachers. Questions in Blocks 3 (ten questions) and 4 (seven questions), consisted of a 5-point Likert scale, in which value 1 corresponded to totally disagreement, 2 to disagreement, 3 to neutral, 4 to agreement, and 5 to totally agreement. In addition, each of these two last Blocks were completed with 2 multiple-choice questions. The Likert-type questions in Blocks 3 and 4 were categorized into three groups: A: Access and use of the application; B: Sources and quality of the information obtained; and C: Knowledge of how the tool operates, in order to study the perception of these aspects from a dual perspective—students and teachers.

The modifications applied to the initial questionnaire were twofold: in Block 2 we included a question to find out if any of the students had taken any specific training course on ChatGPT. This is an aspect that we considered fundamental since the use of ChatGPT has rapidly become widespread and many specific training courses have recently emerged. In addition, in Block 4 we included two multiple response questions about possible advantages and disadvantages of ChatGPT in their future teaching work. These two questions were included because the students in this study are in their last year of training. Therefore, they can consider more closely how it will affect them in their day to day work. The inclusion of these questions was carried out through a panel of experts, using the Delphi Method, in the same way as the initial questionnaire [36, 56–59]. Finally, this instrument showed a very good confidence level (Cronbach´s Alpha 0.826) [60].

C. Statistical Analysis

Data collected from the questionnaire were processed with version 26 of the SPSS (IBM) computer software. Firstly, we implemented descriptive statistics by calculating relative frequencies (%) to each question. Secondly, we calculated mean value and standard deviation of each independent group (science and humanities) taking as a reference the values assigned in the Likert scale responses (see previous subsection). For the multiple-choice questions, we calculated the relative frequencies considering the total number of responses to each item.

Next, to study the influence on perceptions according to the module taken by the students (experimental sciences versus humanities), we used the Mann-Whitney U test for nonparametric data on independent samples [61, 62]. The significance levels used as a reference in the present study correspond to values of $p \leq 0.05$.

III. Results

A. Prior Knowledge about ChatGPT

Our results showed that 98 % of the Master of Secondary Education students had previous knowledge on ChatGPT, 60% of them had used it at least once, and only, 2.8% had specifically taken a course on it (Block 2).

When we compared the students background (sciences *vs* humanities), we found that all science students were already familiar with the application, and only one humanities student was not, (1.42%). In terms of prior use of the program, significantly more science students utilized it compared to humanities students (93.8% vs 47.4%) ($p < 0.05$). Finally, we

did not find differences between sciences and humanities students regarding the percentage of students who have received training on it (2.8%) ($p > 0.05$).

B. Perception of ChatGPT Use as Student

Block 3 data on Perceptions of Access to and use of ChatGPT as students in the various categories described in the study are shown in Table 1. In Category A, which addresses access and use of ChatGPT, the results revealed a wide range of perceptions. The majority of students agreed or strongly agreed (65%) that they were surprised by its potential when using it (question 1). Similarly, they found it to be a tool with easy access and usability (question 2). About half of the students (56%) perceived that this tool could save them a lot of time in assigned tasks (question 3), and some also observed that it could be a personalized tool for the learning process (39%, question 4).

Table 1. Block 3 of the questionnaire: Perception of ChatGPT as student according various categories

Category	Question	Likert (%)					Mean value and SD		P-value[1]
		1	2	3	4	5	Sci.	Hum.	
A	1. I was surprised by its potential when I have used it.	3	3	29	41	24	4.3 (0.75)	3.5 (0.95)	0.001
	2. It is a tool easy to access and use.	2	6	24	31	37	4.3 (0.89)	3.7 (0.99)	0.005
	3. I find that ChatGPT saves much more time on doing tasks than other online resources or textbooks.	4	17	23	33	23	3.8 (1.12)	3.3 (1.14)	0.070
	4. I find that ChatGPT can be a personalized learning tool, since it specifically answers each question.	6	19	36	25	14	3.1 (1.04)	3.4 (1.12)	0.152
B	7. I have asked ChatGPT to generate the sources of information used to generate a work.	37	10	17	24	12	3.0 (1.59)	2.3 (1.32)	0.088
	8. The quality of the work done with ChatGPT is the same as that done with other online resources or textbooks used so far.	19	38	28	9	6	2.5 (1.10)	2.4 (1.05)	0.980
	9. The sources used by ChatGPT to generate the work are reliable.	9	26	51	11	3	2.6 (0.86)	2.8 (0.89)	0.497
C	10. As a student, even if ChatGPT performs the task given I must ensure that I understand the work.	2	0	4	11	83	4.9 (0.42)	4.6 (0.82)	0.116
	11. I understand how the artificial intelligence that ChatGPT uses works and therefore how it generates my tasks.	9	20	26	27	19	3.3 (1.17)	3.2 (1.28)	0.986

A: Access and use. B: Expectations of using ChatGPT in teaching. C: Understanding of the Tool's Functioning.
[2] P-value < 0.05 means differences were statistically differences between experimental groups in the U-Mann Whitney analysis between experimental groups: Humanities vs Science students.

Category B focuses on the Sources and Quality of Information provided by ChatGPT. Questions 7 to 9 address how students perceive the generation of information sources by ChatGPT and the reliability of these sources. Only 36% of students requested information about the sources (question 7). Concerning the quality of the generated work, only 14% agreed or strongly agreed that it could be comparable to traditional resources (question 8). Finally, half of the students (51%) were neutral when checking the veracity of these sources, not acting critically in this regard (question 9).

Category C, which deals with the Understanding of the Tool's Functioning and includes questions 10 and 11, is crucial for assessing the level of understanding and confidence students have in the underlying technology of ChatGPT. Almost all students agreed or strongly agreed that they should cross-check tasks assigned by the application to ensure they are correct (question 10). However, only 46% believed they understand how the application works (question 11).

When we compared questionnaire responses between science and humanities students, significant differences were only observed in questions 1 and 2 of Category A (Table 1). Experimental science students showed a greater surprise at the potential of ChatGPT compared to humanities students (4.3 *vs* 3.5 mean values, question 1). Concerning question 2, science students found the tool easier to access than humanities students (4.3 *vs* 3.7 in the Likert scale mean values).

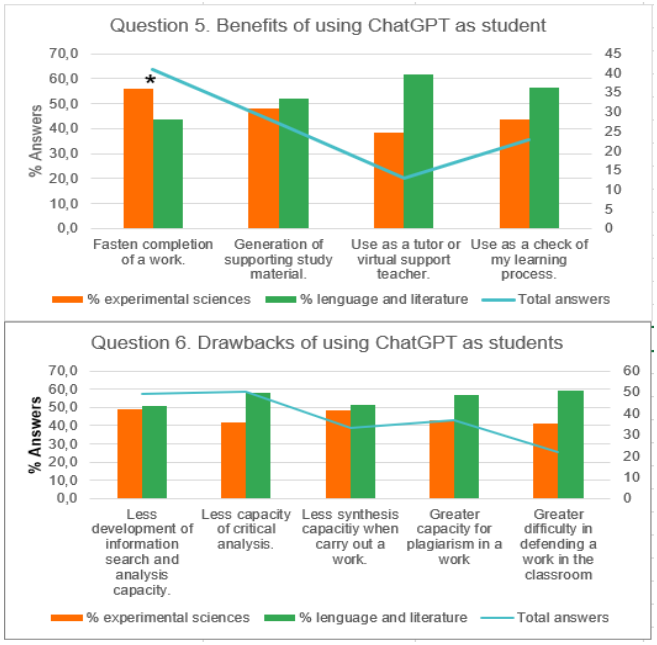

Fig. 1. Results on the perception of A) the benefits (upper graph, question 5) and B) drawbacks (lower graph, question 6) of the use of ChatGPT by students (Category A). The bars represent the percentage (left axis) and the line represents the total number of responses (right axis). * means statistically significant differences between groups ($p<0.05$).

The results of the multi-answer questions 5 and 6 from category A are depicted in Fig. 1. This graph (upper graph, question 5) illustrates the benefits of using the application from the students' perspective. Students perceived the increased speed in completing a task as the greatest

advantage, followed by the generation of support material, and its use in assessing their learning process (highest number of responses, indicated by the blue line). The most significant advantage is seen in its use as a virtual tutor.

In terms of disadvantages, (Fig. 1, lower graph, question 6), the number of responses is more uniform. Similarly, students believed that the use of this tool represents a disadvantage for the development of information search and critical analysis skills. They also perceived as a disadvantage the increased potential for plagiarism and the reduced synthesis capability, in this order. The greatest difficulty reported is regarding how to defend work in the classroom.

When we analyzed these issues comparing the two fields of study, we found that humanities students perceived more advantages and disadvantages than sciences students. However, we only observed significant differences regarding how fast a task is completed; showing sciences students higher results (asterisk in Fig. 1).

C. Perception of ChatGPT Use as Future Teacher

Table 2 displays the data concerning Block 4, which pertains to the perception of future teachers regarding the use of ChatGPT

In Category A, which addresses the Access and Use of ChatGPT, the results reflected mixed opinions. For instance, in question 12 (ChatGPT as a threat to the teaching profession) there was a notable division in opinions: 14% strongly disagreed, while 17% strongly agreed. Question 13, which inquired about the potential usefulness of ChatGPT in future teaching endeavors, showed 31% of respondents fully agreeing on its high utility *vs* 3% who strongly disagreed. Lastly, question 14, focusing on whether ChatGPT would alter approaches to certain tasks, resulted in 53% of participants completely agreeing and no students expressing total disagreement.

Table 2. Block 4 of the questionnaire: Perception of access and use of ChatGPT as future teacher according various categories

Category	Question	Likert (%)					Mean value and SD		P-value[1]
		1	2	3	4	5	Sci.	Hum.	
A	12. ChatGPT can be a threat to the teaching job.	14	18	22	29	17	1.5 (1.27)	2.2 (1.28)	0.026
	13. ChatGPT can be a very useful tool to use in my future teaching work.	3	4	19	43	31	4.1 (0.87)	3.8 (1.03)	0.192
	14. As a future teacher, I believe that ChatGPT will force us to change the approach to certain tasks.	0	2	10	36	52	4.4 (0.83)	4.4 (0.63)	0.590
B	15. As a teacher, I could use ChatGPT to generate high quality content, as long as I corroborate the sources.	3	4	15	44	34	4.3 (0.65)	3.8 (1.10)	0.023
	16. ChatGPT could lead to a devaluation of the quality of the education system.	30	23	26	16	5	2.5 (1.16)	2.6 (1.30)	0.949
C	17. As a future teacher, I must know the tool in order to know how to approach the tasks and how to be able to evaluate it in a way that prevents/detects plagiarism.	2	0	3	15	80	4.8 (0.36)	4.6 (0.82)	0.338
	18. As a future teacher, I must know how artificial intelligence works to understand how the students can use it in their tasks.	2	2	2	29	65	4.6 (0.55)	4.52 (0.86)	0.618

A: Access and use. B: Expectations of using ChatGPT in teaching. C: Understanding of the Tool's Functioning. Responses of Likert scale (1–5) in %
[2] *P*-value < 0.05 means differences were statistically differences between experimental groups in the U-Mann Whitney analysis between experimental groups: Humanities vs Science students.

Category B focuses *on Expectations of using ChatGPT in teaching*. In question 15 on the use of ChatGPT to generate high quality content by corroborating sources, 34% students totally agreed, while 3% totally disagreed. In question 16, regarding whether ChatGPT could lead to a devaluation in quality of the educational system or not, opinions were more divided, with a slightly higher proportion of students totally disagreeing or disagreeing than those who thought otherwise.

Finally, Category C addresses the *Understanding of the Tool's Functioning*. In question 17, 80% of respondents completely agreed on the importance of acquiring knowledge about ChatGPT to effectively address and evaluate tasks, and also avoid and detect plagiarism. In question 18, about understanding the functioning of AI to assess its use in student tasks, the vast majority of students (65%) totally agreed on the need for this knowledge.

Taking into account the two specialties, we found two significant differences. The first one in relation to the threat of ChatGPT use on the teacher job. Future science teachers are less worried about its use than those in humanities (1.5 *vs* 2.2 Likert scale mean values, question 12). The second difference concerns the use of ChatGPT as future teachers to generate high quality content (question 15). Here, science students showed a higher confidence in this tool than those in humanities (4.3 *vs* 3.8, Likert scale mean values).

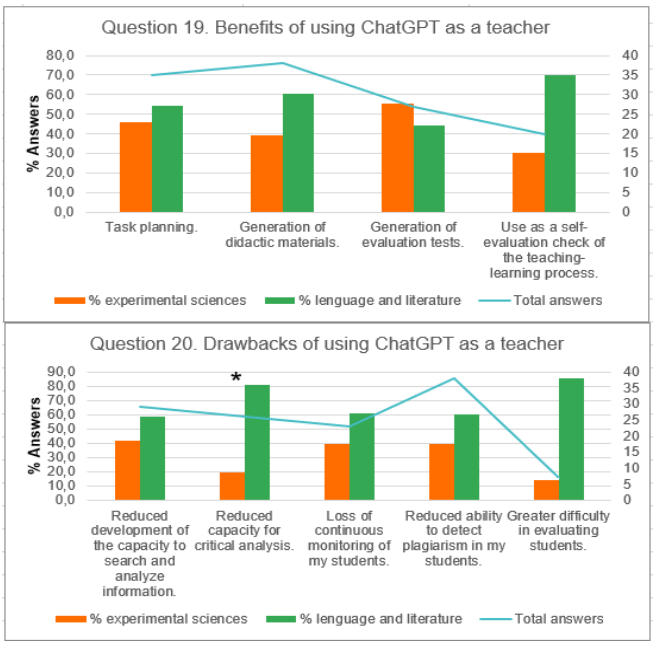

Fig. 2. Results on the perception of the benefits (upper graph, Question 19) and drawbacks (lower graph, Question 20) of the use of ChatGPT by teachers (Category A). The bars represent the percentage (left axis) and the line represents the total number of responses (right axis). * means statistically significant differences between groups ($p < 0.05$).

Fig. 2 shows the aspects that future teachers considered beneficial (Fig. 2 upper graphic) and detrimental to professional teaching performance (Fig. 2 lower graph). The

most frequently selected benefit was ChatGPT use to generate educational material, followed by task planning, creation of assessment tests, and lastly, as a tool for self-assessing the teaching/learning process. In terms of disadvantages, future teachers identified the greatest threat as the reduced ability to detect plagiarism, followed by the decreased development of search and critical analysis skills, the loss of continuous student monitoring, and finally, the increased difficulty of evaluating students.

Analyzing the differences observed between science and humanities students, there were significant differences in only one aspect. Thus, humanities students showed a significantly higher concern about the possible reduction in critical analysis ability derived from ChatGPT use than science students ($p > 0.05$). In the rest of the parameters, the differences were not significant, although it can be generally observed that humanities students showed numerically a higher number of both benefits and drawbacks in the use of ChatGPT in teaching.

IV. Discussion

Starting from the objectives set in this work, and more specifically concerning the Objective 1 (initial level of knowledge on ChatGPT among future secondary school teachers), we observed a high degree of knowledge, much greater than that reported in the previous work developed last year [52]. This increase could be due to the fact that, at the time this questionnaire was launched, the tool had already been available for a year, becoming much more mediatic due to its high potential. This fact may have caused its knowledge popularity and perception to expand and evolve rapidly among future teachers in a very short time.

Regarding Objective 2 (perceptions of ChatGPT from the students' perspective), we observed a generally positive perception towards its use as in previous studies [52]. Similarly, students showed a positive perception of the application use (Category A; application access and use) like the results identify in previous works [43, 63]. However, in this work, the students were more skeptical regarding the perception of the tool as a time-saver in tasks and as a specific instrument for personalized learning than primary teachers in training [52]. This aspect could be due to the greater knowledge of the tool now, as well as to the success it has in the market nowadays and the rapid development of its potential [43, 64].

The pattern of response reported by future secondary school teachers, highlighted, among the advantages, the saving of work and time in tasks, and among the disadvantages, the lesser critical analysis and search capability. This fact is fundamental as it could compromise the development of high order cognitive processes, which, in turn, can affect the development of students' competencies, and ultimately, devalue the educational system with all that this implies. Previously research has evidenced incorrect responses generated by ChatGPT, as well as false sources, have been observed [65]. This aspect can influence the increase in misinformation, with all the repercussions that this entails. In this regard, within Block B, we observed an increase in distrust of sources and in the quality of information generated by the application. Through these results, it can be deduced that there has been an increase in the use and mastery of the tool. The users are now more aware of one of the major problems that this tool presented at the beginning, which was the contribution of false references. This change can be seen as a positive result towards the students' critical analysis capacity, being more skeptical of the information provided by the application. However, we still observed a general lack of knowledge on how ChatGPT generates the information (Block C).

Objective 3 of the study (teacher's perspective on ChatGPT) yielded diverse results. For instance, just under half of the teachers in training considered the tool a threat to the teaching function. In this sense, recent research [37, 38, 66] has shown that the tool does not have the necessary writing skills yet to be considered a threat. However, it seems that threat perceptions are increasing in this study. Although it is a tool that has been on the market for a very short time, it has evolved remarkably, improving its functions very rapidly. Furthermore, the perception among future secondary education teachers may be influenced by their students greater access and autonomy with the use of technologies compared to primary education students.

Despite showing this feeling of threat, future teachers believe that the tool can be very useful for the development of their future teaching work, as already reported by Berg and Plessis (2023) [67]. However, they are aware that they will have to reformulate how they ask for some of their tasks, in order to avoid plagiarism and authorship by students [9–12]. The difficulty in detecting plagiarism is the greatest disadvantage observed by future secondary teachers. Although since the massification of the use of the internet there has already been this fear on part of the teachers [68], the results of the present study demonstrate that the appearance of this tool has drastically increased it. The creation of texts with high originality offered by ChatGPT greatly complicates its detection [69, 70,] and highly efficient tools for its detection have not yet been developed [71, 72]. These facts lead to a change in the way tasks are approached by teachers, an aspect that is very present in the sample of this study and in the need to acquire training in this type of AI. In this study, the percentage of future teachers who had received specific training in it was insignificant, a notable and important aspect that should be addressed in both the permanent training of teachers in active and in university education in the case of teachers in training.

Among the fundamental benefits of ChatGPT use indicated by future teachers are the development of didactic materials, followed by task planning, generation of assessment tests, and finally, the use for self-assessment of the teaching/learning process by the teacher. These aspects could improve the effectiveness of the teacher work [32, 45, 46] and the appropriate adaptation to the characteristics of each student, as proposed by UDL [45], which, in turn would favor the efficiency the strength of the educational system.

The last of the objectives set out (Objective 4) intends to study the differences between students coming from scientific training and those from humanistic training. This aspect has not been previously analyzed and the present study revealed differences between both students and future teachers and also between students with a science

background and students with a humanities background. A previous study on the perceptions of computer science students about ChatGPT in education suggested that many students are familiar with the tool, but do not use it regularly for academic purposes. They also showed skepticism about its positive impacts on learning and suggested that universities should provide clearer guidelines and better education on how and where ChatGPT can be used in learning activities [73]. In a recent qualitative work, 24 students from private universities in Karachi, including humanities and science students, were interviewed. The results showed a mixed trend; most students opined that ChatGPT hinders creative writing, while another group considered it beneficial if used under supervision or controlled conditions [8]. However, there are no previous studies that have analyzed these perceptions in terms of the previous background of students or teachers. In this sense, this study demonstrates that the previous background directly affects the way of understanding and using this technology. Thus, students from scientific training, who are *a priori* more inclined towards the use of technology than their humanities counterparts, were more surprised by the potential and the access to the tool than students from the humanistic studies. In addition, the former group of students are more aware of the influence it can have on changing the approach to tasks in their future classrooms and of the greater knowledge they need on the tool to know what they can use it for students. Also, students from the scientific education highlighted the benefit of the increased speed in the elaboration of works while humanities students found a great inconvenient as teachers in the reduction of critical capacity.

Thus, the differences observed are congruent with the value that humanities students give to critical thinking and subjective interpretation. Humanistic future teachers are skeptical about the development of the creativity by using ChatGPT, as creativity contradicts the inductive reasoning used by AI [54, 55]. For this reason, AI-generated responses could be perceived as less valuable or authentic by humanities students. In addition, the way of understanding technology can also affect the way they use AI tools. Students with science background are more prone to have a greater contact with AI tools due to the AI affinity with scientific aspects, what could explain why they tend to develop more positive perceptions of it.

V. Conclusion

This study highlights the need for a holistic approach that encourages conscious and informed engagement of educators with emerging technologies, recognizing both the opportunities and challenges presented by ChatGPT. As we move towards a radical transformation in the educational sector, driven by intelligent technologies, it is essential that university curricula integrates the use of these tools effectively, preparing future educators to become standard bearers of digital literacy. Our study provides targeted insights into the knowledge and perceptions of future secondary education teachers regarding the use of ChatGPT in educational settings. Key findings reveal a high level of awareness and understanding of ChatGPT among these future educators, surpassing previously reported data. This heightened awareness is likely due to ChatGPT's increased visibility and accessibility.

Notably, students generally view ChatGPT positively, recognizing its utility in time-saving and facilitating personalized learning. However, concerns about information quality and source verification remain prevalent.

In terms of their future teaching role, perceptions are varied. While some see it as a useful tool for generating educational materials and improving teaching efficiency, others express concern about the potential to encourage plagiarism and the reduction of critical thinking and searching skills in students. The need to reformulate tasks to avoid plagiarism and the challenge of detecting AI-generated works are notable concerns.

The background of future teachers affects perceptions of the tool. While science future teachers showed greater enthusiasm for the potential of ChatGPT, humanities future teachers expressed deeper concerns about academic integrity and critical analysis, stemming from a loss of personal authorship and creativity due to the use of these tools. This points to the need for differentiated pedagogical approaches to address emerging technologies in education.

The study suggests a need for deeper AI training for educators to address ethical and practical challenges and recommends differentiated pedagogical approaches based on the teacher's field of expertise. Additionally, it underscores the urgency of incorporating digital and ethical competencies in teacher training programs in line with UNESCO guidelines.

The main limitation of this study is fundamentally derived from the number of samples reached. This aspect is largely due to the difficulty to access to this type of students who have this dual perspective: students and future secondary school teachers.

As for future lines of research, it is necessary to address this investigation with active teachers, as this group of professionals is already being directly affected by the use of ChatGPT, not only by them in their teaching role, but also by their students who have access to the tool. In addition, among active secondary school teachers, more specialties could be included to analyze differences in their perceptions and in the effect that it could have on their teaching. It would also be interesting to analyze both the use of the tool by secondary school students and by university professors.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Conceptualization: CBF; methodology: CBF and AL.; software: CBF; validation: AL, MLS and CBF; formal analysis: CBF; investigation: AL, MLS and CBF; resources: AL and MLS; data curation: CBF; writing—original draft preparation: CBF; writing—review and editing: CBF; visualization: AL and MLS; supervision: AL and MLS; project administration: CBF; funding acquisition: CBF. All authors had approved the final version.

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REFERENCES

[1] A. M. Turing, "Computing machinery and intelligence,". *Mind*, vol. 59, pp. 433–460, 1950. doi: https://doi.org/10.1093/mind/LIX.236.433

[2] J. G. Ganascia, *Artificial Intelligence: Between Myth and Reality*, Paris, France: The UNESCO Courier, 2018.

[3] D. J. Wu and J. E. Bibault, "Pilot applications of GPT-4 in radiation oncology: Summarizing patient symptom intake and targeted chatbot applications," *Radiother. Oncol.*, vol. 190, 109978, 2024. doi: https://doi.org/10.1016/j.radonc.2023.109978

[4] J. R. Chapman, J. Wang, and K. Wiechert, "Let's put AI to really good use!" *Glob. Spine J.*, vol. 14, pp. 7–10, 2024. doi: https://doi.org/10.1177/21925682231208592

[5] P. K. Sahu, L. A. Benjamin, G. S. Aswal, and A. Williams-Persad, "ChatGPT in research and health professions education: Challenges, opportunities, and future directions," *Postgrad. Med. J.*, vol. 100, pp. 50–55, 2024. doi: https://doi.org/10.1093/postmj/qgad090

[6] L. Xu, L. Sanders, K. Li, and J. C. L. Chow, "Chatbot for health care and oncology applications using artificial intelligence and machine learning: Systematic review," *JMIR Cancer*, vol. 7, e27850, 2021. doi: https://doi.org/10.2196/27850

[7] M. Peksen and H. Spliethoff, "Optimising pre-reforming for quality r-SOC syngas preparation using Artificial Intelligence (AI) based Machine Learning (ML)," *Int. J. Hydrogen Energy*, vol. 48, pp. 24002–24017, 2023. doi: https://doi.org/10.1016/j.ijhydene.2023.03.223

[8] A. A. Imran and A. A. Lashari, "Exploring the world of artificial intelligence: The perception of the university students about ChatGPT for academic purpose," *Glob. Soc. Sci. Rev.*, vol. 8, pp. 375–384, 2023. doi: https://doi.org/10.31703/gssr.2023(VIII-I).34

[9] T. Adiguzel, M. H. Kaya, and F. K. Cansu, "Revolutionizing education with AI: Exploring the transformative potential of ChatGPT," *Contemp. Educ. Technol.*, vol. 14, 3, 2023. doi: https://dx.doi.org/10.30935/cedtech/13152

[10] S. K. Kim and U. Wong, "ChatGPT impacts on academia," in *Proc. the 2023 International Conference on Software, Systems Engineering, and Digitalisation (ICSSE)*, pp. 1–6. IEEE, 2023. doi: https://dx.doi.org/10.1109/ICSSE58758.2023.10227188

[11] C. McCarthy, "ChatGPT use could change views on academic misconduct," *Syllabus*, vol. 12, 2, 2023. doi: https://doi.org/10.1002/dap.31202

[12] A. Goto and K. Katanoda, "Should we acknowledge ChatGPT as an author?" *J. Epidemiol.*, JE20230078, 2023. doi: https://dx.doi.org/10.2188/jea.JE20230078

[13] A. Barrett and A. Pack, "Not quite eye to A.I.: Student and teacher perspectives on the use of generative artificial intelligence in the writing process," *Int. J. Educ. Technol. High. Educ.*, vol. 20, p. 59, 2023. doi: https://doi.org/10.1186/s41239-023-00427-0

[14] B. C. Stahl and D. Eke, "The ethics of ChatGPT—exploring the ethical issues of an emerging technology," *Int. J. Inf. Manag.*, vol. 74, 102700, 2024. doi: https://doi.org/10.1016/j.ijinfomgt.2023.102700

[15] J. M. Flores-Vivar and F. J. García-Peñalvo, "Reflections on the ethics, potential, and challenges of artificial intelligence in the framework of quality education (SDG4)," *Comunicar*, vol. 31, 74, pp. 37–47, 2023. doi: https://doi.org/10.3916/C74-2023-03

[16] Government of Spain, "ENIA: Estrategia Nacional de Inteligencia Artificial (National Strategy for Artificial Intelligence)," Ministry of Economic Affairs and Digital Transformation, 2020.

[17] V. Romo-Pérez, J. L. García-Soidán, A. S. Özdemir, and R. Leirós-Rodríguez, "ChatGPT has arrived What do we do now? Creativity, our last refuge," *Rev. Investig. Educ.*, vol. 21, 3, pp. 320–334, 2023. doi: https://doi.org/10.35869/reined.v21i3.4973

[18] C. Cassidy, "Australian universities to return to 'pen and paper' exams after students caught using AI to write essays," *The Guardian*, January 10, 2023.

[19] M. Yang, "New York City schools ban AI chatbot that writes essays and answers prompts," *The Guardian*, 2023.

[20] European University Association, "Artificial intelligence tools and their responsible use in higher education learning and teaching," European University Association, 2023.

[21] UNESCO, Beijing Consensus on Artificial Intelligence and Education International Conference on Artificial Intelligence and Education, Planning Education in the AI Era: Lead the Leap, Beijing, China, 2019.

[22] UNESCO, "Recommendation on the Ethics of Artificial Intelligence," UNESCO, 2022.

[23] UNESCO, *The Sustainable Development Goals Report*, UNESCO: Paris, France, 2020.

[24] OCDE, "OECD digital education outlook 2021: Pushing the frontiers with artificial intelligence, blockchain and robots," OCDE, 2021. doi: https://doi.org/10.1787/589b283f-en

[25] Y. Liu, T. Han, S. Ma, J. Zhang, Y. Yang, J. Tian, H. He, A. Li, M. He, Z. Liu, Z. Wu, D. Zhu, X. Li, N. Qiang, D. Shen, L. Tianming, and B. Ge, "Summary of ChatGPT/GPT-4 research and perspective towards the future of large language models," arXiv preprint arXiv:2304.01852v3, 2023. doi: https://doi.org/10.48550/arXiv.2304.01852

[26] F. J. García Peñalvo, F. Llorens-Largo, and J. Vidal. 2024, "The new reality of education in the face of advances in generative artificial intelligence," *RIED-Rev. Iberoam. Educ. Distancia*, vol. 27, no. 1, 2024. doi: https://doi.org/10.5944/ried.27.1.37716

[27] T. Nazaretsky, J. N. Mikeska, and B, B. Klebanov, "Empowering teacher learning with AI: Automated evaluation of teacher attention to student ideas during argumentation-focused discussion," in *Proc. 2023 CHI Conf. Hum. Factors Comput. Syst.*, pp. 1–14, 2023. doi: https://doi.org/10.1145/3576050.3576067

[28] A. Tack, E. Kochmar, Z. Yuan, S. Bibauw, and C. Piech, "The BEA 2023 shared task on generating AI teacher responses in educational dialogues," arXiv preprint arXiv:2306.06941v1. doi: https://doi.org/10.48550/arXiv.2306.06941

[29] A. Adigwe and Z. Yuan, "The ADAIO system at the BEA-2023 shared task: Shared task generating AI teacher responses in educational dialogues," arXiv preprint arXiv:2306.05360, 2023. doi: https://doi.org/10.48550/arXiv.2306.05360

[30] G. Cooper, "Examining science education in ChatGPT: An exploratory study of generative artificial intelligence," *J. Sci. Educ. Technol.*, vol. 32, pp. 444–452, 2023. doi: https://doi.org/10.1007/s10956-023-10039-y

[31] M. Imran and N. Almusharraf, "Analyzing the role of ChatGPT as a writing assistant at higher education level: A systematic review of the literature," *Contemporary Educational Technology*, vol. 15, no. 4, p. ep464, 2023. doi: https://doi.org/10.30935/cedtech/13605

[32] T. H. Kung, M. Cheatham, A. Medenilla, C. Sillos, L. Leon, C. Elepaño, M. Madriaga, R. Aggabao, G. Diaz-Candido, J. Maningo, and V. Tseng, "Performance of ChatGPT on USMLE: Potential for AI-assisted medical education using large language models," *PLoS Digital Health*, vol. 2, no. 2, 2023. doi: https://doi.org/10.1371/journal.pdig.0000198.

[33] N. Manohar and S. S. Prasad, "Use of ChatGPT in academic publishing: A rare case of seronegative systemic lupus erythematosus in a patient with HIV infection," *Cureus*, vol. 15, no. 2, 2023. doi: https://doi.org/10.7759/cureus.34616

[34] I. Dergaa, K. Chamari, P. Zmijewski, and H. B. Saad, "From human writing to artificial intelligence generated text: Examining the prospects and potential threats of ChatGPT in academic writing," *Biology of Sport*, vol. 40, no. 2, pp. 615–622, 2023. doi: https://doi.org/10.5114/biolsport.2023.125623

[35] Y. K. Dwivedi, N. Kshetri, L. Hughes, E. L. Slade, A. Jeyaraj, A. K. Kar, A. M. Baabdullah, A. Koohang, V. Raghavan, M. Ahuja, H. Albanna, M. A. Albashrawi, A. S. Al-Busaidi, J. Balakrishnan, Y. Barlette, S. Basu, I. Bose, L. Brooks, D. Buhalis, and R. Wright, "So what if ChatGPT wrote it? Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *Int. J. Inf. Manag.*, vol. 71, 102642, 2023. doi: https://doi.org/10.1016/j.ijinfomgt.2023.102642

[36] B. D. Lund, "Review of the Delphi method in library and information science research," *J. Doc.*, vol. 4, pp. 929–960, 2020. doi: https://doi.org/10.1108/JD-09-2019-0178

[37] A. A. Alattar and M. M. McDowell, "The rise of AI coauthors: Navigating the future of scientific writing with ChatGPT," *Journal of Neurosurgery*, vol. 1, pp. 1-2, 2023. doi: https://doi.org/10.3171/2023.3.JNS23254

[38] S. Biswas, "ChatGPT and the future of medical writing," *Radiology*, vol. 307, no. 2, e223312, 2023. doi: https://doi.org/10.1148/radiol.223312

[39] T. Adiguzel, M. H. Kaya and F. K. Cansu, "Revolutionizing education with AI: Exploring the transformative potential of ChatGPT," *Contemp. Educ. Technol.*, vol. 15, 3, ep429, 2023. doi: https://doi.org/10.30935/cedtech/13152

[40] P. Pataranutaporn, J. Leong, V. Danry, A. P. Lawson, P. Maes, and M. Sra, "AIGenerated virtual instructors based on liked or admired people can improve motivation and foster positive emotions for learning," in *Proc. 2022 IEEE Frontiers Educ. Conf. (FIE)*, Uppsala, Sweden, October 08–11, 2022, IEEE. doi: https://doi.org/10.1109/FIE56618.2022.9962478

[41] D. O. Eke, "ChatGPT and the rise of generative AI: Threat to academic integrity?" *J. Respons. Technol.*, vol. 13, 100060, 2023. doi: https://dx.doi.org/10.1016/j.jrt.2023.100060

[42] I. García-Martínez, J. Fernández-Batanero, J. Fernández-Cerero, and S. León, "Analysing the impact of artificial intelligence and computational sciences on student performance: Systematic review and meta-analysis," *J. New Approaches Educ. Res.*, vol. 12, pp. 171–197, 2023. doi: http://dx.doi.org/10.7821/naer.2023.1.1240

[43] M. Farrokhnia, S. K. Banihashem, O. Noroozi, A. Wals, "A SWOT analysis of ChatGPT: Implications for educational practice and research," *Innov. Educ. Teach. Int.*, pp. 1–15, 2023. doi: https://doi.org/10.1080/14703297

[44] D. Gašević, G. Siemens, and S. Sadiq, "Empowering learners for the age of artificial intelligence," *Comput. Educ.: Artif. Intell.*, vol. 4, 100130, 2023. doi: https://doi.org/10.1016/j.caeai.2023.100130

[45] W. M. Lim, A. Gunasekara, J. L. Pallant, J. I. Pallant, and E Pechenkina, "Generative AI and the future of education: Ragnarök or reformation? A paradoxical perspective from management educators," *Int. J. Manag. Educ.*, vol. 21, 100790, 2023. doi: https://doi.org/10.1016/j.ijme.2023.100790

[46] Y. K. Dwivedi, N. Kshetri, L. Hughes, E. L. Slade, A. Jeyaraj, A. K. Kar, A. M. Baabdullah, A. Koohang, V. Raghavan, M. Ahuja, H. Albanna, M. A. Albashrawi, A. S. Al-Busaidi, J. Balakrishnan, Y. Barlette, S. Basu, I. Bose, L. Brooks, D. Buhalis, and R. Wright, "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *Int. J. Inf. Manag.*, vol. 71, 102642, 2023. doi: https://doi.org/10.1016/j.ijinfomgt.2023.102642

[47] B. Cheung, L. Hui, J. Zhang, and S. M. Yiu, "SmartTutor: An intelligent tutoring system in web-based adult education," *J. Syst. Softw.*, vol. 68, pp. 11–25, 2003. doi: https://doi.org/10.1016/S0164-1212(02)00133-4

[48] R. Yilmaz, H. Yurdugül, F. G. K. Yilmaz, M. Sahin, S. Sulak, F. Aydin, M. Tepgeç, C. T. Müftüoğlu, and O. Ömer, "Smart MOOC integrated with intelligent tutoring: A system architecture and framework model proposal," *Comput. Educ.: Artif. Intell.*, vol. 3, 100092, 2022. doi: https://doi.org/10.1016/j.caeai.2022.100092

[49] J. M. Flores-Vivar and F. J. García-Peñalvo, "The algorithmic life of education: artificial intelligence tools and systems for online learning," *Challenges and Challenges of Social Networks in the Communication Ecosystem*, Bonales Daimiel, G., Sierra Sánchez, J., Eds.; McGraw-Hill: vol. 1, pp. 109–121, 2023.

[50] M. M. Rahman, and Y. Watanobe, "ChatGPT for education and research: Opportunities, threats, and strategies," *Appl. Sci.*, vol. 13, 5783, 2023. doi: https://doi.org/10.3390/app13095783

[51] C. S. González-González, "The impact of artificial intelligence on education: Transforming the way we teach and learn," *Qurriculum*, vol. 36, pp. 51–60, 2023. doi: https://doi.org/10.25145/j.qurricul.2023.36.03

[52] A. Lozano and C. Blanco Fontao, "Is the education system prepared for the irruption of artificial intelligence? A study on the perceptions of students of primary education degree from a dual perspective: Current pupils and future teachers," *Educ. Sci.*, vol. 13, 733, 2023. doi: https://doi.org/10.3390/EDUCSCI13070733

[53] R. H. Mogavi, C. Deng, J. J. Kim, P. Zhou, Y. D. Kwon, A. H. S. Metwally, A. Tlili, S. Bassanelli, A. Bucchiarone, S. Gujar, L. E. Nacke, and P. Hui, "ChatGPT in education: A blessing or a curse? A qualitative study exploring early adopters' utilization and perceptions," *Comput. Hum. Behav.: Artif. Humans*, vol. 2, 100027, 2024. doi: https://doi.org/10.1016/j.chbah.2023.100027

[54] N. Chomsky, I. Roberts, and J. Watumull, *Noam Chomsky: The False Promise of ChatGPT*, The New York Times, March 8, 2023.

[55] M. I. Vicente-Yagüe-Jara, O. López-Martínez, V. Navarro-Navarro, and F. Cuéllar-Santiago, "Writing, creativity and artificial intelligence. ChatGPT in the university context," *Comunicar: Rev. Cient. Comun. Educ.*, vol. 77, pp. 47–57, 2023. doi: https://doi.org/10.3916/C77-2023-04

[56] E. López-Gómez, "The Delphi method in current educational research: A theoretical and methodological review," *Educ. XX1*, vol. 21, pp. 17–40, 2018. doi: https://doi.org/10.5944/educXX1.15536

[57] M. R. Álvarez and M. T. Fonseca, "The Delphi method," *REIRE Rev. D'innovació I Recer. En Educ.*, vol. 9, pp. 87–102. 2016.

[58] B. D. Lund, "Review of the Delphi method in library and information science research," *J. Doc.*, vol. 4, pp. 929–960, 2020. doi: https://doi.org/10.1108/JD-09-2019-0178

[59] M. Bakieva, J. M. Jornet, J. González, and Y. E. Leyva, "Teaching collegiality: Logical validation of the instrument for teacher self-evaluation in Spain and Mexico," *Estud. Sobre Educ.*, vol. 34, pp. 99–127, 2018. doi: https://doi.org/10.15581/004.34.99-127

[60] F. Tirado, G. Santos, and D. Tejero-Díez, "Motivation as an educational strategy: A study in botany teaching," *Perfiles Educativos*, vol. 35, 79-92, 2013. doi: https://doi.org/10.1016/S0185-2698(13)71810-5

[61] A. Dietrichson, "Non-parametric tests," *Quantitative Methods*. Bookdown, 2019.

[62] R. Martínez-García, M. B. Caballo, and L. Varela, "Leisure in the natural environment as a promoter of emotional connection with nature. An environmental study with adolescents from Pontevedra (Galicia-Spain)," *Pensam. Educativo: Rev. Investig. Educ. Latinoam.*, vol. 57, 1–16, 2020. doi: http://dx.doi.org/10.7764/pel.57.2.2020.6

[63] C. K. Lo, "What is the impact of ChatGPT on education? A rapid review of the literature," *Educ. Sci.*, vol. 13, 410, 2023. doi: https://doi.org/10.3390/educsci13040410

[64] M. Karanouh, "Mapping ChatGPT in mainstream media: Early quantitative insights through sentiment analysis and word frequency analysis," arXiv preprint arXiv:2305.18340, 2023. doi: https://doi.org/10.48550/arXiv.2305.18340

[65] S. Fergus, M. Botha, and M. Ostovar, "Evaluating academic answers generated using ChatGPT," *J. Chem. Educ.*, vol. 100, pp. 1672–1675, 2023. doi: https://doi.org/10.1021/acs.jchemed.3c00087

[66] J. Wen and W. Wang, "The future of ChatGPT in academic research and publishing: A commentary for clinical and translational medicine," *Clinical and Translational Medicine*, vol. 13, no. 3, 2023. doi: https://doi.org/10.1002/ctm2.1207

[67] G. Berg and E. Plessis, "ChatGPT and generative AI: Possibilities for its contribution to lesson planning, critical thinking and openness in teacher education," *Educ. Sci.*, vol. 13, 998, 2023. doi: https://doi.org/10.3390/educsci13100998

[68] A. Sypsas and A. Lekka, "Exploring secondary education teachers' views on plagiarism and cheating," in *Proc. International Conference on Interactive Mobile Communication Technologies and Learning (IMCL2014)*, pp. 326–330, IEEE, 2014.

[69] P. Rajabi, P. Taghipour, D. Cukierman, and T. Doleck, "Exploring ChatGPT's impact on post-secondary education: A qualitative study," in *Proc. the Western Canadian Conference on Computing Education (WCCCE'23)*, May 2023, Simon Fraser University.

[70] M. Khalil and E. Er, "Will ChatGPT get you caught? Rethinking of plagiarism detection," arXiv preprint arXiv:2302.04335, 2023. doi: https://doi.org/10.48550/arXiv.2302.04335

[71] B. Guo, X. Zhang, Z. Wang, M. Jiang, J. Nie, Y. Ding, and Y. Wu, "How close is ChatGPT to human experts? Comparison corpus, evaluation, and detection," arXiv preprint arXiv:2301.07597, 2023. doi: https://doi.org/10.48550/arXiv.2301.07597

[72] A. M. Elkhatat, K. Elsaid, and S. Almeer, "Evaluating the efficacy of AI content detection tools in differentiating between human and AI-generated text," *Int. J. Educ. Integrity*, vol. 19, 17, 2023. doi: https://doi.org/10.1007/s40979-023-00140-5

[73] H. Singh, M. H. Tayarani-Najaran, and M. Yaqoob, "Exploring computer science students' perception of ChatGPT in higher education: A descriptive and correlation study," *Educ. Sci.*, vol. 13, 924, 2023. doi: https://doi.org/10.3390/educsci13090924

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