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University professors' level of performance in the use of Artificial Intelligence.

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Abstract

The European Union is promoting digitalization as a means to increase the competitiveness of its economy and improve education systems according to new demands. As a result, universities need to take strategic action to adapt to this new reality. The purpose of this research is to measure professors' proficiency in using Artificial Intelligence (AI) by developing a valid questionnaire based on the DigCompEdu tool, which assesses AI competency. The research question aims to examine the correlation between university professors' AI performance and its impact on teaching activity. Four hypotheses are posed, two related to the learning and development of digital competencies in students and two linked to the regulatory framework and the ethical implications. All hypotheses have been confirmed, and the following conclusions have been reached. Firstly, it has been found that professors have low performance in using AI tools beyond ChatGPT or translation tools. Secondly, professors lack confidence in their AI competence when applied to teaching and research. Thirdly, educational institutions are not investing in AI training to develop the AI competence of educators. Higher education institutions have a crucial responsibility to meet the challenges and risks associated with the use of AI. They must ensure that AI is used ethically, academic integrity is maintained, and that they do not fall behind in their efforts to train professors and prepare students with the digital skills required for the job market.

Keywords: *Higher Education; AI literacy; AI educators' competence; digital competence*

JEL Classification: for example, O11, M23, L13

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1 INTRODUCTION

The incorporation of digital technology in higher education has become a crucial element of the academic sphere. The first wave of technological innovation was ushered in by the Internet in the 1990s, followed by the proliferation of smartphones in 2005. The COVID-19 pandemic has expedited digitalization, and it seems that in 2022, the next significant technological adoption has started with the democratization of the use of generative Artificial Intelligence (AI). The widespread use of AI by educators and students has the potential to impact the normal interaction between these parties, which could alter their relationship and the learning process (Molina et al., 2024). The purpose of this study is to explore these relationships by analyzing the initial approach to the adoption of AI among educators in universities. It is important to explore this new reality for two main reasons. Firstly, there is a growing demand for digital citizenship and digital skills in the job market, with a Digital Agenda Policy in all institutions, particularly in the European Union (EU). According to the latest EU report, Digital Decade, by

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the year 2030, at least 80% of individuals between the ages of 16 and 74 will have basic digital skills, and there will be a minimum of 20 million employed ICT specialists (European Commission, 2023).

ChatGPT was launched in November 2022, reaching 180 million users and 1.43 billion visits in August 2023 (Tong, September 2023). This growth – the greatest in the history of online app consumers – has had a significant impact on social and cultural processes (Sued, 2022). The use of certain tools can affect people's perception of reality and can generate opportunities and risks at the same time (European Commission, 2020), depending on how the algorithms are programmed, who is programming them, and the criteria used (Kitchin, 2017). This new reality, which affects the education landscape immensely (Moravec & Martínez-Bravo, 2023; OECD–Education International, 2023), is also transferred to society in general in an extensive philosophical and ethical debate considering potential perils for education (Almarzouqi et al., 2024) and the demands on the labor market, which require professionals with different competencies and high level of digital. (Holford, 2019; Sorgner, 2017). According to The Future of Jobs report from the WEF (2023), it is predicted that 44% of workers' skills will need to change in the coming years. The report also states that there will be a mainstream demand for future digital skills in all sectors and functions.

Furthermore, AI in universities and tertiary education has an evident relevance in reshaping teaching and learning techniques (Rampelt et al., 2019). Although AI has been with us since the middle of twentieth century, the state of the art in the use of AI in higher education is recently impacting and evolving every day (Hattie, 2023). Some research studies provide a comprehensive overview of how AI is being used in higher education, identifying four main areas of research: profiling and prediction, intelligent tutoring systems, assessment and evaluation, and adaptive systems and personalization (Zawacki-Richter et al., 2019). The use of ChatGPT tools has accelerated, and it has become a popular trend among students worldwide. For example, a study conducted at the University of Jordan found that 73% of students agreed that ChatGPT has the potential to enhance the learning process (Ajlouni et al., 2023).

Although the benefits of the use of AI are obvious, the possible challenges and risks are also being pointed out. Bond et al. (2024) conducted a meta analysis discussing potential risks: first, the ethical concerns in the use of data, accountability, transparency, and human dignity. They also highlight the problems with the integration of AI into the curriculum and the disconnection from the educational system and standards. Furthermore, they conclude that there is a lack of studies on ethical considerations, infrastructure problems, lack of qualifications and technical knowledge, and problems with the shift of authority (Alotaibi & Alshehri, 2023). According to INTEF report (2024), several significant factors directly impact educational functions, such as the need to improve the AI competence of professors. This is because there is a risk of displacement of the educator's authority and decision-making capacity being supplanted by machines. It highlights the importance of digital skills for both educators and students, as well as other essential skills like critical thinking, problem-solving, and higher-order thinking skills (van Laar et al., 2017). The traditional role of the lecture-based professor, and even that of a mentor who provides guidance and support, is increasingly being challenged by algorithms capable of delivering the same information or guidance in project development or conceptual explanations. As Enguita Fernández (2024) points out, students now have access to two types of educators who both compete and collaborate: a human educator who must be creative, intuitive, trustworthy, empathetic, and possess university credentials, available only in specific spaces and within limited class time, and an automated one, accessible at any time, built from

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silicon, lacking creativity, often unaware of its limitations, possibly mediocre, but highly efficient, easy to manage, and seemingly omniscient. This shift underscores the growing importance of assessing and enhancing the digital competencies of university educators. By ensuring that professors are proficient in digital tools, institutions can better develop strategies to improve teaching practices and student outcomes, aligning education with the demands of a rapidly evolving world.

Today, we can see that this topic is trending in education, and there is a remarkable proliferation of frameworks (Mills et al., 2024; Ng et al., 202) and studies (Al Shloul et al., 2024; Lee et al., 2024; Xiao et al., 2023). Despite the recent surge in studies, there is a gap in research on how educators currently use AI tools, their attitudes toward these tools, and how their level of AI literacy affects their teaching roles and student outcomes. To address this gap, we have formulated research questions aimed at answering this issue: How are educators adapting to and utilizing the benefits of integrating AI while overcoming potential challenges? What is their level of proficiency in using AI tools?

This research study aims to evaluate the level of proficiency of university professors in using AI by assessing various aspects of their digital competence. Improving the competencies of professors is crucial for preparing future graduates to compete in a technologically advanced global economy. The study is based on a comprehensive theoretical framework that reviews recent literature on AI in education and different tools for measuring AI digital competence. We propose a well-designed questionnaire to confidently evaluate teachers' knowledge and understanding of AI tools, measuring the results in an empirical study. We have developed hypotheses that are rigorously tested, analyzed, and discussed, leading to conclusions.

2 THEORETICAL BACKGROUND

Being digitally competent is crucial for a prosperous society. The EU has been developing a framework to promote digital literacy for the past decade (Ferrari et al., 2014), recently updated to DigCom 2.2 (Vuorikari et al., 2022). The competence is evolving to include the use of AI (Zhai et al., 2021) as AI literacy has emerged as a new educational goal that is aimed at both students and educators (Ng et al., 2021). Since the boom of AI in the socioeconomic landscape, some new frameworks have appeared in the literature in the last two years (Mills et al., 2024; Molina et al., 2024; Ng et al., 2023). Universities and other educational institutions are facing a tremendous challenge and have a responsibility to embrace the opportunities presented by this new technology. Educators' digital competence must be adapted to the AI environment, and teachers need sufficient time to understand and apply all these new tools.

The debate surrounding technology in education (Greenhow et al., 2022), particularly AI tools, is sparking multiple investigations (Chen et al., 2020). From 2016 to 2022, the research in this field covers different perspectives: most studies focus on undergraduate students (72%), only 17% of them on instructors, and 11% on education managers (Crompton & Burke, 2023). It has also generated a clear ethical debate about the impact of AI, giving more relevance to the role of educators as critical agents embracing the new technology. The consequences of AI in education are under investigation as some argue it reduces the acquisition of knowledge and other skills in students such as creativity or learning performance (Borenstein & Howard, 2021; Wang et al., 2023). Therefore, it is essential to consider past experiences in the journey towards digitalization in education and consider all the implications of this new reality. As some authors suggest (Bearman et al., 2023), it should be a specific discussion in higher education because

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there are concerns regarding broader social impacts beyond technological implications. Universities should consider how to develop students' uniquely human skills, rather than replicating things that AI can already do better (Holmes et al., 2022).

As a theoretical background, this paper is based on theories of human capital (Hanushek, 2013), which aims to measure the educational results impacting economic growth and competitiveness.

2.1. Evolution of the educator's digital competence to AI competence

In defining the concept of digital competence, there is a lack of agreement, as was pointed out by the latest Horizon 2022 EU report (Pelletier et al., 2022). Some authors link it to technical knowledge, while others associate it with cognitive skills, social practices, and the creation of digital content. Unquestionably, we need to promote digital competence to foster an innovative and entrepreneurial society underlying the importance of doing so with a critical and ethical mindset (Ali & Aysan, 2023). Furthermore, it is crucial to give attention to the concept of AI competence to effectively focus future discussions and decisions (Bond et al., 2024).

There are various tools to measure digital competence, including the DIGCOM project adopted by the European Commission (Ferrari et al., 2014). This project led to the development of a specific tool for the educational environment, known as DigCompEdu (Redecker, 2017). The model has been studied by different scholars and is one of the most relevant frameworks to measure the digital performance of educators in all of Europe (Cabero-Almenara et al., 2020; Núñez-Canal et al., 2022). Nevertheless, the rapid advancements driven by AI necessitate an update to existing digital competency frameworks. New adaptations are emerging that incorporate current challenges alongside the growing need for literacy in the use of algorithms, often referred to as AI Literacy (Mills et al., 2024). Ng et al. (2021) propose four aspects that define fostering AI literacy: knowing and understanding, using and applying, evaluating and creating, and ethical issues. Furthermore, scholars reviewed the DigCompEdu model to make it suitable for the AI literacy needed by educators. As a result, Ng et al. (2023) redefined the six areas to create a constructive framework that would assist educators in staying up to date with the latest technological advancements and promoting continuous learning and improvement. For relevance to this research, the areas have been reformulated as follows:

Area 1: Professional engagement: This involves reflecting on the basic understanding of AI and its positive and negative impact on education, analyzing the use of AI to improve organizational communication and collaboration with schools or colleagues?, learners, and other parties.

Area 2: Digital resources: Teachers must select AI tools to improve the teaching–learning process, such as personalization and enrichment of resources and learning materials and the use of AI systems that simplify the process of obtaining, creating, and sharing digital resources.

Area 3: Teaching and Learning: There are four ways in which AI can be used to enhance teaching: first, by using AI tools to plan activities; second, by collaborating with the teacher to address student questions quickly; third, by facilitating collaborative learning and implementing methodologies; finally, by enabling teaching adaptation and providing better guidance.

Area 4: Assessment. Teachers can use AI tools to better monitor and analyze students' progress, providing feedback to support their learning.

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Area 5: Empowering students' AI learning, using AI digital technologies to improve student outcomes and enhance student learning with AI.

Area 6: Facilitate students' AI competency, enabling learners to creatively and responsibly use AI systems for information, communication, content creation, well-being, and problem-solving.

As AI tools become more prevalent in education, it is crucial for educators to have the digital competencies necessary to effectively use AI for teaching, learning, and evaluation (Celik et al., 2022). As a consequence,universities are reviewing their assessment methods and classroom practices (Foltynek et al., 2023). This has led to an abundance of open training programs and universities investing in their faculty. However, this also implies the need for updating infrastructure and continuous learning for instructors (Crompton & Burke, 2023). Teachers who are proficient in utilizing these tools can enhance their teaching effectiveness and help students to develop a broad understanding of AI's impact (Bearman et al., 2023). This phenomenon has a direct impact on students and teachers, so it is crucial to verify the performance of educators in utilizing AI to lead this revolution (Molina et al., 2024). For that, we propose the following hypothesis to be tested:

H1: Professors with higher levels of AI performance facilitate the development of AI digital competence in their students

2.2. Impact of AI on professors' classroom practices

Hattie's recent book "Visible Learning: The Sequel" reaffirms that teachers continue to be the most influential factor in student learning success. However, the use of AI in education introduces challenges, as it may threaten teachers' roles and autonomy, raising fears of being replaced or losing control over teaching methods and curricula (Alotaibi & Alshehri, 2023; Bond et al., 2024). Despite these concerns, it is widely agreed that teaching capacity significantly impacts how well students do in their studies, which in turn affects their future success in society (Kunter et al., 2013). Professors who integrate AI into their lectures not only enhance their AI capabilities but also foster successful AI education among students (Bearman et al., 2023; Fuentes et al., 2019). This deduction arises from other cross-curricular competencies like entrepreneurship education, where enhancing educators' entrepreneurial capacity leads to the incorporation of entrepreneurial practices in the classroom (Ruskovaara & Pihkala, 2013). Similarly, AI integration has become crucial in enhancing pedagogical practices in both face-to-face and online education (Summers et al., 2005), enabling educators to create interactive learning environments, provide personalized feedback, and facilitate collaborative learning (George & Wooden, 2023). Moreover, the latest AI educational technologies, with features like chat functions, personalized support, and learning analytics, can further improve teaching skills (Chen et al., 2020). However, it is essential to address potential pitfalls, such as the impact of AI on educators' authority and decision-making, which may affect pedagogical quality and effectiveness (Bond et al., 2024; Zawacki-Richter et al., 2019). Successful integration of AI into classroom practices should align with broader university management to improve operational performance and educational quality, ultimately contributing to the concept of "smart universities" (George & Wooden, 2023).

Other authors stress the need for training in the use of technology and the purposes for which it should be used (Liesa-Orús et al., 2020). Mishra's research suggests that teaching is becoming a design profession where educators select the best activities, resources, and components to create an ideal learning experience for students. Adaptation to educational technology advances

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plays a vital role in this process (Warr & Mishra, 2021). Additionally, it might be considered that the correct use of AI practice has several implications, especially in relationships between students' creativity, self-efficacy, and learning performance. (Wang et al., 2023).

In light of these considerations, recent work emphasizes the need for responsible AI teaching, including setting explicit learning objectives and clear methodologies that address privacy-preserving data collection and tool explainability (Tubella et al., 2024). All of this drives the formulation of the second hypothesis:

H2: Professors with higher levels of AI performance actively participate in learning, promoting, incorporating content, and critically evaluating AI and its impact.

2.3. AI competence and data protection knowledge on university professors' use University Professors' Use of AI: Competence and Data Protection Knowledge

AI capabilities vary significantly, ranging from simple tasks like text translation to advanced functions such as decision-making and, in many cases, analysis that can even surpass human intelligence. Concerns about the ethical use of AI led the European Commission to establish a group of experts in 2018 to ensure AI compliance with community values and fundamental rights (Glauner, 2022). The resulting Declaration of Cooperation on AI among 25 member states culminated in the Coordinated Plan on AI (Morselli, 2019). Following the pandemic, the publication of AI Watch emphasized the need for laws to anticipate future AI developments (Van Roy, 2022). The European Union's regulatory framework, the EU AI Act, established in December 2023, is expected to fully take effect in 2026, aiming to protect fundamental rights, democracy, the rule of law, and environmental sustainability from AI-related risks (European Parliament, 2024).

In universities, defining privacy has been increasingly challenging due to rapidly evolving technological advances (Jones et al., 2022). Universities have swiftly adopted information and communication technologies that collect extensive data on professors, students, and institutional resources. These systems, accessed by various university community members, convert raw data into valuable information through analytical processes. The issue of student privacy, especially in the context of cloud services, has long been recognized, influencing student behavior (Arpaci et al., 2015).

The digital competence of educators in managing data securely is crucial. This competence is shaped by their knowledge level, compliance commitment, and the support and training provided by their institutions. Professors' awareness of legal regulations and potential violations can directly impact students' digital competence in AI (Liesa-Orús et al., 2020). The adoption of an AI compliance policy in education is strongly recommended, therefore that leads us to formulate the following hypothesis The adoption of an AI compliance policy in education is strongly recommended, which leads us to propose the following hypothesis.

H3: Professors with higher levels of AI performance know AI regulations, its benefits and are aware of their responsibility.

2.4. Evaluation of AI risk and ethical issues in the university environment

Many educators lack the digital readiness and expertise to use AI tools effectively, leading to increasing ethical risks related to personal data and learner autonomy (Zawacki-Richter et al.,

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2019). Despite the recent announcement of guidelines for ethics and trustworthiness for different institutions and universities, many challenges still arise, such as AI misunderstandings, misleading information, limitations, and hidden ethical issues (Molina et al., 2024; Nguyen et al., 2023).

These risks include but are not limited to the ethical concerns surrounding AI bias, data privacy, and security. The OECD has specifically highlighted that AI may worsen existing inequalities due to uneven access to technology and varying levels of proficiency among students and educators in utilizing these tools (OECD – Education International, 2023). Another potential risk is the excessive dependence on technology, which may result in a decline in cognitive abilities and critical thinking skills as a result of the readily available solutions or answers provided by automated tools (George & Wooden, 2023). Some studies show that social isolation among younger students can have a negative impact on their mental health (Schiff, 2021). On the other hand, the increase in workload and the obligation to use new tools can cause stress for teachers, and they may require additional training (Moravec & Martínez-Bravo, 2023). There is also a risk of minorizing diminishing undervaluing? knowledge, self-efficacy and creativity in favor of prioritizing forms of learning (Wang et al., 2023). Additionally, there are concerns related to educators' access to technology, their professional development, and their well-being (De Obesso et al., 2023). It is important to consider ethical issues related to data collection on teacher performance in the classroom, as well as broader issues of privacy and data security (Bearman et al., 2023).

To reduce AI-related risks in education, it is important to provide educators with digital skills training,integrate AI into the curriculum, and assess its impacts on the educational environment. Following the most relevant authors, such as Molina et al. (2024), Fowler (2023), and Enguita Fernández (2024), the points on ethics are the key questions regarding AI in education such as challenges to academic integrity, the need to adapt teaching methods to promote essential skills, and the impact of AI tools on students' learning outcomes and motivation. Thus, ethical and responsible use of AI by students is necessary. All these lead to the following hypothesis:

H4: Professors with higher levels of AI performance consider the risks and the AI impact of the use by their students.

In light of the ongoing debate about the relevance of AI in education and its multifaceted impacts, our study is grounded in a comprehensive review of the literature and the established frameworks of digital competence. This foundation allows us to explore implications in higher education by testing the hypotheses that link professors' AI competence with key outcomes in student education and institutional practice.

3. MATERIALS AND METHODS

This study is designed to measure educators' digital AI competence within the context of higher education. Building on the literature, our research employs descriptive statistical analysis to quantitatively assess data collected through measurement instruments. The literature review led to the formulation of a comprehensive research question: What is the relationship between university professors' level of performance in the use of AI and their overall impact on students' AI digital competence, pedagogical practices, awareness of AI regulations, and benefits, and consideration of AI-related risks in education? This research question is strategically crafted to identify and analyze the connections between professors' proficiency with AI and various

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dimensions of the new AI competency framework. To systematically address this inquiry, the study is structured around the following four hypotheses:

H1: Professors with higher levels of AI performance facilitate the development of AI digital competence in their students.

H2: Professors with higher levels of AI performance actively participate in learning, promoting, incorporating content, and critically evaluating AI and its impact.

H3: Professors with higher levels of AI performance know AI regulations, its benefits, and are aware of their responsibility.

H4: Professors with higher levels of AI performance consider the risks and the AI impact of the use by their students.

The hypotheses give a model of study to be tested through the adaptation of DigCompEdu to digital competence.

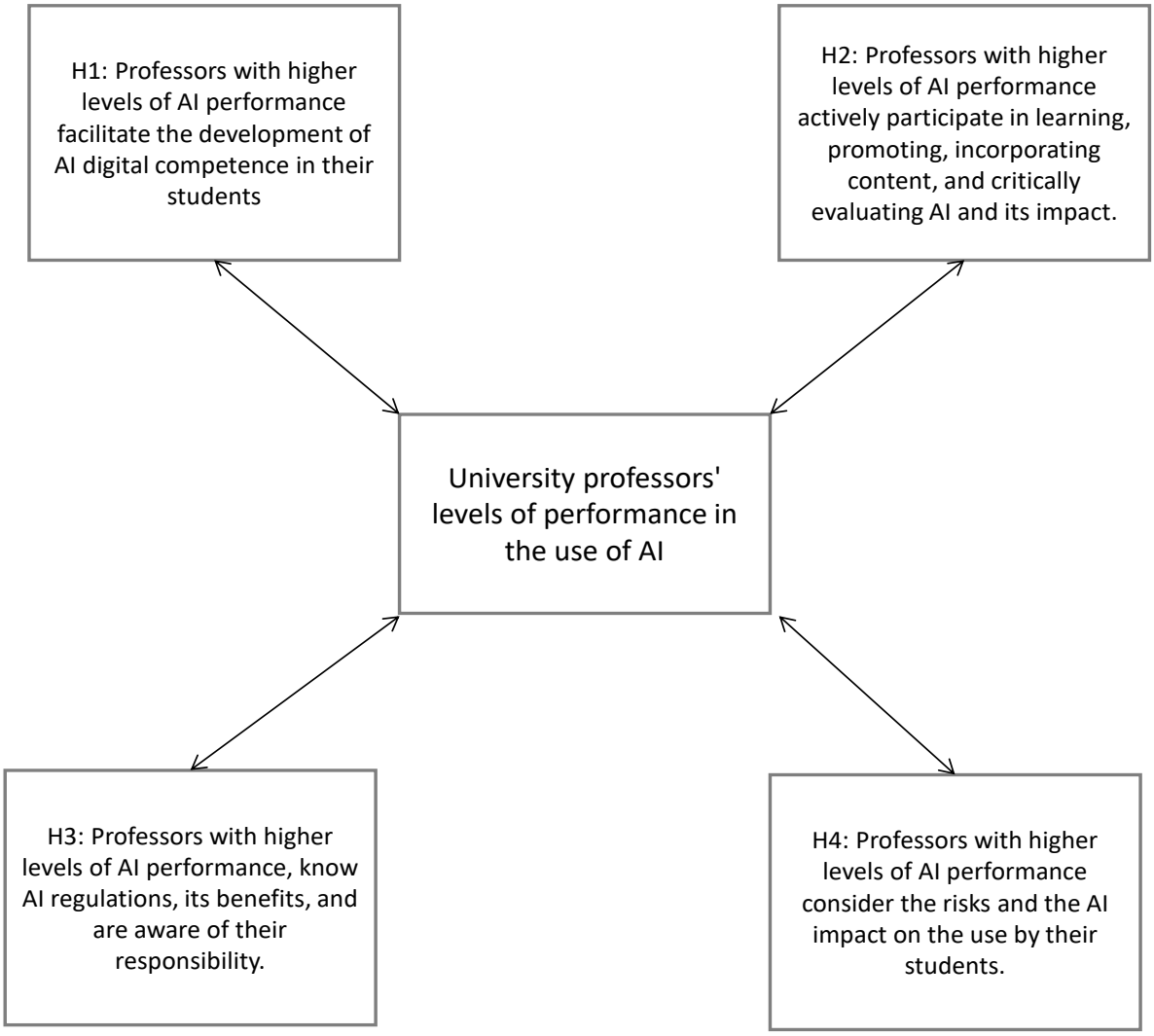

Fig. 1 – Analysis of educators' AI competence and their level of performance.
Source: own research

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To design the study, we first had to test the level of performance on the use of AI among university professors. For that, we decided on the methodology following previous studies, choosing the instrument DigCompEdu and its revision to adjust it to the AI context. Therefore, an adapted questionnaire following Ng et al. (2023) was conducted to test the level of performance analyzing several aspects of the new AI digital competence. The following question has been used to measure the dependent variable: How do you evaluate your performance in the use of artificial intelligence (AI)? Professors answered by assigning six levels of proficiency following the Redecker (2017) model of digital competence: Newcomer (A1) and Explorer (A2), are educators that assimilate new information and develop basic digital practices; Integrator (B1) and Expert (B2) are the stages in which they apply, further expand, and structure their digital practices; and at the highest stages are Leader (C1) and Pioneer (C2), when they have full proficiency.

This paper analyzed 105 responses from a convenience sample of professors from universities and business schools in Spain. In this sample, 62.9 percent of the professors were men, while 37.1 percent were women. About 50% of the respondents have more than 16 years of experience in face-to-face university teaching, while 67.7% have at least five years of experience in online university teaching. Additionally, 62% of the sample hold a doctoral degree or higher.

Tab. 1 – Sample data. Source: own research

Gender	Frequency	Percentage
Male	66	62.9
Female	39	37.1
Total	105	100.0
Years of face-to-face university teaching experience	Frequency	Percentage
From 1 to 5	19	18.1
From 6 to 10	15	14.3
From 11 to 15	18	17.1
From 16 to 20	19	18.1
From 21 to 25	12	11.4
More than 25	22	21.0
Total	105	100.0
Years of online university teaching experience	Frequency	Percentage
From 1 to 5	71	67.6
From 6 to 10	23	21.9
From 11 to 15	6	5.7
From 16 to 20	2	1.9
More than 25	3	2.9
Total	105	100.0
Highest level of qualification you hold	Frequency	Percentage
Bachelor's degree, Graduate, Architect, Engineer or Doctor	39	37.1
Doctor	22	21.0
Accredited Doctor	23	21.9
PhD accredited as a full professor	15	14.3
Accredited PhD as a full professor	5	4.8
Other (Master's, etc.)	1	1.0
Total	105	100.0

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Is your main activity teaching?	Frequency	Percentage
Yes	72	68.6
No	33	31.4
Total	105	100.0

This study employed a structured methodology to ensure validity and reliability. Data were collected from 105 university professors using an anonymous questionnaire, with a snowball sampling technique to reach a diverse sample (Scharager & Armijo, 2001). This method allowed the researchers to expand the sample size through referrals while maintaining control over the respondent pool. The survey was conducted between November and December 2023, targeting professors from various universities and faculties in the Madrid area, well known by the broad university population. Invitations were sent via direct email, LinkedIn, and WhatsApp, providing easy access to the online survey.

After data collection, responses were rigorously reviewed to ensure completeness and validity, resulting in 105 final observations. This curated dataset provided a reliable foundation for the study's statistical analysis.

The authors of the study prioritized confidentiality and ethical standards by ensuring that all participant data remained anonymous. They complied with all ethical standards regarding data permissions for the respondents. The data collected was analyzed using statistical methods, which provided valuable insights into the research question and helped to better understand the relevance of AI competence among educators.

4. RESULTS

The data extracted from the survey responses provides a comprehensive insight into the utilization and familiarity levels of university professors with various AI tools. These findings are instrumental in understanding how AI technologies are integrated into academic contexts to evaluate their potential influence on pedagogical practices, regulatory awareness, and educational outcomes.

ChatGPT emerged as the most popular AI tool, with 27.6% of professors frequently using it and 16.2% considering it essential to their work. This underscores the significant role of AI in enhancing content creation and productivity. However, the majority (52.0%) were unfamiliar with other tools like Jasper, Quillbot, and CopyAI, indicating a gap in the adoption of AI-driven writing assistance. Information search tools such as Bing and Google saw higher utilization, with 29.5% of professors using them frequently and 21.0% demonstrating a clear understanding of their AI-enhanced capabilities. Translation and editing tools like DeepL, Grammarly, and Google Translator are widely used, with 37.1% of respondents considering them essential and 35.2% using them frequently. This reflects a strong reliance on AI for these tasks (see Table 2).

However, in the category of research tools, 47.5% of professors were not familiar with available AI options, suggesting a need for further training and outreach. Similarly, 40.6% had not adopted content management tools like ChatPDF and Umata, indicating that increased support or incentives may be required for broader adoption.

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Tab. 2 – AI tools that teachers have at their fingertips to use in teaching Source: own research

Level of utilization	Text creation: ChatGPT.	Writing help: Jasper, QuillbotCopyAI	Information search: (Bing, Google AI)	Translation and editing (DeepL, Grammarly ,Google Translator)	Research: Perplexit, Elicit	Content management and review (ChatPDF , Umata)	Other
I don't know them.	5.7	52.0	5.7	2.9	47.5	40.6	50.0
It sounds familiar to me, but I don't know what it's used for.	1.0	12.0	5.7	1.0	15.8	15.8	5.4
I know what they're used for, but I don't use them yet.	14.3	16.0	13.3	9.5	16.8	19.8	9.5
I know them and use them sometimes.	35.2	14.0	21.0	14.3	13.9	12.9	13.5
I use them frequently.	27.6	6.0	29.5	35.2	5.0	5.9	13.5
They have become essential to my work.	16.2	0.0	24.8	37.1	1.0	5.0	8.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Following previous studies and literature on educators' digital competence, professors were asked about their level of competence in using AI tools (Cabero-Almenara et al., 2022; Núñez-Canal et al., 2024) They responded by evaluating their performance on the DigCompEdu instrument scale adapted to AI competence (Ng et al., 2023). The professors were questioned about their level of proficiency, and the results are as follows in Figure 2.

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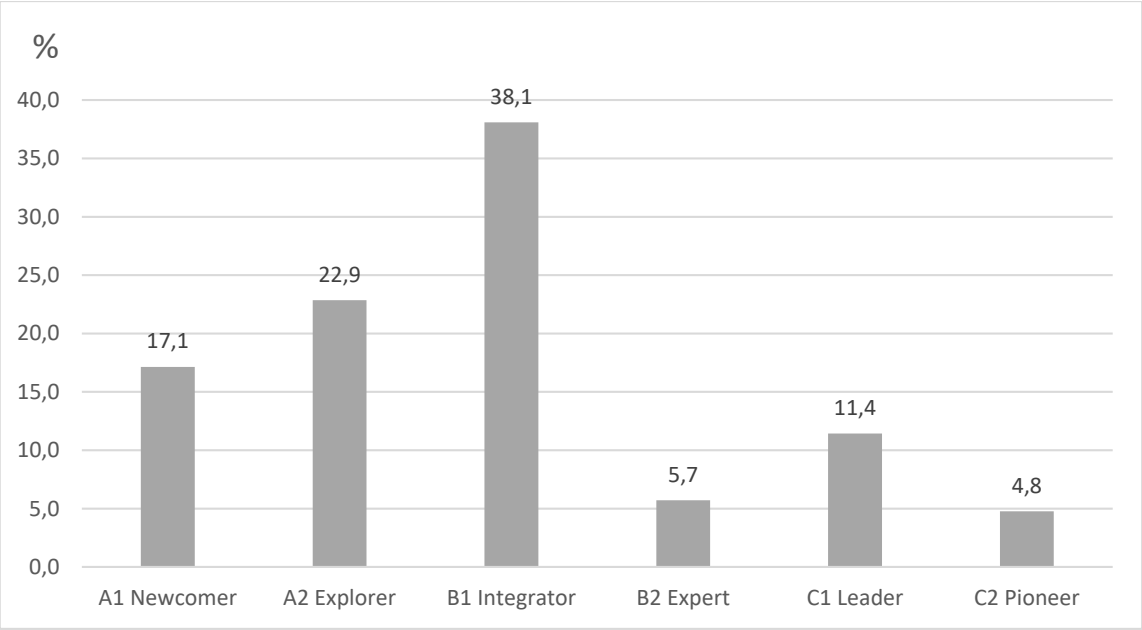

Fig. 2 – How is the use of artificial intelligence (AI) evaluated today? Assign a proficiency level from A1 to C2, with A1 being the lowest and C2 being the highest. Source: own research

The analysis of the measurement of AI performance among professors following the adaptation of DigCompEdu to AI reveals intriguing insights into their perceived digital skills. Notably, 61% (Newcomer, Explorer, and Integrator) of teachers self-assess their AI-related digital competencies at a level classified as "low," falling within the Newcomer to Integrator range. The self-assessment raises questions about whether professors currently have the necessary skills to effectively utilize AI in educational settings. Comparing these results with a study on professors' digital competencies, it was found that self-assessment at the same stage was reported at 37.5% (Núñez-Canal et al., 2022). This contrasts with the results from the current study, indicating that professors are still in the process of learning to use AI tools, in comparison to other digital tools that are more integrated into their daily lives. This may be due to the sudden shift to digitalization caused by Covid. The disparity in proficiency levels suggests a need for further examination into the factors contributing to this perceived lower level and emphasizes the importance of tailored AI training and development programs for educators to bridge this competency gap.

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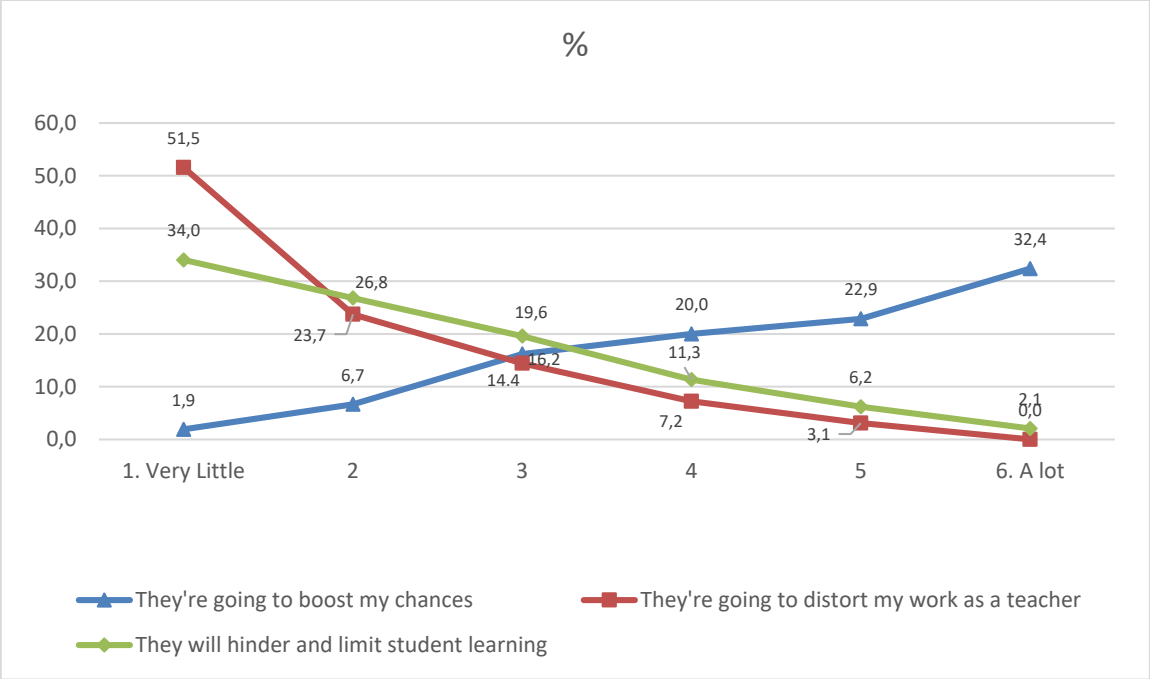

Fig. 3 – How would you define your attitude towards the use of AI tools in your teaching?
Source: own research

When it comes to the impact of AI on teaching abilities, 55.3% of professors believe that AI will enhance their skills to some extent (refer to Figure 3). This contrasts with studies suggesting that AI would diminish the relevance of teaching or create awareness among professors about being replaced by AI. However, these results reveal the level of confidence in their activity and relevance as agents in the learning and teaching process (Alotaibi & Alshehri, 2023; Bond et al., 2024). This reflects optimism about the potential of AI to enhance pedagogy, rather than harm it, always relying on well-trained professors in AI who are willing to improve their teaching in every field of knowledge (Molina et al., 2024). Additionally, 51.5% of respondents are confident that AI will coexist with their instructional roles without diminishing their essential function as educators. However, 60.8% express concerns that AI might negatively affect student learning experiences, indicating mixed attitudes toward AI's role in education. These varied perspectives are crucial for shaping the future of AI integration in teaching.

Regarding institutional support for AI tool adoption, 74.3% of professors believe they receive limited to moderate assistance, while only 3.8% feel completely supported. This significant gap highlights the need for more effective strategies to prepare educators for AI-driven education (see Figure 4 below).

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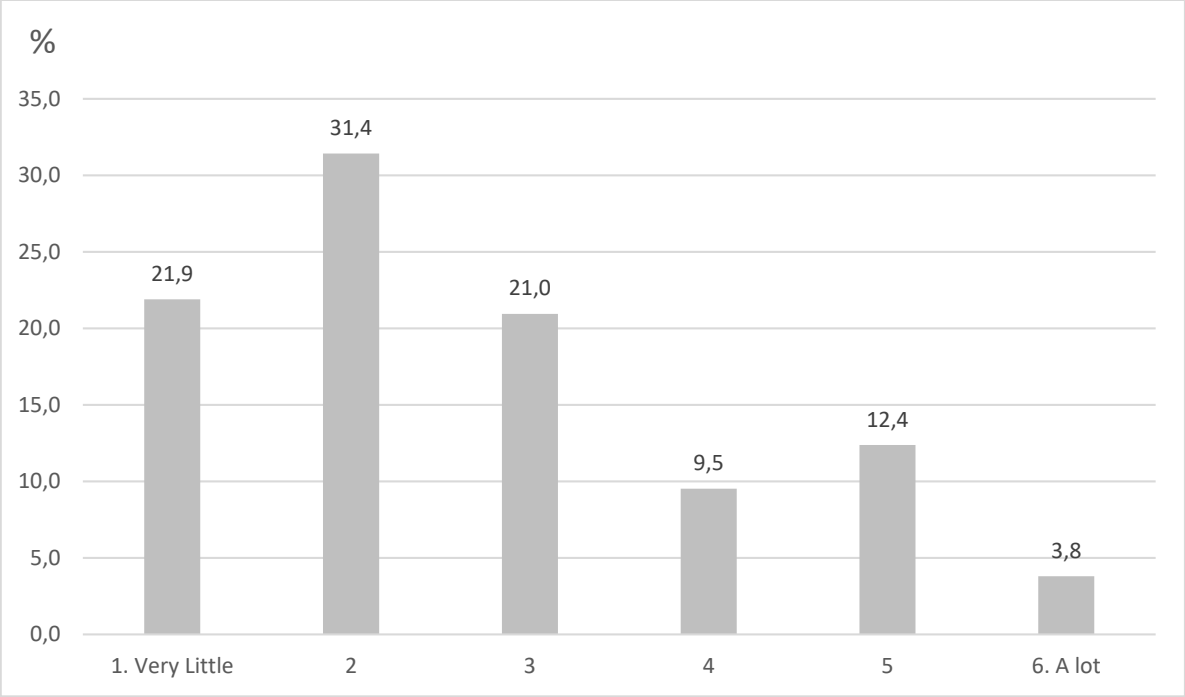

Fig 4 – To what extent do you think your institution is helping to prepare teachers for the use of AI tools? Source: own research

4.1 Factor Analysis and Regression

After conducting a descriptive analysis, we performed a factor analysis and regression to identify the main factors influencing educators' performance in using AI. Cronbach's alpha was also calculated to analyze the reliability of the tool used. The resulting value was 0.977, indicating high reliability, exceeding the acceptable value of 0.8.

A factor analysis was performed to assess the validity of the model and the scales used to measure the variables. The preliminary analysis revealed that the data collected was suitable for factor analysis as the correlation matrix between all variables showed a predominance of R-values greater than 0.30. The SPSS statistical package was used for the study. The Kaiser-Meyer-Olkin (KMO) sample adequacy measure showed a high value of 0.935. Additionally, Barlett's sphericity test was significant with a probability level of 0.000, which is less than 0.05, therefore, we reject the null hypothesis of sphericity and can conclude that the factorial model is adequate in explaining the data.

For the factor analysis, we followed the proposed theoretical model. We used principal component analysis with Varimax normalization and the Kaiser rotation method. Withdrawals were considered for values above 0.535. According to the factor analysis, the model's variables can be classified into four groups. These groups account for 73.257% of the model's overall variability.

The way in which the four factors explain the model variables can be observed in the following Table 3.

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Tab. 3 – Rotated Factor Matrix. Source: own research

Variable	1	2	3	4
Area 5: Train 5-2 students. It is able to explain how an AI system can benefit students in a personalized way.	0.849			
Area 5: Empowering Students 5-1. Learn about the different ways in which custom AI systems can adapt content, educational pathway, and pedagogical approach.	0.848			
Area 4: Assessment 4-1. Knows and understands the use of AI systems to improve and personalize student work assessment strategies.	0.846			
Area 6: Facilitate AI proficiency of students 6-3. He is able to use AI projects to help students learn about the ethical implications of AI and the use of data.	0.843			
Area 6: Facilitate AI proficiency of students 6-4. It is capable of using AI projects to help students critically analyze the biases, lack of empathy, and lack of emotionality of the responses elicited by AI systems	0.831			
Area 4: Assessment 4-3. It is aware that AI systems assess student progress based on predefined models of domain-specific knowledge.	0.807			
Area 6: Facilitate AI proficiency of 6-1 students. It is capable of using AI projects to enrich students' learning in their field of knowledge.	0.786			
Area 6: Facilitate AI proficiency of students 6-2. It is able to use AI projects to improve students' AI proficiency in their field of knowledge.	0.783			
Area 3: Teaching and Learning 3-4. It knows how to effectively use AI tools to give personalized feedback, evaluate students differently and offer them action guides to improve their work.	0.771			
Area 4: Assessment 4-2. Knowing that the algorithm used for the evaluation contains biases, you understand how they can be mitigated.	0.756			
Area 3: Teaching and Learning 3-3. Know how to use AI tools in active methodologies to enrich the learner experience.	0.733	0.537		
Area 3: Teaching and Learning 3-1. Knows how to apply AI in content design, choice of activities, and forms of assessment to achieve educational goals.	0.686	0.539		
Area 3: Teaching and Learning 3-2. It knows how to use AI tools for your development as a teacher and to apply educational innovation.	0.681	0.578		

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Area 4: Assessment 4-4. It is aware that most AI systems do not assess collaboration, social skills, or creativity.	0.613			
Area 5: Train 5-3 students. Recognizes the need for constant monitoring of the results of the use of AI in each group of learners.	0.611			
Area 3: Teaching and Learning 3-5. It knows how to detect and consider in the use of AIs the biases in the source data that condition the results obtained.	0.584			
Area 1: Professional Commitment 1-2. It is able to give several examples of AI tools applied to education and describe their usefulness.		0.714		
Area 1: Professional Commitment 1-5. Understands the fundamentals of AI and how algorithms work.		0.709		
Area 1: Professional Commitment 1-3. It knows how to critically evaluate the positive and negative impact of AI tools on the development of your classes.		0.669		
Area 1: Professional Commitment 1-7. It is aware that interaction with different applications and technologies generates a large amount of personal data that can be used to train AI.		0.668		
Area 1: Professional Commitment 1-6. It is capable of interacting with AI systems to influence the results offered to it by the system.		0.658		
Area 1: Professional Commitment 1-4. It knows how to promote the ethical and responsible use of AI and data in his classrooms and in his educational community.		0.654		
Area 1: 1-1 Professional Engagement. It is actively involved in learning about the use of artificial intelligence (AI) in teaching.		0.621		
Area 2: AI Governance 2-6. It knows how to incorporate digital content created, edited, or manipulated by AI systems and know how that work should be credited.		0.566		
Area 2: AI Governance 2-7. It is able to explain the key principles of data quality used in resources obtained from AI.		0.548		
Area 1: Professional Commitment 1-8. Learns about the EU's ethical guidelines on AI and self-assessment tools.		0.543		
Area 2: Data Governance 2-3. It knows who in your organization has access to data, how access is controlled, and how long it's retained.			0.76	
Area 2: Data Governance 2-2. Learns about the regulations (national and EU) on data processing, including the GDPR and its application in the university environment.			0.74	

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Area 2: AI Governance 2-5. Learns about the high-risk AI use cases and transparency requirements approved by the EU in the upcoming Artificial Intelligence Act.		0.681	
Area 2: Data Governance 2-4. It can weigh the benefits and risks of processing personal data, especially when using AI systems.		0.638	
Area 2: Data Governance 2-1. It is aware of her responsibility as a teacher in maintaining data security and privacy.		0.538	
Area 3: Teaching and Learning 3-6. It considers the risks to students when using interactive AI systems without knowing how to analyze biases in their learning.			0.694
Area 3: Teaching and Learning 3-7. It is able to take into account the impact of AI and the use of data on students.			0.578
Extraction method: principal axis factor. Rotation method: Varimax with Kaiser normalization. to. The rotation has converged in 10 iterations.			

The linear regression model meets the assumptions' requirements for independence, normality, linearity, and homoscedasticity (Durbin, 1970).

The conceptualization of the four factors obtained is as follows:

Factor 1: Teaching and learning by applying AI to feedback, assessment, and pedagogy, and facilitating its use among learners.

Factor 2: Attitude toward the use of AI, data governance, and ethical use.

Factor 3: Knowledge of the guidelines and regulatory framework for AI.

Factor 4: Protecting students from the impact of AI and its risks.

4.2. Hypothesis confirmation for model variables

The confirmation of hypotheses will be conducted through factor analysis. Based on the analysis of the four assumptions, it can be concluded that the linear regression models have been satisfied in this study and it is expected that none of the assumptions in this model will be independently compromised. In this case, the Durbin–Watson statistic takes a value of 2.072 (Table 4), showing that the assumptions of independence, normality, linearity, and homoscedasticity for the linear regression model are met.

The dependent variable of the model: How do you evaluate your performance in the use of artificial intelligence (AI)? Assign a proficiency level from A1 to C2, where A1 is the lowest and C2 is the highest. The confirmation of the hypotheses will be done jointly for the factors obtained from the factor analysis.

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Tab. 4 – Model Summary: own research

Model	R	R-squared	Adjusted R-squared	Standard Estimation Error	Durbin–Watson
1	.775[a]	0.601	0.585	0.877	1.630

a. Predictores: (Constante), REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1
b. Dependent Variable: How do you evaluate your performance in the use of artificial intelligence (AI)? Assign a proficiency level from A1 to C2, where A1 is the lowest and C2 is the highest.

The F-statistic is used to determine the potential linear relationship. It tests the null hypothesis that the population value of R is zero. With a critical level Sig.=0.000, it indicates that there is a significant linear relationship for the four models that were analyzed. Please refer to Table 4 for the ANOVA results.

Tab. 5 – ANOVA Source: own research

Model		Sum of squares	gl	Mean Square	F	Sig.
1	Regression	115.977	4	28.994	37.713	.000[b]
	Residue	76.881	100	0.769		
	Total	192.857	104			

Dependent variable: How is the use of artificial intelligence (AI) evaluated today? Assign a proficiency level from A1 to C2, with A1 being the lowest and C2 being the highest.

Predictors (constant): REGR factor score 4 for analysis 1, REGR factor score 3 for analysis 1, REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1.

According to the regression model, the significance level of the four variables being less than 0.05 means that the null hypothesis is rejected, and the alternative hypothesis is accepted. This indicates that there is a linear relationship between the independent variables and the dependent variable. Thus, the coefficient values for the constant, Factor 1, Factor 2, Factor 3, and Factor 4 are non-zero (refer to Table 5).

The coefficients typified by Beta indicate the impact of the variables on the outcome of the level of performance. The greatest impact comes from Factor 2 Digital Competencies for students to plan their learning, with 0.745, followed by Factor 1 Competencies for the search, creation, development, and use of digital technology, with a coefficient of 0.679.

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Tab. 6 – Hypothesis confirmation table Source: own research

Model		Unstandardized coefficients		Standardized coefficients		
		B	Standard Error	Beta	t	Sig.
1	(Constant)	2.857	0.086		33.390	0.000
	Factor 1: Teaching and learning by applying AI to feedback, assessment, and pedagogy and facilitating its use among learners.	0.679	0.086	0.499	7.899	0.000
	Factor 2: Attitude toward the use of AI, data governance, and ethical use.	0.745	0.086	0.547	8.670	0.000
	Factor 3: Knowledge of the guidelines and regulatory framework for AI.	0.230	0.086	0.169	2.672	0.009
	Factor 4: Protecting students from the impact of AI and its risks.	0.213	0.086	0.157	2.480	0.015
Dependent variable: How is the use of artificial intelligence (AI) evaluated today? Assign a proficiency level from A1 to C2, with A1 being the lowest and C2 being the highest.						

5 DISCUSSION

5.1. Adoption and utilization of AI tools among educators

In the initial phase of this study, we explored the use of AI tools by educators. The COVID pandemic resulted in a significant increase in digital skills among educators, with a reported 57% enhancement (Pérez-Rivero et al., 2022). The emergence of AI has had an even more remarkable impact, leading to a 79% adoption rate for tools such as ChatGPT, as per the findings of this study. This adoption is similar to other studies, as Ajlouni et al. (2023) measured the implementation in students (73%). Therefore, we can conclude that both professors and students are experimenting and learning at the same time with these new learning tools. Recent scholars have been vocal about the potential impact, highlighting the need for educators and institutions to adapt to these changes (Crompton & Burke, 2023).

If we look closely at the results, they uncover a notable disparity in terms of the use of tools and the degree of educators' AI expertise. This difference has brought attention to the issue of a digital readiness gap, which needs to be addressed to ensure equal access to advanced technological tools and digital literacy (Celik et al., 2022). As shown in the results, ChatGPT emerges as the most prominent, with 43.8% using it frequently and even considering it essential for their work. However, there exists a significant knowledge gap among professors regarding other AI writing tools, as 52% admit to not being aware of these resources. Search tools are also implemented by 29.5% of professors, and translation and editing tools exhibit a high use of them by 72.3% of the respondents. Conversely, within the category of research tools, 47.5% of professors lack familiarity with AI tools. A similar trend is observed in content management and review. Therefore, professors acknowledge the potential advantages of AI tools in academia, although there is a varied level of familiarity and adoption across different tool categories. The study of Tubella et al. (2024) also brought the same conclusions as these findings. They note the importance of considering varying levels of expertise in using AI, including technical and practical skills. Others conclude the need to develop new skills and

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effective use of AI by motivating faculty to use it and facilitating training in and access to most AI tools (Bearman et al., 2023). The variety of use of AI among educators demonstrates a complex range of attitudes concerning new technological tools, signaling the necessity for enhanced outreach and training to foster educators' AI skills (Dwivedi et al., 2023). However, it is common to feel worried or uncertain when adopting new digital tools in academia, especially if they may impact job security. Therefore, it is crucial to have a positive attitude toward technology (Torrato et al., 2020) and motivate professors to embrace the digital environment. This is a critical aspect of helping educators adapt to new challenges.

The adoption of AI tools among educators is widespread but uneven, pointing to a need for targeted training to bridge the digital readiness gap and ensure broader familiarity and effective use of AI across different categories of tools.

5.2.Institutional support and AI readiness

Seamless integration of AI has become imperative, prompting universities to undertake concerted efforts to aid their academic staff in embracing these transformative technologies (Celik et al., 2022). However, an examination of the prevailing sentiments among educators reveals a concerning trend. When queried about the extent to which their respective institutions are actively facilitating their readiness for AI tool adoption, a striking 74.3% of professors perceive the assistance rendered as falling within the spectrum of minimal to modest, indicating a palpable disconnect between institutional support and their professional development needs. Alarming, in this context, is the starkly low figure of 3.8%, representing the fraction of respondents who unequivocally affirm the adequacy of the support they receive for AI training from their institutions. This data underscores a glaring discrepancy between the aspirations of educators and the current state of universities' preparedness, raising questions about the efficacy of strategies to empower their faculty in harnessing the potential of AI in their teaching and learning. Addressing this divergence becomes paramount to ensure that educators are equipped to thrive in an AI-enhanced pedagogical landscape and, in turn, provide the best possible learning experiences for students, as has been pointed out by other recent studies (Bond et al., 2024; Zawacki-Richter et al., 2019). In conclusion, it requires a reevaluation of institutional approaches and a more concerted effort to bridge this noticeable gap.

5.3The need for higher levels of performance, the ethical implications and responsible AI use

The study confirms the third and fourth hypotheses, highlighting that professors with higher levels of AI performance are more aware of AI regulations, benefits, and the associated risks. The findings stress the importance of ethical AI use, particularly regarding issues like privacy, bias, and academic integrity. The discussion underscores the need for educators to embrace new technologies while promoting critical thinking and maintaining academic integrity.

The causal analysis confirms all the hypotheses developed to explore the relationship between professors' proficiency and their impact on different factors. Specifically, the first hypothesis, stating that Higher levels of AI performance facilitate the development of AI digital competence in their students, has been validated, and has been consistent with other previous research, such as the study by De Obesso et al. (2023) within the DigCompEdu framework. Celik et al. (2022) also underscore that digital competencies are crucial for effectively utilizing AI in teaching and learning, echoing research by Holmes et al. (2022) that examines AI’s impact on educational elements like assessment.

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These results also support the second hypothesis, which evaluates the connection between professors' AI performance and their active participation in learning, content promotion, and critical evaluation of AI and its impact. The confirmation of this proposal leads to the ideas already suggested by previous studies in the relevance of training and investment in professor capacitation on the use of AI in teaching and learning (Hattie, 2023). This study highlights the need for continuous and tailored AI training for educators, emphasizing the importance of integrating these tools effectively and ethically into the curriculum. Bond et al. (2024) also emphasize the same approach, considering that one of the research gaps in the studies of AI in Higher Education is to focus investigations on critical stakeholders such as educators and their lack of technical knowledge. Zhai et al. (2021) also underline the importance of digital skills training, but their findings suggest that there is a gap in the practical application and effective integration of AI into educational processes. This could indicate that although there is a recognition of the importance of AI, practical implementation and appropriate training are still in development (Crompton & Burke, 2023).

The third and fourth hypotheses have been confirmed as well; they are discussed together as they are closely related to each other: H3 Professors with higher levels of AI performance know AI regulations and its benefits and are aware of their responsibility; and H4 Professors with higher levels of AI's performance, consider the risks and the AI impact on the use by their students. The confirmation reveals the relevant issue of the responsible use of AI in higher education (Aler Tubella et al., 2024). Like other authors that include privacy and responsible use of data as crucial aspects (Sued, 2022), our results reflect the importance of the performance of educators in the use of AI in implementing a trustworthy AI in universities with a holistic view (Rampelt et al., 2019). These results imply the general impact of AI on different challenges, such as student learning processes (Price, 2020) and academic integrity (Fowler, 2023).

Academic integrity, critical thinking, effortful thinking, and the risks of plagiarism are major ethical concerns. These issues are exacerbated by the ease of accessing writing help. Therefore, it is necessary to ensure that the use of these tools respects the principles of academic integrity and that teachers can convey this ethos to their students. As Bond and Khosravi (2023) suggest, guidelines, principles, and frameworks are needed to ensure that AI is used ethically and responsibly in higher education. Therefore, professors must embrace new technologies and adapt their teaching methods to promote critical thinking. These conclusions are consistent with other studies that emphasize the potential problems arising from the lack of human agency when students use AI (Aler Tubella et al., 2024), and the subsequent impact on noncognitive skills and impact on student noncognitive skills (Wang et al., 2023).

Furthermore, the results underscore the ongoing necessity of addressing the ethical dimensions of AI use in higher education (Bond et al., 2024). This study, along with supporting literature, reveals that professors who are well-versed in AI applications tend to express ethical concerns about critical issues such as privacy, bias, accountability, transparency, and human dignity (Aler Tubella et al., 2024; Foltynek et al., 2023; Fowler, 2023). The implications of ethical AI usage extend far beyond the academic sphere, highlighting the importance of preparing students to apply these principles responsibly when they become decision-makers in companies or other organizations. It is imperative that education incorporates broader ethical considerations, as AI increasingly influences all socioeconomic activities. Promoting ethical awareness and good citizenship behaviors among students is essential to ensuring a just and secure world. This need is echoed in the context of consumer behavior and is further emphasized by the persistence of

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unethical AI practices despite regulatory frameworks like the European Union's Artificial Intelligence Act. As Méndez et al. (2023) note, instilling strong ethical foundations in educational settings is crucial to equipping future professionals with the tools to address and mitigate the societal impacts of AI misuse.

6 CONCLUSIONS

This study underscores the transformative potential of AI in education while also highlighting significant concerns related to its impact on both professors and students. The ethical implications and the effects on students' AI skills are critical areas of concern, particularly given the artificial nature of AI, which relies on the aggregation of existing information without the capacity for true innovation or creation. This reality necessitates a closer examination of how effectively educators are utilizing AI tools, as the study reveals several critical gaps. Firstly, educators are not fully leveraging available AI technologies, leading to a potential loss of benefits for students. Secondly, the lack of confidence among professors in their ability to use these tools effectively points to a deficit in training and institutional support. Thirdly, the perceived inadequacy of institutional backing further exacerbates this issue, leading to a mismatch between the skills educators need and their current capabilities, which could detrimentally affect student learning outcomes.

The findings clearly indicate an urgent need for re-education and skills upgrading among teachers, particularly in light of the perceived underinvestment by educational institutions. The risks associated with failing to adapt teaching practices to integrate AI—including threats to academic integrity, impact of AI on students' non-cognitive skills, such as motivation, creativity, and collaboration, ethical implications, particularly concerning data privacy, bias, and accountability, and the potential erosion of individual dignity—are too significant to ignore. Consequently, educational institutions and policymakers must adopt explicit strategies to support and train educators in the effective use of AI. This focus on educators, who play a pivotal role in ensuring the quality of education, aligns with the recommendations of recent research, which emphasizes their centrality in driving educational excellence.

Therefore, this study contributes valuable evidence on the importance of enhancing AI competence among university educators. A comprehensive and proactive approach to AI training is essential to meet the challenges of a digitized world. Investing in the professional development of educators in the field of AI is not only necessary to address current gaps but also crucial to equipping future generations with the skills needed to succeed in an increasingly AI-driven work environment. These conclusions call for a renewed commitment to bridging the gap between technological advancements and educational practices, ensuring that the integration of AI into education is both effective and ethically sound.

Future research on AI integration in education should focus on long-term studies to track the sustained impact of AI on teaching practices and educator proficiency. Comparative studies across different educational levels and cultural contexts are also necessary to tailor AI implementation strategies effectively. Additionally, exploring AI’s direct impact on student learning outcomes is crucial, particularly in developing digital competencies and non-cognitive skills like motivation and creativity. Further investigation into the ethical implications of AI, especially regarding data privacy, bias, and accountability, is needed to develop effective frameworks for ethical AI use. Policymakers should prioritize comprehensive AI training programs for educators, establish clear ethical guidelines, incentivize AI adoption, enhance

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institutional support, and implement continuous monitoring and evaluation mechanisms to ensure AI's responsible and effective integration in education.

7 LIMITATIONS AND FURTHER RESEARCH.

The use of AI at the level of higher education is still at an incipient stage. Future studies will have to analyze how AI tools have been incorporated from a dual perspective: the use made of it by students and the use made of it by teachers. Although a valid sample has been used for this study, broader data may be necessary to consolidate the findings and the conclusions.

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