ANALYSIS OF THE APPLICATION OF AI IN HIGHER EDUCATION

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Abstract: Artificial intelligence is a technology that enables computer systems to simulate human intelligence. Machines can now perform tasks previously treated as exclusive to human cognitive skills. Artificial intelligence focuses on intelligent skills, such as reasoning, decision-making, performing complex tasks, generalizing, learning, creativity, learning from past experience, and discovering something new. In some areas, artificial intelligence performs tasks better, faster, more efficiently, and more productively than humans. Artificial intelligence is more successful in detail-oriented work, such as work that requires quick analysis of a large amount of data, repetitive technical work, discovery of novelties, etc. In education, there is a special interest among the academic community in the use of generative artificial intelligence, which means creating something new, based on various inputs, such as text, animation, sound, 3D models, images, and other types of data. For students, artificial intelligence is important in their study, for learning and mastering the material, research, problem-solving, logical reasoning, and using chatbots (virtual tutors) that provide real-time support. For professors, artificial intelligence is important for preparing course materials, researching, engaging, and grading students in a new way. For the latter, problems occur due to cheating, distribution of misinformation, data privacy, and security, but also lack of human interaction. This paper attempts to answer the following research questions: What is the overall state of artificial intelligence in higher education? What are the perspectives of the academic staff (professors, assistants), administrative staff, and students regarding artificial intelligence applications in higher education? What are the advantages, downsides, threats, and possibilities of using artificial intelligence in higher education? Does artificial intelligence have a future in higher education? Using both primary and secondary data, the main aim is to present the results of a primary survey conducted in 2024 among the academic community (educators and students) about their experience with artificial intelligence tools. An electronic questionnaire was distributed to Macedonian higher education institutions containing open and closed questions regarding respondents' demographic traits as well as their opinions on the research issue. Respondents came from a variety of backgrounds, and they teach or study at several faculties. Collected data are analyzed with descriptive statistics and by using strengths, weaknesses, opportunities, and threats techniques. Results shows optimistic views about the future use of artificial intelligence-powered tools in higher education. Since the research is narrowed down to investigate only the perception of artificial intelligence in Macedonian higher education institutions, it can be a useful starting point for additional international research in higher education, thereby enlarging the investigation on a global scale.
Keywords: Artificial intelligence, High education, Artificial intelligence-powered tools, Academic staff, Students.

1. INTRODUCTION

Evolving technology is gradually penetrating every pore of human life. According to some authors, we have already entered the artificial intelligence (AI) golden-rush era (Duggal, 2024), which has great potential for even more rapid development. According to Statista (Statista, 2024), the global AI market is expected to grow approximately by 54% annually. By 2030 AI will account for 15.7 trillion US$ in the worldwide economy. 35% of businesses currently are using AI and 64% of businesses expect AI to increase their productivity (Element 451, 2023) McKinsey Report states that productivity is expected to rise by 30% in the retail industry, 15% in the healthcare, and 25% in manufacturing industries due to AI (McKinsey Report, 2023). 77% of people worldwide use AI regularly. According to the World Economic Forum (2020), AI has the potential to eliminate 85 million jobs while simultaneously creating 97 million jobs which is a net gain of 12 million jobs.

AI is the ability of computer systems to perform tasks typically associated with intelligent beings (Britannica, 2024). In simple words, AI is computer programs that are capable of learning, reasoning, and thinking on their own. They can simulate human intelligence, that is, human cognitive skills. According to (Duggal, 2024), there are three types of AI: “weak AI” that people use today to perform daily activities and are capable of completing one task at a time, “strong AI” which can understand and solve more complex intellectual problems, and “super AI” that is still a concept and can surpass human intelligence and complete any mental task better than a human. AI focuses on intelligent skills, such as reasoning, decision-making, performing complex tasks, generalizing, learning, perception,

creativity, understanding natural language, and discovering something new. AI has great advantages in performing some tasks, especially those that require greater efficiency, such as repetitive tasks, faster analysis of big data, reducing human errors and obtaining more accurate and precise results, and zero-risk in performing perilous work in hazardous environments (research of space, deep oceans, coal or oil mines), 24/7 productivity, performing multiple tasks with standardized quality, digital assistance and making unbiased decisions (Duggal, 2024). AI is also the driving force for various innovations. Because of these characteristics of AI, it has found great application in medicine, manufacturing production, space exploration, research of ocean depths, online customer support, self-driving cars, changing managerial tasks, especially the hiring process, etc.

AI also has major drawbacks, due to which some authors call it the "monster of capitalism". In this direction, Stephen Hawking wrote that "success in creating AI would be the biggest event in human history. Unfortunately, it might also be the last, unless we learn how to avoid the risks" (McKinsey Report, 2023). Elon Musk, the founder of Space X and Tesla, is of a similar opinion and will state that "with artificial intelligence, we are summoning the demon" (McKinsey Report, 2023). Major disadvantages of AI are the high price, its inability to think "outside the box", the possibility of unemployment in certain sectors where persons can be completely replaced by machines or robots, ethical issues, lack of emotions, inability to build teams, etc. However, machines complete the tasks they are programmed for or have data. Beyond that, they still cannot deliver successful results.

AI has the potential to revolutionize education, making it more personalized, engaging, and effective. productivity (Element 451, 2023). AI has advantages for both professors and students, but also certain disadvantages. In education, a special interest in AI emerged with the appearance of ChatGPT, a natural language processing chatbot in 2022 (Forbes, 2024). AI provides a personalized learning experience and in a short time analyzes a large amount of data establishing various logical and statistical correlations. AI performs cognitive human capabilities that help the academic community to learn and teach. Educators use AI for course preparation, student assessment, completion of administrative tasks, learning, research, and teaching. Students use AI to learn at their own pace, to focus on topics that need more support, and to learn something that is of great interest to them. The major disadvantages of the application of AI in education are the possibility of cheating, lack of human interactions, privacy and security issues, equity and job security (Forbes, 2024). According to Slimi (2023) within the next 20 years, around 47% of jobs in the USA and almost 54% in Europe will be at risk due to AI. Additionally, the forecast is that AI will write high-school essays by 2026, write best-selling books by 2049, translate languages by 2024, and perform surgeries by 2053. According to Walden University, the major disadvantages of AI in education are spreading misinformation (information collected from outdated, wrong, and biased data), cheating (using ChatGPT for writing essays, homework, tests, and projects), and isolation and disconnection between students and educators that can lead to decreased motivation and engagement in learning (Walden University, 2024).

2. LITERATURE REVIEW

What worries members of the academic community is generative AI because of its open questions of ethics, misuse, and quality control (Coursera, 2024) Generative AI sometimes produces misleading, inaccurate, and fake information that students and educators are using for their research and projects. Generative AI is the new generation of AI. The difference between traditional AI and generative AI is in their capabilities and applications.

Traditional AI, which is also called "narrow" or "weak" AI, originates from 1955, when Stanford professor John McCarthy first used the term, defining it as "the science and engineering of making intelligent machines" (Manning, 2020). Traditional AI is capable of making future predictions or making a decision based on historical facts. Traditional AI can perform a certain activity smartly and successfully. It is composed of algorithms that respond to a particular set of inputs. AI can learn from the data that is "fed with" and make decisions or forecast situations based on that data. For example, when playing chess, the AI knows the basic rules, some important moves/strategies, and based on the human moves, it makes its own, selecting the strategy for which it was programmed. AI does not make new moves in chess but exclusively relies on the data it owns. Hence, traditional AI is a master strategist that makes smart decisions based on a specific set of rules (Forbes, 2023). Voice assistants Alexa and Siri, Amazon's and Netflix's recommendation engines, and Google search algorithms work similarly. They follow predefined rules, do a particular job, and do not create anything new (Forbes, 2024).

The beginnings of generative AI are tied to the fall of 2022 with the appearance of ChatGPT. This AI is the new generation of AI that has the ability to create new things. It is enough to start with a question, a word, or a sentence and the generative AI creates texts, music, images, animations, 3D models, and other types of creative content. Generative AI creates brand-new, original output. It can produce human-like text that is hardly distinguishable from text written by a human (Forbes, 2023).

Although generative AI will provide a better experience for educators and students, ethical issues, privacy, equity, and data accuracy remain threats. According to Grand View Research, the global AI in education is expected to

grow at a compound annual growth rate of 36% from 2022 to 2030 (Grand View Research, 2024). There is also a growing number of publications on the Internet regarding the application of AI education. According to Wang et al, the explosion of AI research in education began in 2017, reaching a peak in 2021, primarily due to the effects of Covid-19 and the need for online education (Wang et al, 2023). More and more papers describe theories for the application of AI in education, but some focus more on virtual reality and neural networks. However, AI in education from the point of view of generative AI is still in its infancy and there is no clear idea of how AI will incorporate fully into the educational sector.

3. METHODOLOGY

For the preparation of this paper, primary and secondary data were used. Primary data was collected through a survey conducted in the first half of 2024 using an electronic questionnaire delivered to Macedonian higher education institutions. The questionnaire contains open and closed questions about the demographic characteristics of the respondents and their opinions about the research topic. The research included 126 respondents, members of the academic community (educators and students). They belong to different fields, teaching or studying at different faculties (economics, politics, law, art and design, communications, medicine, informatics). Descriptive statistics are used for the analysis of the collected data.

Secondary data is collected from various Internet contents like books, publications in reputed journals, websites, and articles written about AI.

4. DISCUSSION AND ANALYSIS

The primarily conducted survey is analyzed in three parts: the first refers to the demographic data of responders, and the second part refers to the advantages, disadvantages, prospects, and threats of the application of AI in higher education. SWOT analysis is used in this part to highlight the most helpful and harmful aspects of AI tools usage in higher education. The third part analyses the difference between the experience of the academic staff (professors, assistants), and students about the application and satisfaction of AI in higher education.

Demographic data of the responders

Regardless of gender all professors, administrators, and students can harness the benefits of AI tools to enhance teaching, learning, research, and administrative tasks in academia. According to the gender distribution (see Table 1), females dominate with around 62% (78 female and 48 male respondents), while according to the age distribution, the young population up to 25 years of age with 77 respondents (61%) dominates in the research. Occupation distribution of the participants also confirms that the young population, students dominate in the research with 56%. The use of AI tools at faculties level in higher education is generally driven by factors such as faculty policies, resource availability (technology infrastructure), specific academic disciplines, and individual preferences and skills. Regarding the faculty's participation in the survey, most of the responders 53 (42%) were coming from the Faculty of Economics and Administrative Sciences.

Table 1: Demographic data of the respondents

Demographic data						
Features		**Total**	**%**	**Faculty**	**Total**	**%**
Gender	Female	78	62	Faculty of Economics (and Administrative Sciences)	53	42
	Male	48	38	Faculty of Engineering	22	17
Age	up to 25	77	61	Faculty of Law	6	5
	26-30	13	10	Faculty of Dental Medicine	10	8
	31-50	28	22	Faculty of Medicine	3	2
	51-64	7	6	Faculty of Education	10	8
	over 65	1	1	Faculty of Humanities and Social Sciences	12	10
Occupation	Student	70	56	Faculty of Art and Design	2	2
	Assistant	20	16	Vocational Medical School	0	0
	Professor	27	21	English Language School	0	0
	Administration	1	1	Administration	0	0
	Other	8	6	Other	8	6

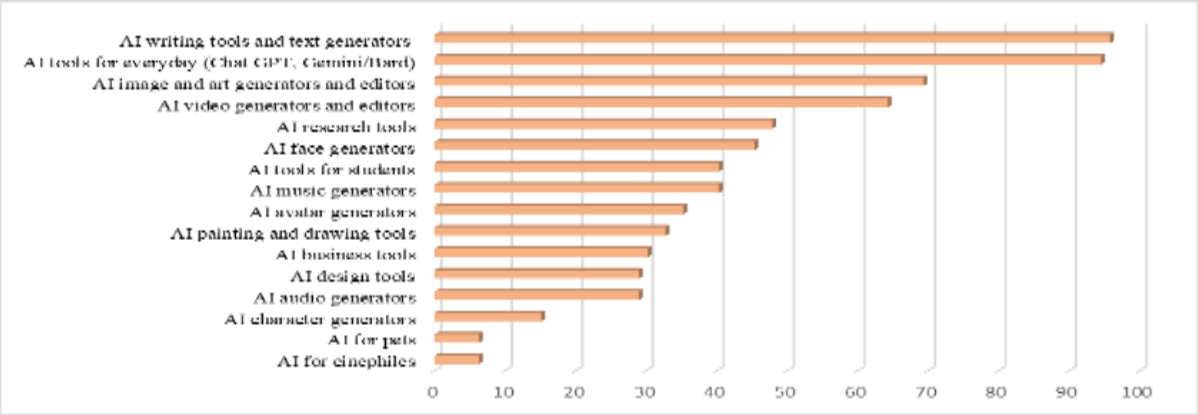
Source: Own research

Swot analyses based on the survey results

To estimate the literacy regarding the new AI tools responders were asked whether they were familiar with the listed AI tools shown in Figure 1. Results revealed claims of Pittner et al. (2023), and Limna et al. (2023) that most of the responders know about AI writing tools and text generators, namely 95.7% as well as AI tools for everyday use (Chat GPT, Gemini/Bard) with 94.5%. However, they have the least knowledge of AI character generators (15.2%), AI for cinephiles (6.3%), and AI for pets (6.3%). Only two responders did not know and were not familiar with AI

tools. Most of the responders 86.5% believe that AI tools will be used more in the near future, 9.6% do not know, and only 3.9% do not believe in AI usage.

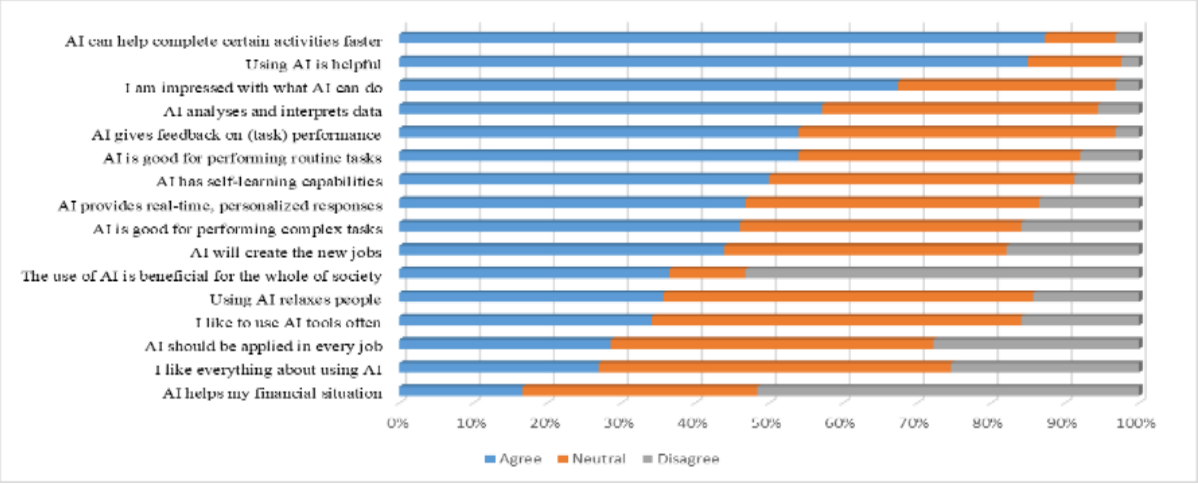
Figure 1: Familiarity with AI tools



Source: Own research

AI can completely transform higher education by providing professors, researchers, and students with cutting-edge resources and insights while also making learning more accessible, efficient, and personalized. Responders were impressed with what AI can do and emphasized that using AI in higher education is very helpful. They highlighted that the main advantage of AI tools applied to higher education is the speed and efficiency in completing certain activities. AI tools can easily analyze and interpret data and give feedback on task performance. They are better for performing routine than complex tasks and have self-learning capabilities. There are several ways in which AI can positively impact various aspects of society through automation, efficiency, enhanced education, economic growth and job creation, accessibility and inclusion, transportation and mobility, crises and disaster management, etc. Although the responders recognize that AI will create new jobs they mostly disagree (52%) that AI can help them improve their financial situation (see Figure 2). Surprisingly, besides the expectation that AI has the potential to bring widespread benefits to society as a whole, most of the responders (33 students, 15 professors, 14 assistants, and 5 others) do not recognize the beneficial use of AI for the whole of society.

Figure 2: Advantages of using AI tools in higher education

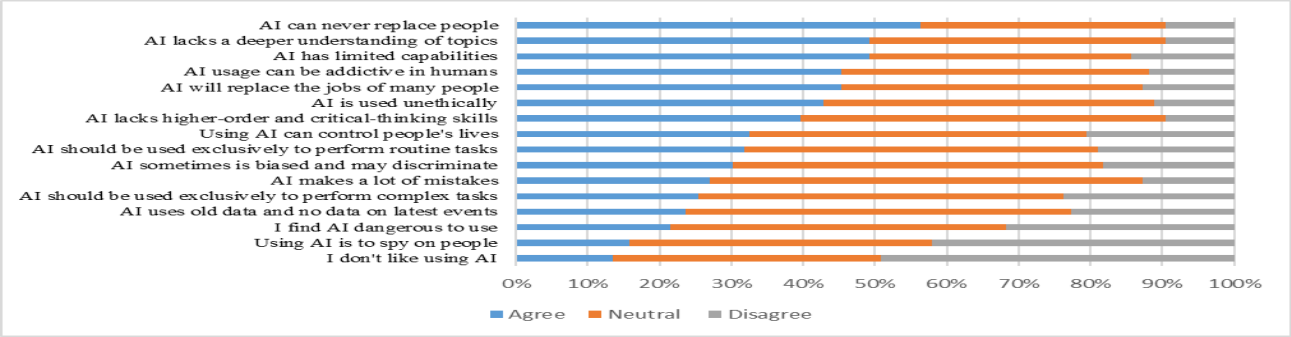


Source: Own research

To ensure the responsible and effective integration of AI technologies into educational settings it is also important to analyze the disadvantages of AI tools in higher education. Although some of the main drawbacks of AI tools are the lack of human interaction and the possibility of completely replacing the people responders have recognized with 71 answers that human connection and mentorship are essential components of the learning experience and that AI tools can never fully replicate people. The main recognized shortcomings are the AI's limited capabilities and lack of deeper understanding of the topics. Job displacement and ethical considerations regarding transparency, accountability, and decision-making were also underlined (see Figure 3). Large is the number of neutral answers

especially regarding the following statements "AI makes a lot of mistakes" (60%), "uses old data and no data on the latest events" (54%), "sometimes is biased and may discriminate" (52%), "performing complex tasks" (51%), "should be used exclusively to perform routine" (49%), or "it is used to control people's lives" (47%) or" to spy on them" (42%).

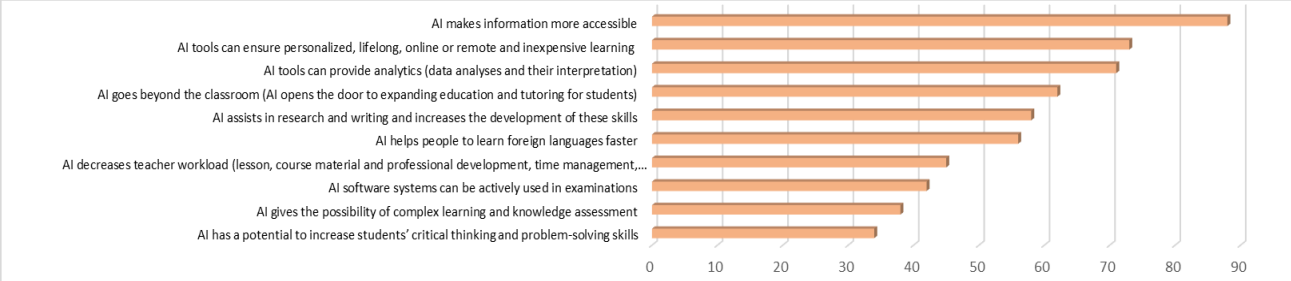
Figure 3: Disadvantages of using AI tools in higher education



Source: Own research

The application of AI tools in higher education brings both challenges and threats that universities must navigate and address carefully. The survey revealed that the integration of AI can open a lot of new opportunities for higher education. As presented in Figure 4 for most of the responders (88) AI tools make information more accessible, while for 73 they can ensure personalized, lifelong, online or remote, and inexpensive learning. A large number of 71 answered that AI tools can easily provide data analyses and give their interpretation. More than half replied that AI goes beyond the classroom. AI opens the door to expanding education and tutoring for students, assists in research and writing, and increases the development of these skills. A small number of responders (38) answered that AI gives the possibility of complex learning and knowledge assessment and has the potential to increase students' critical thinking and problem-solving skills (34 responders). This confirms the argument that dependence on technology increases the risk of students becoming passive consumers of content rather than active learners engaged in meaningful learning experiences.

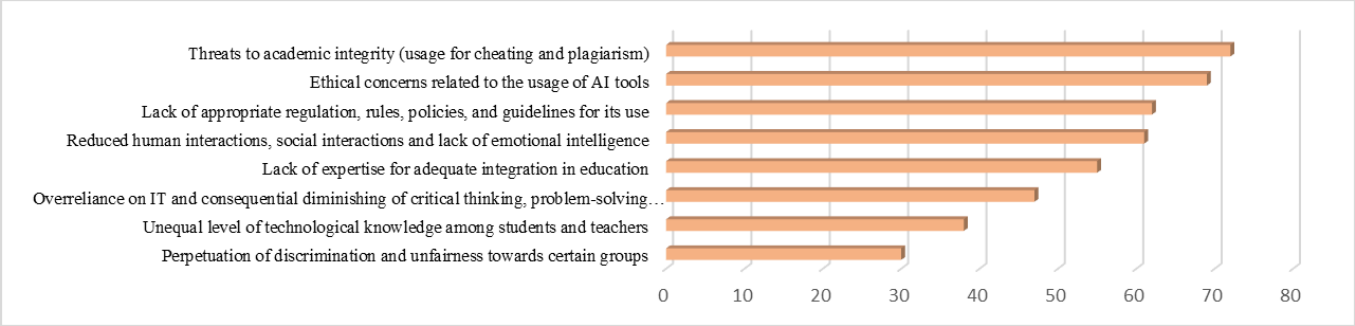
Figure 4: Challenges of using AI tools in higher education



Source: Own research

Potential threats of AI application in higher education responders encompass mainly regulatory, ethical, social, educational, and technical implications. (see Figure 5) To address these challenges and threats and maximize the promise of AI tools while mitigating risks and guaranteeing inclusivity in higher education settings, careful planning, ethical considerations, and stakeholder collaboration are needed. Hence, to address these concerns a multidisciplinary strategy should be integrated by combining teachers, administrators, legal and technology experts, and students. To mitigate risks and maximize the benefits of AI usage in higher education, universities must invest in human capital, prioritize ethical issues, encourage fair access to AI technologies, and develop a culture of responsible AI use.

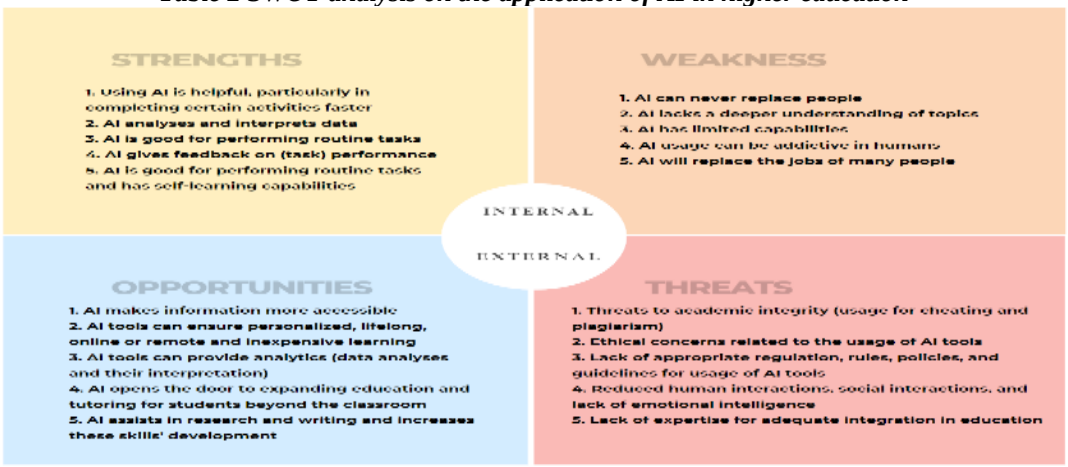
Figure 5: Threats of using AI tools in higher education



Source: Own research

In Table 2 below based on the survey results SWOT analysis is conducted and presented with the five most important answers agreed by the majority of the responders. These results can be used as guidelines for future profound research in the same area.

Table 2 SWOT analysis on the application of AI in higher education



Source: Own research

Usage and satisfaction of ai application in higher education

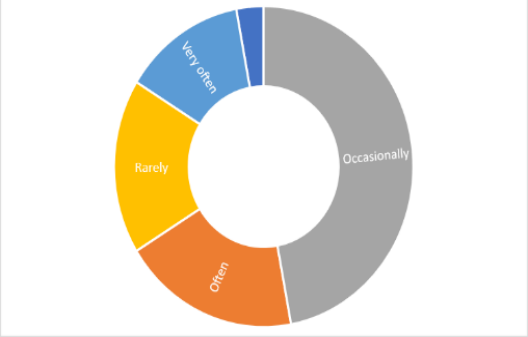
The results from the third part of the survey confirm that AI tools are advancing much faster than academic staff, and students know how to use them. In the future, the biggest challenge will be showing what is possible to turn into what is applicable. i.e. learning by all stakeholders in higher education how to use AI tools more effectively. According to the survey, AI tools are being used by only 54% of the responders, while 46% have given negative responses. Regarding gender**,** females dominate in AI tools use (42 female versus 26 male responders). From an occupation perspective, AI tools are mostly used by students (34), 15 professors, and 13 assistants. Regarding the types of AI tools used, 52 out of 63 responders who answered the question pointed to Chat GPT. Gemini/Bard, Quillbot, and Grammarly are also highlighted as the most used AI tools. Nowadays, many students view ChatGPT as an always-available tutor, i.e., a valuable resource for personalized education. It can be a useful tool for professors and assistants to get started with a new research topic because it provides insightful information on broad concepts. However, as Pittner et al. (2023) have emphasized, it is crucial to address the fact that ChatGPT lacks a deeper comprehension of the concepts and issues. It cannot accurately deliver information on the finer points or more sophisticated subjects.

Out of 126 responders, only 68 positively answered the questions concerning the usage and satisfaction of AI applications in higher education. Figure 6 shows that responders are using AI tools primarily for studying (46), work (39), fun (28), and least for hobbies (16) and other reasons (1). Concerning how often respondents are using AI tools (see Figure 7) most of them, 47% respond occasionally, 19% are using them often, 17.6% rarely, 13% very often, and 3.4% very rarely.

Figure 6: Purpose for using AI tools

Source: Own research

Figure 7: Frequency of AI tools use



Source: Own research

Most of the respondents, 67.6%, are satisfied with the quality of the AI tools and 82.3% recommend their use. Only a small percentage (8.8%) of the responders are not satisfied with the quality and 7.3% will not recommend future use of AI tools. However, the percentage of responders that are neutral regarding satisfaction with AI applications (23.5%) is high and they do not know whether they would like to recommend AI tools usage (10%). This only enhances the necessity of further discussion, policy introduction, and ethical considerations when using AI. Furthermore, it justifies the argument that AI has many drawbacks when someone is using it independently and without human supervision/inspection of AI-generated outputs.

5. CONCLUSION

AI integration in higher education has implied significant changes recently, not only in terms of how it is applied but also in terms of the usage and satisfaction it offers. AI tools in higher education are still in development and it may take some time to take an application fully.

Based on data obtained from the survey the primary advantages of AI tools in higher education are determined to be efficiency, productivity, and personalized learning. Among the shortcomings are ethical implications, threats to academic integrity, and the need for legal policies, acts, or guidelines to ensure responsible use. In contrast to the belief that AI can replace people and contribute to society, most of the responders agree that AI can never replace people and do not believe that AI has the potential to bring widespread benefits to society as a whole. The many neutral answers among professors, assistants, and students confirm the limited understanding among responders of AI technology and its implications in higher education.

AI will continue to be more present and essential for higher education. Since it can completely transform higher education AI tools should always be regarded more as a solution than as a threat. Reaching a higher level of usage and satisfaction with AI tools in higher education will depend on judgments about the trade-off between the benefits (advancing teaching and research practices to better prepare students for the demands of the modern workforce) and costs regarding ethical, social, and economic considerations, such as data privacy, dishonesty in exams or essays, algorithmic bias, and even job displacement. Therefore, higher education should focus more on how to increase the awareness of students, professors, assistants, and administration, as it can lead to increased usage and knowledge of AI tools in the future. This can be accomplished in two ways: by highlighting the advantages more or by thinking about how the disadvantages might be mitigated by providing them with security and comfort.

The main research's drawback is that it is narrowed down only to investigating the perception of AI in Macedonian higher education institutions. However, this study can be a useful starting point for additional international research in higher education, thereby enlarging the investigation on a global scale.

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