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ChatGPT as a tool for Personalized Learning

Examining the Impact of ChatGPT on Academic performance in Personalized Learning contexts

Joana Margarida Antunes Bezerra

Master Thesis

presented as partial requirement for obtaining the Master Degree in Information Management

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Master Thesis presented as partial requirement for obtaining the Master's degree in Information Management, with a specialization in Business Intelligence

Supervised by

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STATEMENT OF INTEGRITY

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration. I further declare that I have fully acknowledged the Rules of Conduct and Code of Honor from the NOVA Information Management School.

Portugal, July of 2024

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ABSTRACT

This research explores the impact of Artificial Intelligence (AI) tools, particularly Generative AI (GenAI) technology, on students' academic performance and their integration into personalized learning processes. It responds to the current gap in studies assessing their effectiveness in educational settings, specifically addressing the unexplored area of how students interact with AI within personalized learning contexts. A new and innovative theoretical model was developed, resulting from the combination of two models known for explaining performance. This study used a mixed method approach to comprehensively investigate this important topic. The quantitative data was analyzed using the structured equation modeling (SEM), by using Partial Least Squares (PLS) technique. Our results demonstrated the model's strong explanatory power on behavioral intention to use AI tools and students' academic performance. Particularly, creativity and reactivity in the face of emergencies or unexpected circumstances significantly influence students' academic performance. Perceived enjoyment, perceived usefulness, and perceived ease of use were found significant in predicting the behavioral intention to use AI tools, which in turn significantly influenced students' academic performance. Qualitative results from experts' interviews revealed all perceived benefits of AI tools like ChatGPT in education, recommending its integration into student learning processes, while also highlighting the associated risks. Highlighting the originality of this research, the study addressed the student's and teacher's perspectives towards AI in personalized learning environments and also pioneers in giving a deeper understanding on how it affects academic performance. As the field evolves, this research stands out by offering valuable insights for education stakeholders.

KEYWORDS

Artificial Intelligence; Education; ChatGPT; Personalized Learning; Academic Performance; Higher Education

Sustainable Development Goals (SDG):

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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
AIEd	Artificial Intelligence in Education
GenAI	Generative Artificial Intelligence
TAM	Technology Acceptance Model

1. INTRODUCTION

The increased use and development of Artificial Intelligence (AI) has significantly impacted education. As this technology continuously advances, there is a need to address its impact and leverage it to transform current educational systems, which are often too rigid and fail to support all students effectively (Furini et al., 2022). Incorporating AI into education is crucial for redefining teaching and learning paradigms, making them more adaptive, efficient, and immersive (Ferreira Mello et al., 2023). Over the years, the increasing integration of technology into educational practices, has led to the intersection of traditional academic performance factors with the influences that AI has. Understanding the impact of AI on academic performance stands as one of the four key domains in research regarding AIEd focusing on student learning outcomes, along with motivation and engagement, 21st-century skills, and noncognitive aspects (Chiu et al., 2023). This highlights the significance of academic performance within the broader context of AIEd research. While the inclusion of AI in the educational context has introduced new challenges such as data privacy, AI acceptance and data bias (Chen et al., 2020; Latif et al., 2023; Van Der Vorst & Jelicic, 2019; Wang et al., 2023) it has also been proven to have significant positive results for both teachers and students in various roles including learning assisting, teaching, assessment, and administration (Chiu et al., 2023; Escotet, 2023; Latif et al., 2023). Additionally, the education paradigm is further shifting with the introduction of Generative Artificial Intelligence (GenAI), a type of AI technology that can produce new content, such as text, images, or music. GenAI tools are being integrated into educational practices to automate activities and support in a variety of roles. This involves a deeper knowledge and more discussions on the pros and cons of GenAI use in education, to reconstruct better learning practices and enhance students' outcomes (Ruiz-Rojas et al., 2023).

The topic of AI in education, namely GenAI, is increasingly crucial due to the technology's ability to personalize the learning experience for each student. Learning systems powered by AI are capable of tailoring the content, pace, and delivery of instruction according to individual needs of students, contributing to enhancing their engagement (AalSaud, 2021; Putra Pratama et al., 2023). Recently there have been notable examples of personalized learning tools using this type of technology, one of such is Khanmigo, a GenAI-powered educational tool developed by Khan Academic and OpenAI, that leverages it to provide personalized assistance to students and teachers. Khanmigo can help explain concepts, answer questions, provide practice problems, and assist with lesson planning, making the learning process more interactive and tailored to individual needs (Ferreira Mello et al., 2023). While these tools have demonstrated their potential to enhance the learning experience, the evidence regarding their impact on academic performance remains unclear, underexplored in literature.

AI Chatbots are increasingly being used in educational contexts, particularly for personalized learning settings, serving both as service assistants and teaching assistants (Pérez et al., 2020). Released to public use in 2022, ChatGPT, the GenAI Chatbot developed by OpenAI is a prime

example of these tools. ChatGPT's language model is designed to provide detailed responses to user prompts (Haleem et al., 2022), and when applied to educational contexts, has showed to provide students with very personalized and interactive learning experiences, raising questions about how to evaluate its efficacy and how to ensure it's used in a responsible and ethical way for educational purposes (Su & Yang, 2023).

Although research on the integration of AI in education (AIEd) has seen significant growth since 2012 (Chen et al., 2022), research on the application of more recent tools, like ChatGPT, is still in its early stage, due to its recent release. Because of this, there is an opportunity for researchers to explore its use (Crompton & Burke, 2023) and impact on students' academic performance. The aim of this study is to investigate how AI tools, specifically generative AI tools like ChatGPT, impact students' academic performance within personalized learning contexts, where these tools are used by students to tailor and enhance their individual learning experiences. Therefore, the following research questions were posed:

- RQ1: What factors influence students' academic performance in the evolving context of utilizing AI tools such as ChatGPT?
- RQ2: Does the perception of AI tools such as ChatGPT influence students' academic performance?
- RQ3: What are the perceived benefits and challenges associated with students using AI tools such as ChatGPT in their individual learning experiences?

In more detail, within this study we will try to identify the most important factors that influence students' academic performance when utilizing AI tools like ChatGPT in educational settings, evaluate how different stakeholders perceive these tools and understand if those perceptions impact students' academic performance, and, additionally, identify benefits and challenges associated with integrating AI tools into individualized learning processes. While studies by Adiguzel et al. (2023), Chen et al. (2022) and Crompton & Burke (2023) have made valuable contributions by exploring the current state of AIEd and ChatGPT, gaps remain regarding personalized learning and the specific impact of ChatGPT on academic performance. This study aims to address these gaps by evaluating the recent advancements in GenAI-powered tools, providing essential insights for educators and policymakers. There are some studies that explore how personalized learning can be facilitated by ChatGPT (Chaudhry et al., 2023; Latif et al., 2023; M. M. Rahman & Watanobe, 2023), yet research on how student interact with these tools in personalized learning environments remains underexplored. Additionally, it's important to assess if the factors that influence academic performance have changed with AI and ChatGPT use. Since ChatGPT is quite new in the education landscape, it's relevant to understand the current challenges that both student and educators have with its utilization, especially in the context of personalized learning. This study distinguishes itself by addressing these gaps and identifying key factors that influence academic performance among students using AI tools in personalized learning. Additionally, from our research, this is a newly researched topic in south European countries. While some published studies, such

as those by Gouveia et al. (2023) mention the transformative impact of AI on higher education, they do not further investigate how this relationship affects academic performance. This study is one of the first, to our knowledge, to explore the relationship between AI and academic performance within personalized learning settings.

The current study is structured as follows. In the next section, we review previous studies on Artificial Intelligence in Education (AIEd) and AI in personalized learning contexts. We also examine how academic performance has been measured and evolved through traditional metrics and AI, and discuss gaps identified in the literature. Following this, we present the conceptual model, methodology employed, and results. The paper concludes with a discussion of the results, including practical and theoretical implications, as well as limitations and suggestions for future research.

2. LITERATURE REVIEW

2.1. PREVIOUS STUDIES ON ARTIFICIAL INTELLIGENCE IN EDUCATION (AIED)

Artificial Intelligence (AI) refers to machines that can mimic human abilities such as sensing and decision-making. Through various methods like learning from experience, analyzing information, and processing text and images, AI systems can acquire knowledge that then equips them to make decisions, summarize information, set and follow prompts, and understand text and images, among other tasks (Mondal, 2019).

The rise of Artificial Intelligence in Education (AIEd) has been introducing plenty of changes in this sector, having become a topic of growing research in recent years (X. Chen et al., 2022; Crompton & Burke, 2023). If AI in Education initially took the form of computer-related systems, it now has been transformed into web-based and mobile education tools that enable customization and personalization of learning while also improving teacher effectiveness and efficiency (Chen et al., 2020). In education, AI has multiple applications and prospects: it can be used for educational management, institutional planning, content design, adaptive and personalized learning, test scoring, predictive forecast of student outcomes, and overall enhance educational experiences (Chiu et al., 2023; Escotet, 2023; Latif et al., 2023). Not only can it help in educational settings, but AI is also shown to be relevant in the preparation of students to the job market, equipping them with the necessary skills (Tominc & Rožman, 2023).

One form of AI that has grown significantly in recent years is Generative Artificial Intelligence (GenAI), a branch of AI capable of producing new content such as text, images, or audio that closely resembles human-created work. Examples of current tools using generative AI technologies include Dall-E 2 and GPT (3.5 or 4.0), which are revolutionizing various industries and communication methods (Feuerriegel et al., 2024). GPT Generative-trained Transformer is the technology behind ChatGPT, the AI tool developed by Open AI, currently being widely used in the educational field (Gill et al., 2024; Khalil & Er, 2023). ChatGPT is an AI chatbot that can simulate conversations with users and provide answers to prompts. To do that, it uses natural language processing models and is trained on a large dataset of text data. It uses a neural network architecture called a Transformer, which is particularly well-suited to processing and generating text (Rudolph et al., 2023).

Several studies put ChatGPT's best capabilities to practice and highlighted potential ways it can be a useful tool to help students and teachers in educational settings. Some authors says that AI Chatbots are used in educational settings primarily for service support or teaching assisting purposes (Pérez et al., 2020). However, the role of educational AI chatbots can go much beyond these two purposes. For instance, ChatGPT's capacity to perform sophisticated cognitive processes, such as problem solving, decision making, reasoning, and perception, has been associated with numerous applications to enrich educational experiences. Escotet (2023), Gill et al. (2024) and Rahman & Watanobe (2023)have emphasized its utility in

generating learning materials, answering learner's questions, generating content, offering suggestions for enhancement of essays, helping personalized learning, and offering lesson planning support. Various other studies have highlighted these capabilities, for example, Khalil & Er (2023) tested essay writing by analyzing fifty essays written by ChatGPT, from which forty demonstrated high level of originality when checked by plagiarism-detection software used by higher education institutions. In another study, Chaudhry et al. (2023) tested ChatGPT's capabilities to answer assignment questions and compare its answers with those of the highest performing students who completed the same assignments. The results indicated that ChatGPT could perform equally in case analysis assignments, self-reflection group work and problem-solving. Qureshi (2023) also used ChatGPT to test whether its use changes students' academic performance, by creating two distinct groups and observing their performance with and without ChatGPT, which showed that students that used ChatGPT had an advantage in terms of earned scores, despite inconsistencies and inaccuracies. And finally, to test ChatGPT capability to answer high order thinking and high difficulty level questions, (Ghosh & Bir, 2023) evaluated its aptitude to answer medical biochemistry questions, resulting in ChatGPT being successful with a median score of four out of five.

The use of ChatGPT in academic settings provides both opportunities and challenges. Integrating it in learning management systems allows to boost education experience for both teachers and students (Escotet, 2023). In more detail, for students ChatGPT can help facilitating the learning process, and for teachers it can help create innovative assessments (Crawford et al., 2023), lesson planning, personalized learning, and facilitate assessment and evaluation (M. M. Rahman & Watanobe, 2023). ChatGPT can both serve as assistant for instructors and as virtual tutors for students (Lo, 2023). However, all these opportunities come with various challenges as many studies have also indicated. Starting with reliability, precision, accuracy issues and sometimes even fabricated facts (Gill et al., 2024; X. Wang et al., 2023). Other type of challenges are ethical implications and bias in the data, integrity of assessments, cheating and plagiarism, over reliance on AI and digital divides (Adiguzel et al., 2023; M. M. Rahman & Watanobe, 2023; X. Wang et al., 2023). To address these challenges, authors have offered several insights and recommendations that can lead to an optimization of the use of ChatGPT in education. Crawford et al. (2023) emphasizes the importance of future-proofing subjects and degrees in higher education, a concept supported by Gill et al. (2024), who suggests establishing specific guidelines for teachers and students, effective monitoring, and regulatory actions. Additionally, education should transform and evolve towards human-focused learning (Gill et al., 2024), acknowledging the crucial role of teachers in the integration of AI in educational practices (Gill et al., 2024; Su & Yang, 2023), and developing an approach that fosters trust in student-centered teaching and evaluations, with a focus on assessments designed as a part of the learning process, rather than being solely evaluations of learning (Rudolph et al., 2023).

2.2. Artificial Intelligence in Personalized Learning Contexts

With the growing AI application in education, new developments are being introduced in personalized learning environments, a learning approach where learning is tailored to each student's background and capabilities. The main objective is to establish learning environments that meet individual learner needs in contrast to standardized one size fits all approaches (Goksel & Bozkurt, 2019). Personalized Learning through data mining-based AI algorithms allows students to learn at their pace and preferred method, helping at the same time teachers with methodologies according to student' real needs and interests (Chen et al., 2020). AI can also personalize support to both teachers and students by acting as a tutor and giving personalized answers to questions, assisting in time management tasks, and giving access to a plenitude of educational resources (Putra Pratama et al., 2023). AI tools like ChatGPT are being used for personalized learning purposes as several studies have revealed (Chaudhry et al., 2023; Latif et al., 2023; Qureshi, 2023; M. M. Rahman & Watanobe, 2023). For learners, ChatGPT can serve as an Intelligent tutoring system that can give clear instructions to enhance individual learning experiences (Qureshi, 2023). It can give instant feedback to specific student's queries and deconstruct difficult topics with tailored responses (Chaudhry et al., 2023; Latif et al., 2023), proving to be an effective tool to improve students' outcomes. For teachers ChatGPT can support in the planning of learning activities and analyzing student performance data (M. M. Rahman & Watanobe, 2023), making administrative tasks more effective and leaving teachers more time to adapt teaching methods based on each student.

The applications of AI in personalized education have been shown to be beneficial and well perceived by learners and instructors (Al-Badi et al., 2022). For example, in higher education AI facilitates personalized learning paths since it can respond to diverse individual needs while promoting effective knowledge retention (Sajja et al., 2023). However, in order to ensure a successful AI implementation in this context, institutions have to be aware of challenges such as fairness and data bias induced by data (L. Chen et al., 2020; Latif et al., 2023; Van Der Vorst & Jelicic, 2019; X. Wang et al., 2023), as well as issues like the absence of peers in personalized learning paths and a lack of motivation and incentive systems (Maghsudi et al., 2021). Additionally, a personalized learning model is only successful if the challenges of infrastructure, data, and presentation layers it's built upon are well addressed and any risk of problems mitigated (Furini et al., 2022).

2.3. Academic Performance Through Traditional Metrics and AI Developments

A range of individual and academic factors have been found to influence academic performance. Ruby & David (2014), applied data mining techniques to analyze personal and academic data, having highlighted a set of factors impacting academic performance including

medium of study, theory marks obtained, extra-curricular activities, family income, and previous course. These findings are aligned with the factors identified by Wentzel & Wigfield (1998) which included student motivation, study habits, learning environment, teacher quality, and individual characteristics as the factors influencing academic performance. Further, Win & Miller (2005) studied first-year university students' data, to understand the effects of individual and school factors on performance, identifying a high schools' role as a significant influence on academic performance in higher education, alongside the positive effects of favorable family backgrounds.

Some researchers have explored the impact of AI on academic performance, primarily revealing positive outcomes largely because of AI's capability of personalizing learning paths, depending on student needs (Tapalova & Zhiyenbayeva, 2022; Van Der Vorst & Jelicic, 2019). For instance, Van Der Vorst & Jelicic (2019) defend that AI can improve academic performance by offering personalized learning tailored to individual needs. AI not only provides insights of student performance to the teacher, but it can also interpret those insights and give suggestions for improvement (Van Der Vorst & Jelicic, 2019).

Building on the broader theme of AI's impact on academic performance, specific tools such as ChatGPT have gained significant interest from academic authors. Many researchers agree that the AI chatbot can improve academic performance, since it can facilitate personalized learning journeys and respond effectively to student queries (Chaudhry et al., 2023; Qureshi, 2023). However, over-reliance on ChatGPT may expose students to challenges such as lack of critical thinking, difficulty handling information overload, risk of plagiarism, which all combined can potentially lead them to inaccuracies and ultimately to poorer performance (Qureshi, 2023). Therefore, it´s necessary to understand that the improvement of academic performance through ChatGPT will always depend on correctly educating students about its limitations and guiding them on how to use it effectively for better learning.

2.4. PERFORMANCE AND ACADEMIC MODELS

Regarding the measurement of performance, worth mentioning two important models. The first one is the comprehensive study of Charbonnier-Voirin & Roussel (2012) on adaptive performance. Drawing from the framework of eight dimensions to evaluate adaptive performance proposed by Pulakos et al. (2000), Charbonnier-Voirin & Roussel (2012) conducted factor analysis alongside other techniques in a multi-step process to assess if there were strong correlations between variables and if the model could be improved in any way. As a result, they streamlined the framework, reducing redundancy and enhancing the reliability of the model, creating a new one containing only five conceptually distinct dimensions: creativity, reactivity in the face of emergencies or unexpected circumstances, interpersonal adaptability, training and learning effort, and managing stress. The second model to evaluate performance highlighted is Alalwan's et al. (2019) approach to researching academic performance. Alalwan et al. (2019) synthesized three theories—Constructivism Theory, Communication Theory, and the Technology Acceptance Model (TAM)—to develop a

comprehensive model that aimed to evaluate factors influencing student academic performance within the context of utilizing social media for collaboration and communication.

3. CONCEPTUAL MODEL AND HYPOTHESES

Our study's unique and innovative research model results from a combination of two well established models: Charbonnier-Voirin & Roussel's (2012) model on adaptive performance and Alalwan's et al. (2019) model on academic performance, using relevant aspects of both and applying them to the context of AI's impact on students' academic performance. The visual representation of the proposed conceptual model can be seen in Figure 1.

From the findings of Charbonnier-Voirin & Roussel's (2012), our conceptual model incorporates the five dimensions identified by them as significant in measuring adaptive performance, namely creativity, reactivity in the face of emergencies or unexpected circumstances, interpersonal adaptability, training and learning effort, and managing stress. While adaptive performance has traditionally been studied in organizational settings, it offers valuable insights into understanding and enhancing academic performance. By assessing these factors within the educational context, it is possible to understand how students' abilities and behaviors contribute to their overall academic performance. Drawing from the model of Alalwan et al. (2019), our conceptual model will exclusively retrieve the constructs associated with the TAM model, namely perceived enjoyment, perceived ease of use and perceived usefulness, since communication and collaboration constructs are not relevant for the aim of students' academic performance in the context of AI tools like ChatGPT usage for individual learning processes. These three constructs have been shown to influence students' behavioral intention to use social media for educational purposes, which in turn impact their academic performance positively (Alalwan et al., 2019). Building upon such insights, this study will adopt a similar approach and will apply this relation to examine if these same constructs influence behavioral intention to use AI Tools, and if it be translated into improvements in academic performance.

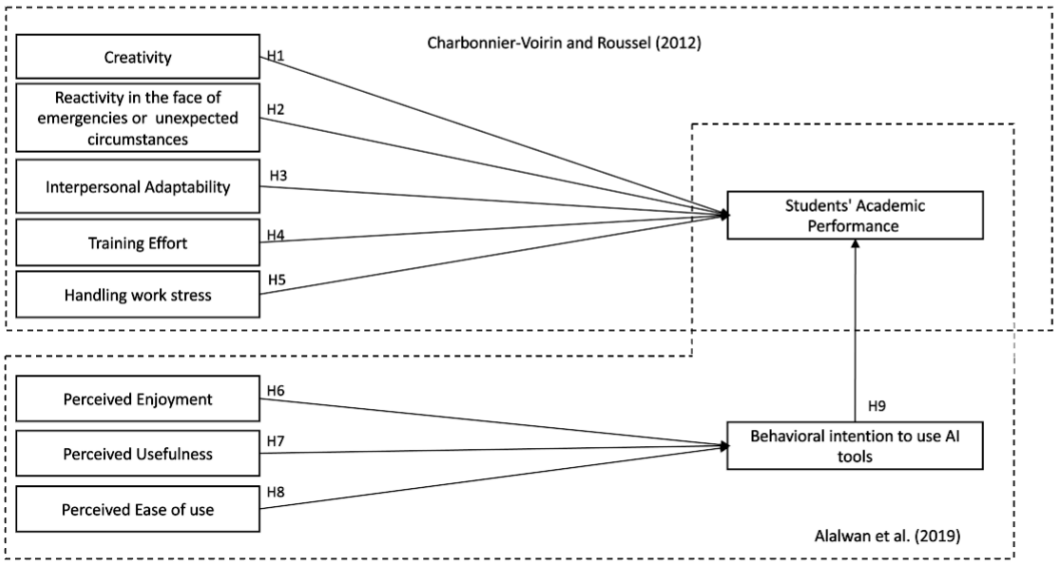

Figure 1 - Conceptual Model

Creativity refers to an individual's ability to find new ideas and solutions in response to new challenges and has been shown to have a significant impact on adaptive performance (Charbonnier-Voirin & Roussel, 2012). Creativity plays a crucial role in addressing complex academic tasks as it fosters problem-solving skills (Lewis, 2005). Given its significance in measuring adaptive performance, this study seeks to assess its relevance in measuring academic performance. It is therefore hypothesized that students who are more creative have better academic performance:

Hypothesis 1: Creativity positively impacts students' academic performance.

Reactivity in the face of emergencies or unexpected circumstances is the ability to quickly adapt and effectively respond under high-pressure and uncertain situations (Charbonnier-Voirin & Roussel, 2012). In the educational context, students may encounter unexpected obstacles, for example, the emergency of COVID-19 confinement had a significant effect on students' performance (Gonzalez et al., 2020). This study aims to explore the significance of reactivity in the face of emergencies or unexpected circumstances in measuring academic performance, hypothesizing that higher reactivity levels will significantly result in better academic performance:

Hypothesis 2: Reactivity in the face of emergencies or unexpected circumstances significantly impacts students' academic performance.

Interpersonal adaptability refers to the ability to adjust and interact effectively with a diverse range of individuals in different work settings (Charbonnier-Voirin & Roussel, 2012). In educational settings, collaborative learning and work is significant in measuring academic performance (Al-Rahmi & Shamsuddin, 2020; Wentzel et al., 2010).In this study it will be assessed the relevance of interpersonal adaptability in improving academic performance. Therefore, we hypothesize:

Hypothesis 3: Interpersonal adaptability positively impacts students' academic performance.

Training effort is the willingness and commitment to engage in continuous learning and development to enhance performance (Charbonnier-Voirin & Roussel, 2012). Students' willingness and commitment to class attendance and engage in study sessions, workshops or trainings is closely linked to academic success (Gray & Mannahan, 2017). This study aims to investigate the influence of training effort on academic performance, hypothesizing that students who demonstrate higher levels of training effort will achieve better academic performance:

Hypothesis 4: Training effort positively impacts students' academic performance.

Handling work stress is the ability to manage and cope with stress in the work environment, demonstrating resilience and maintaining performance under pressure (Charbonnier-Voirin & Roussel, 2012). Stress can impact how well students perform on standardized tests, potentially leading to results that do not accurately reflect their true abilities or knowledge (Heissel et al., 2021). This study aims to assess the significance of handling work stress in measuring academic performance, proposing that students who effectively manage stress will achieve better academic performance. Therefore, we hypothesize:

Hypothesis 5: Handling work stress positively impacts students' academic performance.

Perceived enjoyment is defined by Teo & Noyes (2011) as the extent to which using technology is perceived as enjoyable in itself, independent of any expected performance outcomes. For Alalwan et al. (2019), perceived enjoyment is the extent to which students perceive enjoyment in using social media, perceiving it as beneficial for improving performance by enhancing their behavioral intention to use social media. For the current study, perceived enjoyment refers to which extent students perceive that the enjoyment of using AI tools like ChatGPT would impact their behavioral intention to use those tools. Therefore, we hypothesize:

Hypothesis 6: Perceived enjoyment positively impacts behavioral intention to use AI tools like ChatGPT.

Perceived Usefulness is defined by Davis, (1989) as the extent to which an individual perceives that using a specific system would improve their job performance. Based on this definition, perceived usefulness stands as a critical factor influencing intention and use behavior(Alalwan et al., 2019), and it is significant in explaining behavioral intention to use AI tools (Na et al., 2023; Y. Wang et al., 2021). In this study, Perceived Usefulness refers to the extent to which students perceive that the usefulness of AI tools like ChatGPT would impact their behavioral intention to use those tools. Therefore, we hypothesize:

Hypothesis 7: Perceived usefulness positively impacts behavioral intention to use AI tools like ChatGPT.

Perceived ease of use supposes that a system perceived as easier to use than another is likelier to be embraced by users (Davis, 1989). In other words, perceived ease of use refers to how users believe that using the technology will require minimal effort (Wu et al., 2024) . In this study, perceived ease of use is the degree to which students view that the ease of use of AI

tools like ChatGPT would be significant in impacting the behavioral intention to use those tools. Therefore, we hypothesize:

Hypothesis 8: Perceived ease of use positively influences the behavioral intention to use AI tools.

Behavioral Intention to use AI Tools like ChatGPT is the individual's willingness and motivation to engage in a specific behavior, in this case, to use ChatGPT to learn (Habibi et al., 2023). Similarly to Alalwan et al. (2019) in this study, it will be investigated whether the impact of behavioral intention to use AI tools like ChatGPT is significant or not to determine individual academic performance, hypothesizing that the Behavioral Intention to use AI tools positively influences academic performance:

Hypothesis 9: Behavioral Intention to use AI tools like ChatGPT positively influences academic performance.

4. METHODOLOGY

4.1. MIXED-METHODS APPROACH

The methodology employed in this study follows a mixed methods approach, combining quantitative and qualitative research methods to comprehensively study the impact of AI on education and its influence on academic performance, namely in personalized learning contexts. This methodology was chosen because integrating both is beneficial for a better understanding of a topic, rather than choosing just one approach (Almalki, 2016; Östlund et al., 2011; Venkatesh et al., 2013). Furthermore, mixed methods approach provides enriched findings with qualitative insights that researchers do not anticipate if the study is only done quantitatively (Bryman, 2006).

Within our study we integrated qualitative insights from experts through direct interviews with quantitative data insights collected through a survey targeted for students, aiming to provide a robust understanding of the topic. We believe that the mixed methods approach allows to complement each other: it is anticipated that the qualitative results from teachers' interviews will offer additional insights to complement the findings of the survey.

4.2. QUALITATIVE RESEARCH METHODOLOGY

The importance of qualitative research lies in its open-ended approach that enables the discovery of unexpected insights and perspectives (Bryman, 2006). Qualitative research methodologies encompass various data collection techniques such as interviews, ethnographic observation, and document reviews (Creswell et al., 2011). For the current study, individual interviews were selected as the preferred method for qualitative data collection. In comparison to other qualitative methods like focus groups, interviews offer the advantage of allowing participants to openly express themselves without the influence of group dynamics (Boyce & Neale, 2006). Interviews with experts in the educational field were chosen for this study, involving teachers actively engaged in higher education with significant expertise and several years of experience.

A total of ten teachers were contacted via email, out of which three accepted the invitation to participate anonymously in the study. The selected teachers represented different subjects and teaching experiences in higher education. Structured interviews were conducted with open questions designed to allow flexibility for the interviewees to explore the topic in depth (Appendix F). These interviews were conducted online via Teams calls and lasted approximately thirty minutes each. The interviews were recorded, and later transcribed and analyzed manually.

4.3. QUANTITATIVE RESEARCH METHODOLOGY

Quantitative research is important because it allows for systematic and objective insights into trends, patterns, relationships and clusters in data, which compared with qualitative research, ensures that the evaluation of results is made from objective methods (Ramona, 2011). Overall quantitative research is beneficial since it centers on aspects of social behavior that are quantifiable, in alternative to just interpreting those social behaviors' meanings from a qualitative standpoint (M. Rahman, 2016). Quantitative research involves systematic empirical study where data is quantified and analyzed statistically. There are different methods to conduct quantitative research, including: distribution of surveys to gather data from large samples, controlled experiments to test hypothesis, observational studies to collect numerical data or even analyzing existing datasets (Allwood, 2012). For the current study, a survey was the chosen method for collecting quantitative data as they can efficiently collect data from a large sample size, allowing researchers to generalize findings to a larger population (Fricker & Schonlau, 2002).

The survey was developed by adapting items from earlier literature, according to the research model constructs. A list of the constructs and items used can be found in the appendix A. In detail, measurement items for creativity, reactivity in the face of emergencies or unexpected circumstances, interpersonal adaptability, training effort and handling work stress were adapted from Charbonnier-Voirin & Roussel (2012); items for perceived enjoyment were adapted from Teo & Noyes (2011), items for perceived usefulness and perceived ease of use were adapted from Davis (1989), items for behavioral intention to use AI tools were adapted from Habibi et al. (2023) and finally items to measure students' academic performance were adapted from Alamri et al. (2020). Each item was measured on a seven-point Likert scale, ranging from 1 (totally disagree) to 7 (totally agree). Additionally, this survey also contained demographic questions, namely gender, age, and education level.

The questionnaire was initially developed in English, reviewed for content validity by an information system academic. The questionnaire was then translated to Portuguese and then back to English, to ensure consistency. Final version of the survey was distributed in both English and Portuguese languages, targeting current and former students of higher education institutions. The distribution of the questionnaire occurred during a period of forty days between April and end May 2024. Invitations to participants were distributed via email, messaging apps, social media platforms, and online survey-sharing groups. To guarantee continuous data collection, these invitations were sent out every two days. Additionally, it also required sending a second and third follow-up emails to reinforce invitation to take part in the study, and to reduce non-respondents.

The minimum sample size needed was defined prior to the survey invitation distribution. According to (Cohen, 1992), for a significance level of 5% and a minimum R^2 value of 0.10, the recommended sample size should be 157 answers, when the maximum number of arrows pointing at a construct is six, which is the case of the current research model being analyzed.

At the end, a total of 179 responses were collected from which 178 were considered valid / complete answers, above the minimum size needed. Of this sample, 57% of respondents were women and 41% men. The majority of respondents, almost half of them, were in the age group of 22 to 25 years old, with 48% of total answers, followed by respondents of age group of 26 to 30 years old with 23%. Regarding education, most respondents had higher education levels, with the greater part having a bachelor's degree, which accounted for approximately 42% of the data. Detailed information of demographic data of respondents is available in Appendix C.

The common method bias was examined using two different methods. Firstly, it was analyzed by using Harman's single factor test to check if the variance extracted was less than 50% (Podsakoff et al., 2003). This test was performed using the statistical software SPSS, and the sample data met the requirements as the maximum variance extracted was 40,579%, ensuring that no single factor explained more than 50% of the variance. Secondly, common method bias was examined by using the random dependent variable test proposed by Hair et al. (2017) and Kock and Lynn (2012). This test was performed in SmartPLS 4.0 software (Ringle et al., 2022) allowing us to assess the nonexistence of collinearity, which was verified by ensuring the Variance Inflation Factor (VIF) was below 5, meeting the method criteria. The results of these two methods indicated that there is no common method bias present in the data, allowing us to proceed with our analysis.

5. RESULTS

5.1. QUALITATIVE RESEARCH RESULTS

Factors Influencing Students' Academic Performance

Regarding factors that influence academic performance, responses were diverse but shared some common perspectives. Two of the interviewed teachers emphasized overall motivation and engagement, which they found to be highly correlated with involvement and interest in the course. Interviewee 3 mentioned “well-defined career goals” as leverage for persistence and better academic performance, saying, “the students who are most successful in this (master thesis) are those who are pursuing a theme that means something to them (...)”. Interviewee 2 also noted additional factors not mentioned by the other interviewed, such as attendance at lessons, the health and well-being of the student, as well as the students’ academic track record. Overall, the three interviewees highlighted the importance of study’ methods, and hard-working mindsets as relevant factors. Interviewee 1 added that students who engage in group environments as part of their study methods usually perform better, further noting that he encourages his students to do group work to foster collaborative learning.

Perceived Role of ChatGPT and similar AI tools in Influencing Academic Performance

A common trend in the interviewees' answers was the contrasting opinions each one had on the role that ChatGPT and similar AI tools have in academic performance, with all of them noting both positive and negative aspects. All interviewees highlighted ChatGPT as a useful tool for answering technical and practical questions, stating that it can be a leverage tool when used in a responsible and ethical way. Interviewee 2 gave as an example the multiple advantages obtained with the tool in classes that involve writing code. Contrasting with these positive views, all interviewees noted a lack of criticism on the student’s side regarding to ChatGPT’s answers. They state that the influence of ChatGPT on academic performance can be negative if the tool is used without a sense of learning and critical thinking, only to get the job done. Interviewee 3 stated that “(...) when the student, without knowing anything about the subject, asks ChatGPT to write a text about a certain topic, then disaster is normally predicted. The student must have the knowledge to be able to use ChatGPT responsibly (...)”. Additionally, Interviewee 1 identified the gap between students who use the technology without criticism and teachers who are not aware of the technology or simply don’t want to use it, saying that “if teachers aren't technologically inclined enough to use technology in the classroom and students only want to use technology to solve their own problems, it's probably not going to work.”

Integration of ChatGPT in Learning Processes of Students

Interviewees shared varied observations regarding the integration of ChatGPT in learning processes. Overall, they mentioned how they notice that students use ChatGPT to solve practical problems, improve text, summarize content and produce code. They reinforced the idea that the way students have been integrating ChatGPT into their learning processes may not be the most effective for actual learning, especially when used without a critical mindset. Interviewee 1 mentioned that versions of ChatGPT have evolved quickly, as well as the metadata and sources behind it. Due to this rapid growth, a lot of incorrect and even fictitious information is being created by ChatGPT. This underscores the importance of using the tool critically, as this rapid growth influence on education hasn't yet been fully explored.

Interviewee 2 noted that students integrate ChatGPT into their learning process not only to aid in repetitive and complex tasks but also to interpret the logic behind them which results in "(...) students lose all sense of interpretation and analysis." Interviewee 3 also highlighted the lack of interpretation from students who now see ChatGPT as an author and treat it as such, stating that "The misuse has to do with those people who use ChatGPT as if it were an author, because ChatGPT is not an author. ChatGPT doesn't have critical thinking. ChatGPT is a good text predictor that predicts the most likely next word, but it doesn't have critical analysis." Overall, they reinforced how ChatGPT is useful in helping with practical tasks but pointed out that students are using the technology to a point where they are losing their sense of criticism.

Factors Influencing Behavioral Intention to Use AI Tools

Interviewees presented diverse factors influencing the behavioral intention to use AI Tools like ChatGPT. They all agreed that time is a very important factor, leading students to use the tool in two ways: saving time on studying and getting answers fast. Interviewee 1 goes further to say that the desire for quick answers, combined with the perception that academic tasks require too much time and effort, motivates students to use ChatGPT. Interviewee 3 reinforced how the perception of saving study time leads students and emphasized that some sources from ChatGPT are incorrect, so students must always be critical when analyzing ChatGPT's quick answers, stating, "Technology is neither good nor bad, it's what we make of it". Interviewee 2 noted additional important factors for the behavioral intention of students to use the technology, such as ease of use, perceived usefulness, low risk and tool's open access. In conclusion, all interviewees agree that the behavioral intention to use AI tools like ChatGPT should not surpass the sense of criticism.

5.2. QUANTITATIVE RESEARCH RESULTS

Structural equation modeling (SEM) is a well-known statistical technique commonly used in research to test and validate models by analyzing the relationships between observed and

latent variables (Ringle et al., 2022). There are two main SEM techniques: covariance-based techniques and variance-based techniques. Our theoretical model was tested using a variance-based technique, namely Partial Least Squares (PLS). PLS technique is considered suitable for this study because it is a powerful statistical technique (Henseler et al.,2009), suitable for studying complex models with numerous constructs and non-normal data distributions (Ringle et al., 2022). The analysis of PLS was conducted using the two-step approach proposed by (Anderson et al., 1988), where first the model estimation evaluation was performed, followed by the assessment of the full structural model. This sequential process allows for the identification and correction of issues within the measurement model before integrating it into the structural model, resulting in more accurate results. Smart PLS 4.0 was the software chosen to estimate the research model (Ringle et al., 2022).

5.2.1. Measurement Model

The adequacy of the model was evaluated through well-defined statistical steps, which involved the analysis of the items' reliability, internal consistency, convergency validity, and the discriminant validity of the measurement model. The steps taken are described as follow.

The first step was to evaluate item reliability which according to Hair et al. (2017), exists if item loadings are higher than 0.7. This criterion was met and is documented in Table 1. Next, it was assessed that all constructs have composite reliability and Cronbach's alpha above threshold 0.7, which proves that there is Internal consistency (Hair et al., 2017), as can be seen also in Table 1. Afterwards Convergent Validity was evaluated by ensuring that the average variance extracted (AVE) for each construct was greater than 0.50, which according to Fornell and Larcker (1981), confirms convergent validity. Table 1 provides a summary of the item reliability, internal consistency, and convergent validity metrics, demonstrating that the model meets the necessary evaluation criteria.

Table 1 - Quality Criterion (AVE, Cronbach's alpha, Composite Reliability) and Factor Loadings

Construct	Item	AVE	Cronbach's Alpha	Composite reliability	Loadings
Interpersonal Adaptability (AI)	AI1	0.733	0.879	0.887	0.827
	AI2				0.857
	AI3				0.888
	AI4				0.851
Behavioral Intention to use AI Tools (BI)	BI2	0.894	0.882	0.882	0.947
	BI4				0.944
Creativity (CR)	CR1	0.578	0.757	0.759	0.758
	CR2				0.731
	CR3				0.782
	CR4				0.768
Training Effort (EA)	EA1	0.776	0.905	0.929	0.871
	EA2				0.912
	EA3				0.891
	EA4				0.848

Construct	Item	AVE	Cronbach's Alpha	Composite reliability	Loadings
Reactivity in the face of emergencies or unexpected circumstances (GI)	GI1	0.703	0.862	0.916	0.816
	GI2				0.895
	GI3				0.875
	GI4				0.761
Handling work stress (GS)	GS1	0.649	0.746	0.799	0.817
	GS2				0.750
	GS3				0.850
Perceived Enjoyment (PEN)	PEN1	0.850	0.941	0.944	0.902
	PEN2				0.919
	PEN3				0.931
	PEN4				0.938
Perceived Ease of Use (PEU)	PEU1	0.788	0.946	0.949	0.846
	PEU2				0.888
	PEU3				0.924
	PEU4				0.868
	PEU5				0.881
	PEU6				0.918
Perceived Usefulness (PU)	PU1	0.775	0.942	0.948	0.836
	PU2				0.870
	PU3				0.909
	PU4				0.915
	PU5				0.840
	PU6				0.906
Students' Academic Performance (SAP)	SAP1	0.894	0.941	0.941	0.950
	SAP4				0.949
	SAP5				0.937

Lastly discriminant validity was evaluated through three measures: the cross-loadings criterion, the Fornell-Larcker criterion and the heterotrait-monotratit (HTMT) ratio of correlations. Firstly, the cross-loadings criterion was assessed to confirm that the loading of each indicator was higher than all its cross-loadings (Götz et al., 2009). The results, provided in Appendix D, show that all loadings are greater than their respective cross-loadings. Secondly the Fornell-Larcker criterion was applied, which was for square root of AVE to be greater than the correlations between the constructs (Fornell and Larcker, 1981). As seen in Table 2, all diagonal values representing the square root of AVE are greater than the off-diagonal values representing correlations between the constructs. Finally, the HTMT ratio of correlations was evaluated to ensure it was below the threshold of 0.90, as recommended by Henseler et al. (2015). This criterion was also met and with all three criteria satisfied, discriminant validity was evaluated.

Table 2 - Fornell-Lacker measure: Matrix of correlation constructs with the square root of AVE (in bold)

Constructs	AI	BI	CR	EA	GI	GS	PEN	PEU	PU	SAP
Interpersonal Adaptability (AI)	**0.857**									
Behavioral Intention to use AI Tools (BI)	0.139	**0.943**								
Creativity (CR)	0.471	0.329	**0.760**							

Constructs	AI	BI	CR	EA	GI	GS	PEN	PEU	PU	SAP
Training Effort (EA)	0.480	0.306	0.550	**0.881**						
Reactivity in the face of emergencies or unexpected circumstances (GI)	0.403	0.244	0.611	0.473	**0.838**					
Handling work stress (GS)	0.486	0.308	0.594	0.533	0.586	**0.804**				
Perceived Enjoyment (PEN)	0.220	0.756	0.385	0.311	0.331	0.366	**0.922**			
Perceived Ease of Use (PEU)	0.244	0.664	0.334	0.280	0.208	0.339	0.628	**0.888**		
Perceived Usefulness (PU)	0.271	0.746	0.350	0.228	0.276	0.347	0.719	0.677	**0.880**	
Students' Academic Performance (SAP)	0.154	0.794	0.342	0.294	0.176	0.258	0.700	0.622	0.718	**0.943**

The measurement model results demonstrate that the construct reliability, indicator reliability, convergent validity, and discriminant validity are all satisfactory. Therefore, the constructs are suitable for testing the structural model.

5.2.2. Structural Model

To evaluate the structural model, collinearity was further tested by verifying that the variance inflation factor (VIF) was below 5 for all items (Hair et al., 2017). Initially, items BI3 and SAP3 were removed as they had higher VIF values, exceeding 5. Afterward, collinearity was tested again, and two more items, BI1 and SAP2, had to be removed for the same reason. Collinearity was tested a third time, with all VIFs obtained being lower than 5, as seen in Appendix E.

In the next step the structural model and the hypothesis were evaluated based on the examination of standardized paths. The path significance levels were estimated through using the bootstrapping resampling method with 5,000 resamples. The results are represented in Figure 2.

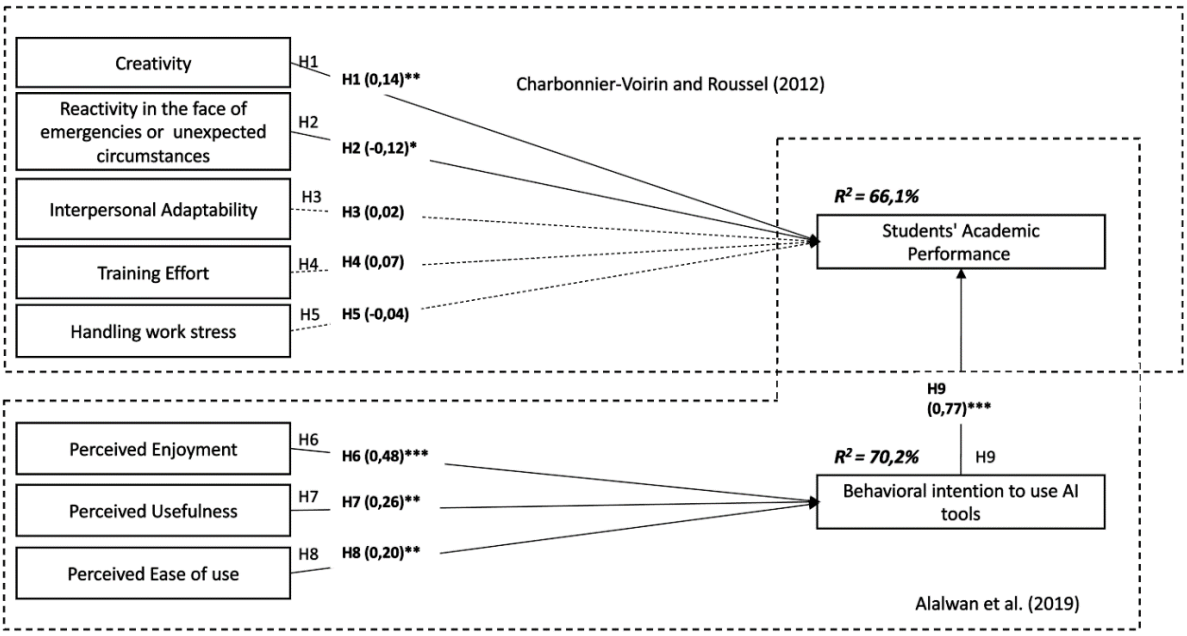

Figure 2 - Structural Model Results

The model explains 66.1% of Students' Academic Performance and 70.2% of Behavioral intention to use AI tools. Out of nine hypotheses considered, six were statistically significant, as demonstrated in results' summary in Table 3. The relationships between creativity ($\hat{\beta}$ = 0.143; p<0.05), reactivity in the face of emergencies or unexpected circumstances ($\hat{\beta}$ = -0.115; p<0.10), and behavioral Intention to use AI tools ($\hat{\beta}$ = 0.769; p<0.01) towards explaining students' academic performance were found to be statistically significant, confirming respectively the hypotheses H1, H2, and H9. The relationships between interpersonal adaptability ($\hat{\beta}$ = 0.020; p>0.10), training effort ($\hat{\beta}$ = 0.067; p>0.10), and handling work stress ($\hat{\beta}$ = -0.036 p>0.10) towards explaining students' academic performance were found to be not statistically significant leading to hypotheses H3, H4 and H5 not being proven. Regarding behavioral intention to use AI tools, all the relationships from the three constructs were found to be statistically significant in explaining it. Perceived enjoyment ($\hat{\beta}$ = 0.476; p<0.01), perceived usefulness ($\hat{\beta}$ = 0.261; p<0.05), and perceived ease of use ($\hat{\beta}$ = 0.199; p<0.05) were found to be statistically significant in explaining behavioral intention to use AI tools, confirming respective hypothesis H6, H7 and H8.

Table 3 – Results's summary

Hypotheses		**Original sample (O)**	**Sample mean (M)**	**Standard deviation (STDEV)**	**T statistics (|O/STDEV|)**	**P values**	**Hypotheses statistically supported**
H1	CR -> SAP	0.143	0.139	0.073	1.965	0.049	Supported
H2	GI -> SAP	-0.115	-0.103	0.066	1.747	0.081	Supported
H3	AI -> SAP	0.020	0.029	0.050	0.406	0.685	Not Supported
H4	EA -> SAP	0.067	0.065	0.061	1.098	0.272	Not Supported
H5	GS -> SAP	-0.035	-0.036	0.068	0.511	0.609	Not Supported
H6	PEN -> BI	0.476	0.487	0.104	4.583	0.000	Supported
H7	PU -> BI	0.261	0.249	0.120	2.179	0.029	Supported
H8	PEU -> BI	0.199	0.199	0.085	2.329	0.020	Supported
H9	BI -> SAP	0.769	0.768	0.044	17.423	0.000	Supported

Legend:
AI = Interpersonal Adaptability;
BI = Behavioral Intention to use AI Tools;
CR = Creativity;
EA = Training Effort;
GI = Reactivity in the face of emergencies or unexpected circumstances;
GS = Handling work stress;
PEN = Perceived Enjoyment;
PEU = Perceived Ease of Use;
PU = Perceived Usefulness;
SAP = Students' Academic Performance

6. DISCUSSION

As GenAI technology is still in its early stages of development and is relatively new, its influence on students' academic performance has not yet been fully investigated and understood in previous studies. To fill this research gap, this study uses a unique and innovative research model that combines two different models to evaluate performance, adapted to the context of this study, namely Charbonnier-Voirin & Roussel's (2012) model and Alalwan's et al. (2019) model. The work main findings are presented as follow.

Model Explanatory Power

The R^2 values obtained indicate that the model has strong explanatory power. For the behavioral intention to use AI tools, 70.2% of the variance is explained by the model, and for the construct of students' academic performance, 66.1%. This suggests that the combination of both models is effective in providing a robust explanation of students' academic performance. For behavioral intention to use AI tools, the current model's explanatory power is consistent with the limited existing literature. For instance, Strzelecki's (2023) model explained 73.4% of the behavioral Intention to use ChatGPT in higher education, which is comparable to the current study's findings. In terms of students' academic performance, the current model performs significantly better than other studies with different research models, which explained almost 50% less variance in academic performance (Hadi & Muhammad, 2019).

Creativity

The findings reveal that creativity positively influence students' academic performance (H1), consistent with earlier literature that shows that creative thinking has a positive influence on academic achievement (Huang et al., 2017; Yang & Zhao, 2021). This implies that, as predicted, creativity—the ability to come up with new solutions and ideas to solve challenges in educational settings—is an important skill in measuring academic performance, just as it is in measuring adaptive performance in organizations (Charbonnier-Voirin & Roussel, 2012).

Reactivity in the face of emergencies or unexpected circumstances

The findings revealed that reactivity in the face of emergencies or unexpected circumstances helps explaining students' academic performance. However, a negative sign was obtained, contrary to what was expected and hypothesized (H2). When adapting Charbonnier-Voirin & Roussel's (2012) model to the academic context, it becomes apparent that this construct does not positively impact academic performance, as it does adaptive performance in the original model. This implies that although students can adapt to new unexpected situations, academic performance is inevitably going to be reduced due to the disruption of their planning and study time.

Perceived Enjoyment

Regarding the adapted constructs from Alalwan's et al. (2019) model, the findings reveal that perceived enjoyment influences the behavioral intention to use AI tools (H6), aligned with previous research by Teo & Noyes (2011). This implies that the extent to which students believe that using ChatGPT or similar AI tools will enhance their learning performance through an enjoyable experience positively impacts their intention to use these tools.

Perceived Usefulness

Similarly, perceived usefulness also positively explains behavioral intention to use AI tools (H7), consistent with some existing literature (Na et al., 2023; Y. Wang et al., 2021). The results of the current study confirm that students' perception of AI tools as useful, is a significant factor in their behavioral intention to use them. The significance of both perceived enjoyment and perceived usefulness in influencing behavioral intention to use AI tools can be attributed to their strong importance in forming a positive attitude towards using ChatGPT, which is itself a significant predictor of the intention to use the technology, as evidenced by Dahri et al. (2024).

Perceived Ease of use

Perceived ease of use explains behavioral intention to use AI tools (H8). This finding supports the hypothesis that the perceived ease of using AI tools positively influences the intention to use them, aligning with findings of Wu et al. (2024).However, recent findings by (Y. Wang et al., 2021) suggest the contrary, indicating a need for further research to determine whether the perceived ease of use indeed translates into the actual behavioral intention to use AI tools in educational contexts.

Behavioral Intention and Academic Performance

Within our work we also assessed the relationship between behavioral intention to use AI tools and students' academic performance. The findings reveal that, as hypothesized, behavior intention to use AI tools positively influences students' academic performance (H9), consistent with some literature (Masa'deh et al., 2022). This fact also confirms that TAM constructs provide valuable insights into understanding behavioral intention to use technology in educational settings and its positive impact on academic performance in higher education (Alalwan et al., 2019).

Qualitative Findings

In addition to the quantitative findings, this study conducted qualitative research to complement the quantitative analysis. The qualitative results suggested similar views on factors that influence students' academic performance, on the role and integration of AI tools in learning processes, and on what motivates students to use this technology. All interviewed shared similar views and noted particularities that provide broader context and deeper understanding to the quantitative results and existing literature. This mixed-methods

approach enhances the comprehensiveness of the research, offering a well-rounded perspective on the use of AI tools in education.

There are notable areas of convergence between the qualitative and quantitative findings, particularly regarding the factors influencing the behavioral intention to use AI tools like ChatGPT. Perceived usefulness emerged as a significant factor in the interviews, mirroring the quantitative analysis that highlighted its statistical significance in explaining behavioral intention to use AI tools. Interviewed experts provided deeper insights, explaining that this perception is often driven by the need for fast results, and by the minimal risk, easy access, and utilization of GenAI tools like ChatGPT. One area of divergence was regarding collaborative learning and group work. One interviewee highlighted collaborative learning as a crucial factor influencing academic performance, aligning with existing literature (Al-Rahmi & Shamsuddin, 2020; Wentzel et al., 2010) indicating that group dynamics significantly improve academic performance. However, the quantitative results show that the construct interpersonal adaptability, which evaluated the way students adapt and work in groups, was not statistically significant in explaining academic performance. This discrepancy highlights a unique aspect of our model that should be further investigated. Other than these, there were not many areas of convergence or divergence, as the focus of the qualitative assessment was not to confirm the quantitative results but to provide broader context and deeper explanations beyond the research model itself.

When discussing the factors that influence students' academic performance, all interviewees mentioned student's motivation, a well-documented factor in the literature (Agustina et al., 2021; Strzelecki, 2023; Wentzel & Wigfield, 1998). Teachers also highlighted both the positives and negatives aspects of AI tools integration in students' learning processes. They unanimously acknowledged that AI tools help deconstruct complex topics, assist in repetitive tasks, and free up time for actual learning. and aid in designing personalized study plans tailored to individual needs and learning pace (Al-Badi et al., 2022; Chaudhry et al., 2023; Qureshi, 2023; M. M. Rahman & Watanobe, 2023; Sajja et al., 2023). Challenges were also noted, but mainly they highlighted the current lack of critical analysis of results and the risk of incorrect outputs of AI tools (L. Chen et al., 2020; X. Chen et al., 2022; Latif et al., 2023; Van Der Vorst & Jelicic, 2019).

6.1. PRACTICAL AND THEORETICAL IMPLICATIONS

To understand the factors that influence academic performance in these changing times and what leads students to use these tools, a new and innovative research model was designed combining two models in literature that evaluate performance. The combined model uses synergistically Charbonnier-Voirin & Roussel's (2012) model, who provided five key factors significant in explaining adaptive performance, and the technology acceptance based constructs from Alalwan's et al. (2019) model to evaluate academic performance. For the

theory, we believe that this new model can be used as a foundation starting point for future research on performance across different sectors and technologies. Our results demonstrated strong explanatory power in predicting academic performance in higher education contexts. This model contributes significantly to existing literature, by introducing a unique model tailored to this changing field in an area that is rising in research. It applies Charbonnier's adaptive performance framework to academic contexts, examining whether the factors crucial for adaptive performance also explain academic achievement. Moreover, by integrating Alalwan's model, originally used for social media, into the study of AI technology, the research broadens the application of existing frameworks, thereby enhancing understanding across broader perspectives.

The current research provides significant practical implications across different education stakeholders, mainly teachers, students, and educational institutions. For teachers this study highlights how AI tools offer opportunities in enhancing personalization in teaching practices. For teachers, AI tools can aid teachers to provide tailored learning practices according to different students' needs, improving their engagement and outcomes. Additionally, these tools can help teachers be more efficient with handling administrative tasks. Moreover, this study supports the professional development of teachers seeking deeper knowledge in integrating AI technologies into their pedagogical approaches, in understanding how the technology is impacting academic performance. This study further emphasizes the transformative effect tools like ChatGPT have on educational approaches, enabling teachers to leverage these insights in their teaching practices. For students, the results of this study encourage the use of GenAI tools like ChatGPT in self-learning processes, as these tools are indicative of better academic performance. Broadly this study provides insights into how AI can enhance learning experiences with personalization of study learning approaches. By exploring opportunities and weaknesses of these tools and capturing perspectives from teachers, students gain a comprehensive understanding of how to effectively leverage AI tools to improve academic performance. Furthermore, the study helps institutions understand the importance of establishing ethical guidelines and best practices for AI tool usage. Insights from interviews emphasize the need for institutions to educate students about responsible AI use, including awareness of biases and potential errors, thereby fostering a culture of ethical AI adoption in education.

6.2. LIMITATIONS AND FUTURE RESEARCH

Sample Generalization

The generalizability of our findings should be made with caution, the qualitative data collected were based exclusively in information from one south European country' teachers, and the perspectives and outcomes may differ significantly across different countries. Additionally, the survey was primarily distributed through Portuguese channels, resulting in a lack of diversity

in the nationalities of student respondents. Future research should aim to validate our study in a broader, more diverse context, with different cultural backgrounds, and across different age groups.

Scope of Education level and Technology

Our study focused on higher education, future research could test our innovative theoretical model in different educational levels to check if same patterns persist. Additionally, the quantitative survey concentrated on students' perspectives regarding AI tools, specifically in GenAI technology. This focus didn't allow to fully capture the impacts of different AI technologies. Future research should test the theoretical model with a range of different AI tools based in different technologies, as the factors affecting adoption and students' performance can differ.

Academic Performance Evaluation

In this study subjective measures from the two combined models were used to evaluate the academic performance. However, other researchers use objective metrics such as exam scores and the grade point average (GPA) to measure this variable, due to fact that these are usually accepted as good measures of it (Al-Badi et al., 2022; Kumar, 2021; Tessema et al., 2014). Additionally, there are researchers who argue that performance evaluation should consider historical academic data and background of the student for a more comprehensive assessment (Win & Miller, 2005). Future research could integrate both subjective and objective metrics to evaluate academic performance. Further research should incorporate longitudinal studies to examine the long-term effects of AI tools on academic performance as well as his evolution. Although the impact of AI on academic performance topic is gaining research attention, the depth of theoretical grounding and comparative analysis is restricted by the relatively limited body of work. Specifically, research on the direct impact of behavioral intention to use AI tools on students' academic performance is limited, highlighting it as an important and much-needed area for future research.

Further Future Research

The quantitative results revealed several areas that need further investigation. Notably, the study identified a discrepancy with literature regarding the impact of perceived ease of use in behavioral intention to use AI tools. Another discrepancy with literature was regarding the effect of group work on academic performance, in the context of AI usage. As research on these relationships in the context of AIEd is still very recent, future research should incorporate these relationships to better sustain literature findings

By addressing these limitations and pursuing the suggested research directions, future studies can build a more comprehensive understanding of the effects of AI on academic performance and provide actionable insights for educational practitioners.

7. CONCLUSIONS

The impact of AI in education has significantly increased over the last years, leading to more effective and personalized academic experiences (Owoc et al., 2021). Research on how AI tools influence academic performance is essential for educational institutions and teachers. By understanding this impact, institutions will more easily define best practices for integrating these tools into curriculums, ultimately ensuring successful student outcomes. We have successfully explored the impact of AI tools, especially the ones using the most recent GenAI technology, on students' academic performance and their integration in students' self-learning processes. The study developed a new research model, combining two well-established models in literature. Through a mix-methods approach, we integrated qualitative analysis, gathering teachers' perspectives through structured open-ended interviews, with quantitative analysis through survey data collected, testing the newly constructed research model. The quantitative data was analyzed using PLS-SEM, demonstrating that the theoretical model has a strong explanatory power understanding behavioral intention to use AI tools and students' academic performance.

Key findings have emerged from this study. From a qualitative perspective, teachers unanimously acknowledged positive aspects of AI tools like ChatGPT and its usefulness, advocating for its integration into students learning processes, while also highlighting the risks associated, that students often overlook. From a quantitative perspective, the findings revealed that creativity and reactivity in the face of emergencies or unexpected circumstances influence students' academic performance. Additionally, perceived enjoyment, perceived usefulness, and perceived ease of use influence the behavioral intention to use AI tools, which is itself also significant in explaining students' academic performance. Overall, this mixed-methods approach helped meet the study's objectives by answering the research questions. The first research question (RQ1) was answered by the quantitative findings that highlighted the factors of the conceptual model, significant in explaining academic performance. The second research question (RQ2) was also addressed by quantitative findings, which indicated that students' perceptions indirectly influence academic performance. This influence is significant in measuring behavioral intention to use AI tools, which consequently positively impacts academic performance. The third research question (RQ3) was primarily explored through a literature review and qualitative assessment. Interview results revealed the benefits and challenges associated with integrating these tools into individual learning processes. These results contribute to the existing body of knowledge by filling the literature gap regarding how students currently interact with GenAI tools within the context of personalized learning, specifically when they are used to tailor students' individual study processes.

This study underscores the importance of AI in today's evolving GenAI context, and its impact on academic performance, offering insights that may inform teachers, students, and institutions. These insights are crucial to sustain the development of best practices for educational institutions on integrating AI into learning practices, with a particular focus on

personalized learning and self-learning strategies. As the field continues to evolve, increasing efforts should center on understanding on how to leverage the benefits and opportunities of AI tools to maximize students' academic performance, while ensuring an integration of AI in higher education that promotes responsible and effective use of these new tools.

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APPENDIX A – ITEMS AND CONSTRUCTS TABLE

Constructs	Items	Source
Creativity	CR1 - I do not hesitate to go against established ideas and propose an innovative solution for my academic tasks. CR2 - Within study or project groups, people rely on me to suggest new solutions. CR3 - I use a variety of sources/types of information to come up with an innovative solution to academic tasks. CR4 - I develop new tools and methods to resolve new academic tasks.	Charbonnier-Voirin & Roussel (2012)
Reactivity in the face of emergencies or unexpected circumstances	GI1 - I am able to achieve total focus on the academic tasks to act quickly. GI2 - I quickly decide on the actions to take to resolve academic tasks. GI3 - I analyze possible solutions and their ramifications quickly to select the most appropriate one for academic tasks. GI4 - I easily reorganize my work to adapt to new academic tasks' circumstances.	Charbonnier-Voirin & Roussel (2012)
Interpersonal Adaptability	AI1 - Developing good relationships with all my counterparts is an important factor for my effectiveness in academic tasks. AI2 - I try to understand the viewpoints of my counterparts to improve my interaction with them in academic contexts. AI3 - I learn new ways to do my academic tasks better in order to collaborate effectively with such people. AI4 - I willingly adapt my behavior whenever I need to in order to work well with others in academic contexts.	Charbonnier-Voirin & Roussel (2012)
Training Effort	EA1 - I undergo training on a regular basis at or outside of school/university to keep my competencies up to date. EA2 - I am on the lookout for the latest educational innovations to improve the way I work. EA3 - I look for every opportunity that enables me to improve my academic performance (training, group project, exchanges with classmates, etc.) . EA4 - I prepare for change by participating in every project or assignment that enables me to do so, in academic contexts.	Charbonnier-Voirin & Roussel (2012)
Handling work stress	GS1 - I keep my cool in situations where I am required to make many decisions in academic contexts. GS2 - I look for solutions by having a calm discussion with classmates. GS3 - My colleagues ask for my advice regularly when situations in academic contexts are difficult because of my self-control.	Charbonnier-Voirin & Roussel (2012)
Perceived Enjoyment	PEN1 - Academic tasks are more interesting with AI tools like ChatGPT. PEN2 - Using AI tools like ChatGPT is fun. PEN3 - I like using the AI tools like ChatGPT. PEN4 - I enjoy those aspects of my academic tasks/learning that require me to use AI tools like ChatGPT.	Teo and Noyes (2010)
Perceived Usefulness	PU1 - Using ChatGPT or similar AI tools in my academic tasks would enable me to accomplish tasks more quickly. PU2 - Using ChatGPT or similar AI tools would improve my performance in academic tasks.	Davis et al. (1989)

Constructs	Items	Source
	PU3 - Using ChatGPT or similar AI tools in my academic tasks would increase my productivity. PU4 - Using ChatGPT or similar AI tools would enhance my effectiveness on the academic tasks. PU5 - Using ChatGPT or similar AI tools would make it easier to do my academic tasks. PU6 - I would find ChatGPT or similar AI tools useful in my academic tasks.	
Perceived Ease of use	PEU1 - Learning to operate with ChatGPT or similar AI tools would be easy for me. PEU2 - I would find it easy to get ChatGPT or similar AI tools to do what I want it to do. PEU3 - My interaction with ChatGPT or similar AI tools would be clear and understandable. PEU4 - I would find ChatGPT or similar AI tools to be flexible to interact with. PEU - It would be easy for me to become skillful at using ChatGPT or similar AI tools. PEU6 - I would find ChatGPT and similar easy to use.	Davis et al. (1989)
Behavioral intention to use AI Tools	BI1 - I intend to use the ChatGPT or similar AI tools in academic tasks. BI2 - I like using the ChatGPT or similar AI tools in academic tasks. BI3 - I plan to continue to use ChatGPT or similar AI tools in academic tasks. BI4 - I will recommend my friends to use the ChatGPT or similar AI tools in academic tasks.	Habibi et al. (2023)
Students' Academic Performance	SAP 1 - ChatGPT or similar AI tools has improved my comprehension of the concepts studied. SAP 2 - ChatGPT or similar AI tools has led to a better learning experience in this module. SAP 3 - ChatGPT or similar AI tools have allowed me to better understand my studies. SAP 4 - ChatGPT or similar AI tools are helpful in my studies and make it easy to learn. SAP 5 - ChatGPT or similar AI tools improve my academic performance.	Alamri et al. (2020)

APPENDIX B - ETHICS COMITEE OF NOVA IMS APPROVAL

This is to certify that
Project No.: **OTHER2024-3-192117**
Project Title: **ChatGPT as a tool for Personalized Learning: Examining the Impact of ChatGPT on Academic performance in Personalized Learning contexts**
Principal Researcher: **Joana Margarida Antunes Bezerra**

according to the regulations of the Ethics Committee of NOVA IMS and MagIC Research Center this project was considered to meet the requirements of the NOVA IMS Internal Review Board, being considered **APPROVED** on 3/19/2024.

It is the Principal Researcher's responsibility to ensure that all researchers and stakeholders associated with this project are aware of the conditions of approval and which documents have been approved.

The Principal Researcher is required to notify the Ethics Committee, via amendment or progress report, of
- Any significant change to the project and the reason for that change;
- Any unforeseen events or unexpected developments that merit notification;
- The inability of the Principal Researcher to continue in that role or any other change in research personnel involved in the project.

Lisbon, 3/19/2024

NOVA IMS Ethics Committee
ethicscommittee@novaims.unl.pt

APPENDIX C – DEMOGRAPHIC DATA

Characteristics		Frequency	Sample data
Gender	Female	102	57.3%
	Male	73	41.0%
	Don't know/ Prefer not to say	3	1.7%
Age	18-21	29	16.3%
	22-25	86	48.3%
	26-30	41	23.0%
	>31	20	11.2%
	Don't know/ Prefer not to say	2	1.1%
Education	High School	27	15.2%
	Bachelor	74	41.6%
	Postgraduate	19	10.7%
	Master	50	28.1%
	Doctorate	3	1.7%
	Don't know/ Prefer not to say	5	2.8%

APPENDIX D – CROSS-LOADINGS

Constructs	AI	BI	CR	EA	GI	GS	PEN	PEU	PU	SAP
AI1	**0.824**	0.157	0.366	0.323	0.264	0.358	0.120	0.183	0.213	0.143
AI2	**0.861**	0.147	0.431	0.392	0.337	0.410	0.234	0.274	0.298	0.122
AI3	**0.890**	0.063	0.422	0.476	0.369	0.453	0.212	0.227	0.209	0.144
AI4	**0.849**	0.111	0.397	0.461	0.430	0.452	0.196	0.148	0.214	0.110
BI1	0.156	**0.947**	0.308	0.305	0.217	0.278	0.658	0.605	0.696	0.712
BI2	0.144	**0.932**	0.339	0.274	0.271	0.303	0.768	0.654	0.738	0.757
BI3	0.089	**0.962**	0.312	0.305	0.254	0.304	0.697	0.621	0.722	0.749
BI4	0.135	**0.929**	0.281	0.272	0.175	0.277	0.722	0.620	0.656	0.773
CR1	0.323	0.289	**0.754**	0.482	0.518	0.506	0.319	0.204	0.249	0.240
CR2	0.435	0.276	**0.728**	0.343	0.445	0.535	0.312	0.249	0.302	0.246
CR3	0.410	0.222	**0.787**	0.438	0.475	0.468	0.323	0.312	0.287	0.259
CR4	0.276	0.222	**0.769**	0.412	0.429	0.321	0.227	0.248	0.232	0.290
EA1	0.346	0.316	0.423	**0.871**	0.387	0.426	0.278	0.277	0.244	0.320
EA2	0.396	0.249	0.537	**0.911**	0.423	0.476	0.243	0.204	0.163	0.251
EA3	0.501	0.240	0.488	**0.890**	0.418	0.511	0.285	0.244	0.200	0.226
EA4	0.488	0.257	0.511	**0.849**	0.454	0.485	0.290	0.255	0.179	0.208
GI1	0.352	0.158	0.501	0.417	**0.808**	0.470	0.260	0.096	0.108	0.090
GI2	0.309	0.216	0.481	0.375	**0.897**	0.534	0.278	0.142	0.219	0.178
GI3	0.357	0.276	0.549	0.415	**0.875**	0.486	0.353	0.249	0.348	0.177
GI4	0.368	0.117	0.551	0.415	**0.765**	0.481	0.184	0.186	0.181	0.105
GS1	0.363	0.270	0.444	0.443	0.487	**0.808**	0.242	0.248	0.256	0.195
GS2	0.466	0.139	0.359	0.289	0.364	**0.742**	0.222	0.283	0.248	0.113
GS3	0.394	0.287	0.570	0.494	0.523	**0.857**	0.374	0.296	0.319	0.265
PEN1	0.212	0.687	0.370	0.303	0.301	0.346	**0.903**	0.483	0.652	0.634
PEN2	0.168	0.639	0.334	0.259	0.324	0.343	**0.918**	0.578	0.630	0.596
PEN3	0.217	0.742	0.359	0.267	0.304	0.347	**0.931**	0.635	0.728	0.692
PEN4	0.211	0.712	0.355	0.315	0.293	0.314	**0.936**	0.614	0.637	0.654
PEU1	0.182	0.522	0.267	0.178	0.142	0.295	0.448	**0.845**	0.524	0.462
PEU2	0.216	0.636	0.250	0.289	0.160	0.251	0.571	**0.889**	0.653	0.620
PEU3	0.188	0.616	0.320	0.249	0.214	0.342	0.626	**0.924**	0.607	0.557
PEU4	0.181	0.551	0.254	0.143	0.14	0.281	0.474	**0.868**	0.586	0.526
PEU5	0.260	0.600	0.336	0.310	0.209	0.314	0.598	**0.880**	0.603	0.559
PEU6	0.268	0.601	0.351	0.305	0.237	0.323	0.606	**0.918**	0.625	0.576
PU1	0.190	0.622	0.228	0.105	0.204	0.281	0.666	0.565	**0.835**	0.581
PU2	0.216	0.683	0.326	0.277	0.261	0.296	0.632	0.566	**0.871**	0.704
PU3	0.239	0.732	0.327	0.243	0.235	0.288	0.681	0.643	**0.910**	0.645
PU4	0.219	0.663	0.299	0.161	0.287	0.305	0.645	0.621	**0.915**	0.641
PU5	0.301	0.505	0.273	0.144	0.203	0.307	0.460	0.531	**0.839**	0.501
PU6	0.281	0.696	0.382	0.245	0.259	0.357	0.677	0.635	**0.906**	0.689
SAP1	0.140	0.761	0.322	0.292	0.171	0.250	0.666	0.597	0.663	**0.949**
SAP2	0.134	0.775	0.319	0.253	0.170	0.231	0.682	0.574	0.673	**0.950**
SAP3	0.106	0.723	0.296	0.266	0.162	0.235	0.641	0.575	0.654	**0.954**
SAP4	0.167	0.729	0.327	0.264	0.161	0.234	0.652	0.591	0.691	**0.946**
SAP5	0.176	0.754	0.349	0.309	0.164	0.267	0.656	0.596	0.704	**0.916**

APPENDIX E – COLLINEARITY STATISTICS (VIF)

Collinearity statistics (VIF)

Items	VIF	Items	VIF
AI1	1.790	**GS3**	1.329
AI2	2.384	**PEN1**	3.205
AI3	2.705	**PEN2**	3.879
AI4	2.366	**PEN3**	4.215
BI2	2.640	**PEN4**	4.512
BI4	2.640	**PEU1**	2.703
CR1	1.515	**PEU2**	3.494
CR2	1.431	**PEU3**	4.822
CR3	1.576	**PEU4**	3.177
CR4	1.457	**PEU5**	3.670
EA1	2.187	**PEU6**	4.948
EA2	3.400	**PU1**	2.465
EA3	3.445	**PU2**	3.155
EA4	2.674	**PU3**	4.398
GI1	2.192	**PU4**	4.485
GI2	2.533	**PU5**	2.975
GI3	2.066	**PU6**	3.969
GI4	1.732	**SAP1**	4.681
GS1	1.642	**SAP4**	4.755
GS2	1.657	**SAP5**	3.806

APPENDIX F - TRANSCRIPT OF INTERVIEWS

Interviewee 1: Male, University Professor

Interviewee 2: Female, University Professor

Interviewee 3: Female, University Professor.

Transcript of answers:

From your experience as a teacher, what do you consider to be the key factors that influence students' academic performance?

Interviewee 1:

“Okay, students have to have a vision of the field they're going to work in when they choose a course. I didn't really have experience in the field, but I had an idea, and I was motivated to study the subject. So, I think the fact that you want to study a particular subject is an important factor. Then whether you succeed or continue depends a lot on how you are used to working, for example whether you have a study method or not. For example, I liked to take notes and then discuss them with other colleagues. If it was a quantitative subject like analysis, where we always have a series of classes at the beginning of the course, I found it important to do exercises together because it really helped to clear up any doubts in order to progress in the exercises. So, motivation, the study methods that students may or may not have, some soft skills that each of us has, like the perception that you need to have some resilience, some discipline in the course, we don't all have them and sometimes in a slightly unconscious way. It's not that people are less mature, that they can't perform on the course, but maybe later on they realize that it's important to have that discipline and so on. And sometimes they get to the middle of the course, and they already have an introductory course. And finally, I would say, also from my experience, because I involve students very well in group work, I would say that group involvement is also an important characteristic. I usually give students the opportunity to choose their own classmates to form the group after a class or two, if I think there's a need to work in a group and there are people who are not in a group. I place people more or less efficiently. And sometimes it doesn't go so well. The first year is the hardest. You wouldn't do it that way anywhere else, and you have to experiment. As a student myself, I had a group my first year that never happened again. Then it happened the second semester. In the first year there was a different group and in the first semester of the second year it changed a little bit and that was the one that lasted until the end. We also had a five-year degree. No, you only have 3. "

Interviewee 2:

“So, the most important factors that influence student performance are attendance at lessons, so their presence, study at home, work at home. There's also a very important part,

which is health, in other words well-being. The state of the student also has a lot of influence, sometimes even mental health, I'd say. I'm not talking about data here, but the student's history, so a student who was good in the past will tend to be good in the present. So, the student's record in other subjects also undoubtedly influences their performance. Above all, the most important factors, yes, I would like to see attendance, hours of study and, above all, motivation, commitment to the subject, enjoyment too, if the student also likes what is being taught and the teacher. So, two points: liking the topic and liking the teacher also have a lot of influence on the student's perception and performance. And on a not so direct level, but one that can have an impact, whether you live near the college or not, because this also influences other aspects. If you're someone who lives close by, who has to commute constantly, that also seems quite relevant, even in the student's day-to-day routines. Thinking about more factors, I think those would be the main ones".

Interviewee 3:

"The factors that I'm sure influence students' academic performance, and we're talking here about a student's success at the end of a course, are factors that have to do with how the student views their long-term goals. In other words, if the student has well-defined long-term career goals, this is a determining factor and a critical success factor for the student's performance in any course. On the other hand, another factor has to do with the consistency of objectives. So, it's not enough to have objectives, you have to be consistent. In other words, the student wants to finish a course or take a course, but they have to want to continue, which is called persistence, stamina or grit. So, it's about having long-term goals and persisting with them. Another critical success factor for good student performance is that the topics and subject matter are of an incremental level of difficulty. It's important that the student is hard-working enough to think: ""I've found a problem here. I'm going to try to find a way of solving it and clarifying the problem, and the formula could be studying more, reading more, going to a group of friends, going to a teacher's office hour, going to clarify this doubt with a support group at the university"". So, it's important that when students encounter problems, because it's normal, because the learning process is not an easy process, that they seek this out, that they have the ability to seek satisfaction from their questions. So be a worker.

And then there's another issue, which is having a good relationship with what you're learning, with the subject you're learning. I see that students, in the example of a student doing a thesis, the students who are most successful in theses are those who are pursuing a theme that means something to them or that they know they will eventually need to apply in a certain context, so the theme itself, the topic. They have to find some level of usefulness in what they are learning. However, there are certain subjects that are extremely abstract and that they can't understand the degree of usefulness because they're not yet mature enough to do so. And then they have to be really persistent, thinking: ""ok, I have this subject that's on the course, it makes sense, it has to be related to the course, even though I'm not seeing the immediate usefulness at the moment"", because we don't just study for tomorrow, we study

for the day after tomorrow and I think that's important. These are critical success factors for student performance. So having goals, being consistent, being hard-working, not giving up, being persistent in your studies, looking for ways to solve problems and, ultimately, trying to find the reason why, why it could be useful in your future".

How do you perceive the role of ChatGPT and similar AI tools in influencing individual academic performance?

Interviewee 1:

"I think any technology that can be used in the classroom or even for self-study is extremely important. I think we should encourage students to use it and then discuss how they used it and what they got out of it. And that's where I think there can be a gap. For example, if teachers aren't technologically inclined enough to use technology in the classroom and students only want to use technology to solve their own problems, it's probably not going to work. If there's a willingness on both sides, even if there's no expertise in the tool on either side, that's very important. The technology facilitates, I'm going to say computing, the use of data, the handling that we've done, which frees up the teacher for the actual EXPLANATION of the content to the student, and the student, because they have the supporting technology to solve some of the more technical issues, can focus more on what the content means and what they can do with that content. So, it's important for that to happen".

Interviewee 2:

"So, it has both positive and less positive aspects. I'd say there are two aspects. I notice that students use ChatGPT a lot to solve some exercises, for example even to write code in a very direct way, in class. It's not as if they're hiding, it's solving: they go to ChatGPT, write and learn. But I even see this as a positive factor because, for example, depending on the topic, writing code, it's normal for a person not to know everything and it's a method of learning for the future. So, using technology to give some answers to practical exercises, even for me I see it as a positive point. A more negative point is when it's used without any sense of learning, especially in a written format, for example, being asked to write an introduction. So. it depends on how the students see it. I see ChatGPT positively as a learning tool because it shows answers and can help with problem-solving and future learning. Negatively, depending on how they see it in the sense that they're just asking to get answers, not having any interest in learning from what it says and just getting something done and not even understanding or reading what's been given. So, it has these two aspects, and the students often don't respond in class when they're doing exercises. There's no prohibition on using the tool, obviously, but I find it funny that they use this tool a lot, which I wasn't aware of, which was already used a lot. Maybe I'm just old or something, because it was never a tool that I would have thought of using in the classroom and they use it a lot. I'd say it has two sides, one side of learning, which is good, and the other side of just showing what's been done without understanding, a negative part."

Interviewee 3:

“I realize that using ChatGPT responsibly has a great influence on individual student performance. But it has to be a responsible and critical use of this Generative AI tool. If the student uses this tool responsibly, ethically, for whatever topic, I realize that this has a huge leverage effect on time and improvement. If we're talking about ChatGPT, we're talking about text, improving the production of text that the student has written beforehand, because it's perfectly possible to improve beforehand. However, when the student starts from knowing nothing and asks the PT chat to write a text on a certain topic, then disaster is predicted, i.e. the student has to have the knowledge to be able to use the GPT chat responsibly, but it has a huge leverage effect in terms of time”.

In your experience working with students, how have they integrated ChatGPT and similar AI tools in their learning processes?

Interviewee 1:

“I think you're all using ChatGPT, and as I said in the previous question, rightly so, because ChatGPT ends up getting answers faster, which can and do support learning with the continuous presentation of content, for example in a text, in an assignment, etc. I think there's little criticism of what the ChatGPT is for. The various versions of the GPT chat have evolved rather quickly, which means that there hasn't been time to thoroughly explore each version. As the amount of functionality or data accessible by the version increases, the ChatGPT's responses may also vary. Therefore, if there is no criticism, if we don't pay attention criticism of the result, only copy-paste, insert things this way and that, which has happened in some thesis and in some works that we have seen, I would say that the algorithms that ChatGPT uses to search for information sometimes mix the information and then the result is not completely true. There are questions that should be explored a little bit to see if this information is really fictitious, if this information is really valuable. So, I always tell students to make sure they understand the versions they're using, what they need to uncover in order to understand. As the version increases, there may be more metadata used, so there are more sources, and that may improve the answer in the end, yes, but it also creates more correlations between the different sources, and there may be information that is not the most correct, and it's important that that happens. In other words, our brain also has so many synapses and does so many things, and it has a huge advantage, which is this question of emotion, of us knowing and having perceptions. A chatbot doesn't have that, we can program it to have that, but it doesn't. We look at scientific physiology films. Yes, we're already talking about a level, it's like that's already a very high level”.

Interviewee 2:

“So, I notice a lot that they use it to solve problems of writing code, even during practical lessons. So certain exercises where they have to write in SQL, write some queries themselves, they ask ChatGPT and learn from that. So, I've seen those situations, but I've also noticed that

they also use, for example, instead of interpreting some result themselves, they ask ChatGPT to interpret it. So the students lose all sense of interpretation, of analysis. So, one thing I've seen from both levels is to solve more practical exercises and I think that's a positive format, but then all the sense of interpretation that we need to develop, writing and even speaking, they fall short because they're not the ones doing it. And I notice that sometimes there's a difference between when something has been written by the student and when it hasn't, and there are certain platforms that nowadays even allow us to assess that. So, it's been in those contexts, but during lessons, from time to time they use it, especially for writing code which I find interesting and good, as well as other code learning websites which I also use for certain questions I have. So that's it".

Interviewee 3:

"The good cases, then, are those who use ChatGPT responsibly. Students can use ChatGPT for various tasks, so to speak. For example, I think and I'm sure there are students who use ChatGPT to improve texts, for example to improve parts of the English in a thesis. Okay, I realize that students make good use of it if they produce the first draft of the text, for example in the case of a thesis, and they could use GPT chat to improve the English, and that's a good use of a ChatGPT-type tool. They can also use generative AI tools, which are not ChatGPT, but others, in the case of research, summarizing texts. For example, imagine a student who has to read 10 papers on a particular topic, they can use ChatGPT to summarize those 10 papers and then use the result of that summarization to build their own text in a thesis or to build their own report. You can use GPT chat to improve your programming code. You can use the GPT chat to make a first draft of lines of code, but then, if the student doesn't know that programming language, the GPT chat could be giving lots of errors and the result is a disaster. So it seems to me that the best ways for students to use ChatGPT at the moment are precisely for text improvement, summarization and code production or code review, but the code review must be done by the student because ChatGPT doesn't have the right context. Even if you put a paragraph of context in there, they never know the full context and so it's important that this technology is used well by the students, that's it. The misuse has to do with those people who use the GPT chat as if it were an author, because the GPT chat is not an author. GPT chat doesn't have critical thinking. GPT chat is a good text predictor that predicts the most likely next word, but it doesn't have critical analysis. When students try to use ChatGPT as if it were an author, as if it were a group colleague, that's a bad result, so to speak".

Based on your experience, which factors do you believe to be the most influential on individuals' behavioral intention to use ChatGPT/related tools in their personalized learning contexts?

Interviewee 1:

"One of the behaviors is to quickly solve a problem that they have to do. It could be a test, it could be an assignment, it could be anything, which makes perfect sense because it's using

technology to try to find a solution. If we relate this question a little bit to the first one about what motivates students, maybe if we're talking about a student who already has a study method and has a certain objective in using the tool, the behavior of being able to use technologies like ChatGPT is a very useful behavior because it will have criticism. Also in relation to the third question, I would say that there is always a student who works in this sense of ""getting by"" and sometimes these two degrees are mixed up, that is, the student even has an interesting performance, but for example he has very little time, so he has to get by and emotionally the use of the tool is good: ""it's already solved, I have an answer from ChatGPT, I put it in my work, give it a touch and that's it"". So, I think that the intention of wanting to do it right away, related to the need or the perception that you have to think and work with some time will be the two factors that should support the use of the tools. And then, in a more rational than emotional way, being aware of the topic, understanding what the topic is, in order to quickly have the sensitivity to ensure that it really goes in the right direction, and I would say that this more or less balances the use a little".

Interviewee 2:

"Factors that lead students to adopt this technology, the ease of use. There's even a variable in the literature, which is perceived ease of use, also perceived usefulness. The whole ease of use is one of the most important variables. Then there's the quality presented. Although it's not perfect, the truth is that ChatGPT shows good results. So, it's easy of use, it's ease of getting jobs done, documents done and quick and immediate responses, without a lot of demand. Quick and immediate responses, without too much demand. The fact that, basically, it's open, there's no payment associated with it. The fact that it also helps to solve problems easily. So, ease, access. Of course, I was going to try to think of something to complement it, because now it's very easy to get, to get answers, easy to use, to be credible, in other words trust, also trust, little risk. There's no risk, a lot of risk or practically none. It's not as if using it poses any risk. So, the part of being open access and I think these are the main factors, yes, these would probably be it. "

Interviewee 3:

"So, I'm looking into it. I can't disclosure you at the moment, but you can go to some of the theses that are going to be presented next week and you might find some answers to this question. But even so, there are factors that are common knowledge and one of them is time. I realize that students want to use ChatGPT because it saves them time. The time it takes them to read a 20-page paper, using ChatGPT to summarize parts of that paper is tiny, in other words, the time they use is very, very small. So the time factor here is a factor that I think is quite important in what I think is the student's perception of using GPT chat. A student who says I have four projects to hand in in a week and if the student, even if they have planned it, always has time constraints and they will probably understand the use of the GPT chat as a time lever, they will understand the use of the GPT chat as a time lever. But I also think that the students who use the GPT chat are starting from a principle, which is probably not a very

correct one, and that is the state of variability of the students who use the GPT chat as an author, because they are too lazy to go and study the subject. They ask the GPT chat ""write me a paragraph or two on a certain topic"" that they themselves haven't read or haven't attended classes on, and I believe that this too is one of the factors that can influence the students' intention in using the GPT chat. In other words, once again there's that situation where the student misperceives, but perhaps perceives the GPT chat as an author or something that has, for example, knowledge that they don't have. The GPT chat is a model, it has been trained on sources that are true and correct and it has also been trained on the wrong sources and, not knowing the context, the output can be completely wrong. But yes, this is also a factor that students who perceive that they are using a generative AI tool in a bad way, in addition to leveraging time, can get it into their heads that using this tool will save them hours of study, which is a bad principle in itself, but yes, people have this notion and that's why we, in class, when we tell students if they have used ChatGPT or another generative AI tool, tell them what they used, what they used it for, describe the process. Because that's important, because that makes the student responsible, which is the responsibility that we, as humans, have to have in the future, because the future depends on the use of these tools. But good use is not the wrong use of the tool. Technology is neither good nor bad, it's what we make of it. If we use a technological tool to do something good with a certain method, the output will always be much better than when we don't use it. But if you use a technological tool to do something