Exploring the Role of Artificial Intelligence (AI) in the Education Process: AI that Supports Cognitive Processes

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Abstract: This paper examines the impact of Artificial Intelligence (AI) on higher education. It discusses the understanding of the concept and its evolution, the opportunities and risks involved in the development of AI, and analyses research among teachers and students. In the study presented here, teachers at a higher education institution were interviewed to find out about the purpose of using AI, the applications they use, and how AI contributes to solving the tasks and problems they face in their work. Although learning is based on internal processes and structures, it is interesting to examine the role that external AI support can play in this cognitive process and the experiences of teachers from different disciplines. The survey also covered students' experiences of using AI. Data was collected through a questionnaire. The results show that educators are already making use of the potential of AI, applying it in their teaching, research and publishing processes. However, the responses show that this use is still at an early stage. Teachers at the institution surveyed, recognize the opportunities and risks of using new technology, both from an educational and the student's perspective.

Keywords: artificial intelligence; education; learning; higher education

1 Introduction

Defining artificial intelligence (hereafter AI) is not a straightforward task, given the various approaches found in the literature. When examining definitions, the scope ranges from engineering and mathematical foundations to frameworks that include aspects of human thinking. Given these diverse perspectives, one certainty is that the study of AI encompasses multiple disciplines, making its interdisciplinary nature impossible to overlook. In most cases, the study of AI seeks to discover attributes similar to human intelligence. In the application of AI, the technical

solution is usually expected to attempt to model human behavior and cognition. In contrast, we are exploring the potential of AI to support the cognitive learning of students in a variety of disciplines for educational experiences. An intriguing classification of definitions is provided by Russell and Norvig [1], drawing on the formulations of several different textbooks, distinguishing thought processes and reasoning from behavior. They further organize these definitions by comparing them to human behavior and ideal, rational behavior. Based on this, the following approaches are distinguished.

- **Systems that Think Humanly:** These systems model the workings of the human mind and cognition, thus considered artificial intelligence.
- **Systems that Act Humanly:** According to the Turing test, if a machine's behavior is indistinguishable from a human's, it is considered intelligent.
- **Systems that Think Rationally:** These are machines and software that aim to be more perfect and rational than human thought.
- **Systems that Act Rationally:** These systems require knowledge representation and the ability to make inferences to arrive at correct decisions across a broad spectrum of situations, acting rationally based on these decisions.

Although each of the four approaches has its advocates, it is crucial to recognize that the significant variations in perspectives across these approaches enrich the research field.

A mature, simplified approach to the concept of AI is given by the European Union, according to which AI refers to the human-like abilities of machines, such as reasoning, learning, planning and creativity. This definition allows technology to perceive its environment, engage with what it senses, solve problems, and plan actions to achieve specific goals. A computer not only receives data but also processes it and responds accordingly. A crucial declaration is that the systems discussed are capable of modifying their behavior to some extent, based on the analysis of the effects of their previous actions and independent operation [2].

Underlining the importance of the topic, they also stress that AI is a central element of today's digital revolution and a key priority for the EU. Future applications are expected to bring substantial changes, but AI is already present in our daily lives. It distinguishes between the main types of AI in software-based and physical aspects. Software-based AI includes virtual assistants, image analysis software, search engines, speech and facial recognition systems, while physical AI encompasses robots, self-driving cars, drones, and the Internet of Things. The use of AI-based systems in higher education generates a significant amount of sensitive data, including student personal data, performance and behavior. With the help of steganography, this data can remain hidden, ensuring that student privacy is protected. For example, information hidden in images or other digital media containing student data can prevent unauthorized access and data theft. [3]

Research in AI and machine learning, such as the classification of skin lesions, requires an interdisciplinary approach involving medicine, computer science and machine learning. The presentation of such projects in higher education provides students with the opportunity to gain a broader knowledge and understanding of how AI can be applied in different fields. [4] The protocol-oriented programming paradigm helps to develop scalable and maintainable AI-based educational applications. This approach allows easy integration of AI modules and user interfaces, as well as efficient testing and updating of AI models. [5]

The European Parliament Resolution on a comprehensive European industrial policy on artificial intelligence and robotics states that "artificial intelligence and robotics have the potential to transform multiple industries and lead to greater production efficiency, making European industry and SMEs more competitive on a global scale. The availability of large datasets, as well as testing and experimental facilities, is of great importance for the development of artificial intelligence" [6].

According to Russell and Norvig's framework, it is necessary to differentiate between weak and strong artificial intelligence. Weak AI, also known as weak artificial intelligence hypothesis systems, act as if they are intelligent (it is unknown whether they possess true intelligence). Strong AI, or strong artificial intelligence hypothesis systems, truly think and have their own consciousness. The test for achieving strong AI is the Turing Test, which requires that a machine should respond to questions on any subject in such a way that the questioner cannot determine they are not communicating with a human. Simplified, if in the experiment, the machine convinces at least 30% of the human participants that it is also human, then it demonstrates a level of intelligence that clearly proves the existence of AI capable of thought [7]. Although the test was devised decades ago, it is not easy to pass. The Turing Test is only suitable for identifying systems that mimic human behavior, which can still be considered weak AI [8]. Beyond these, there are additional experimental tests which we will not discuss in detail here, but they include "Chinese Room", "Brain Prosthesis" and "Brain in the Tank" [1].

The technological singularity refers to a possible future event when, due to the emergence of "superhuman" intelligence, technological progress and social change accelerate, altering the environment in ways and at speeds that those living before the singularity are unable to comprehend or reliably predict. Raymond Kurzweil [9] sees an exponential pattern of technological progress, whereby current progress will eventually lead to the singularity. The analysis of technology history demonstrates that technological change is exponential, contrary to the current intuitive-linear perspectives. Therefore, in the current century we will experience not 100 years of progress, but 20,000 years at the current rate. Benefits and outcomes of this development, such as chip speed and cost efficiency, will also increase exponentially. Even the rate of exponential growth is set to accelerate exponentially [10]. This progression can be generalized by Moore's Law, which articulates an empirical observation in technological development stating that the complexity of

integrated circuits roughly doubles every 18 months. The generalization implies that this principle will apply to all technologies.

2 Background on the Use of AI

2.1 Risks of Using AI

The concept of singularity also impacts the evolution of society. While this may seem obvious, there is no complete agreement on the specifics of this topic. Ray Kurzweil predicts that by 2029, an AI will reach the level of human intelligence. He has identified 2045 as the date for the singularity, at which point our effective intelligence will be amplified a billionfold by merging with the artificial intelligence we have created. Kurzweil believes that intelligent machines will enhance our cognitive abilities. Although they are not yet integrated into our bodies, by the 2030s it is expected that the parts of our brains involved in cognition could be connected to the cloud [11].

The uncertainties inherent in the widespread application of AI include the following considerations:

- Development of AI should cease at a boundary point where its benefits are still enjoyable, but control over it remains.
- Systems powered by artificial intelligence operate as a “black box” to us. We cannot see how they function, and even their creators may lose track of their operations over time due to machine self-learning.
- Concerns about privacy invasion. AI works with the data we provide. Is it used solely for the purposes we have authorized?
- Trust issues. Do we accept AI’s decisions as correct, for example, in medical applications? Can we diagnose and perform surgery immediately if a smartwatch indicates a serious problem?
- Exponential growth caused by machine learning also manifests in the intelligence of AI, potentially creating a vast gap between human and machine intelligence.
- Our digital footprint is continually expanding across all areas, constantly providing AI with access to this data trove. The complexity of Big Data and Smart Data systems is at AI’s disposal, often neglecting self-defense measures. [12]
- AI learns from us. As humanity is, so too will AI become. Although this is outside the current scope of study, there are unfavorable trends. In one

experiment, a self-learning AI, which gathered information through a chat service, started sending deviant responses within a few days.

Russell and Norvig [1] identify additional risks beyond those previously mentioned:

- Automation may lead to job loss for many people.
- Individuals might end up with too much (or too little) free time.
- People may lose their sense of uniqueness.
- Individuals could lose some of their personal rights.
- The use of artificial intelligence systems might eliminate accountability.
- The success of AI could potentially signal the end of the human race.

In the field of education, attention has also been drawn to the risks associated with its application [13] [14] [15]. However, automation and the use of AI are not universally feared. For instance, due to the aging population in Japan, there is an expected shortfall of 370,000 caregivers by 2025. The solution is seen in robotics [16].

2.2 Attitudes Towards Artificial Intelligence

The Social Science Research Center and Corvinus University (in Hungary) have conducted a study on societal attitudes towards AI. The research extensively addressed how people perceive the usefulness and fears associated with AI solutions increasingly present in everyday life. One of the main findings of the study is that the perceived utility and sense of danger associated with various AI technologies vary significantly. Apart from the detailed results in each segment, the focus of our study is close to the focus of segment 3 of the research, which reflects low utility and high fear, pertains to the use of AI in education. This segment particularly considers the use of systems for monitoring students, indicating significant apprehensions.

An experimental component of the research involved examining metaphors related to artificial intelligence. Participants were asked to compare AI to a concept of their choice. The majority of respondents associated AI with robots and computers [17]. This finding carries important implications for its application in the education sector, suggesting prevalent perceptions and potential biases that could influence the integration of AI technologies in educational settings.

A further study investigated university students' attitudes towards robots, AI, and the effects of these technologies on employment, revealing their future expectations and visions [18]. According to the findings, AI is perceived as socially and economically beneficial. The applications of AI, as viewed by the students, are expected to radically transform educational processes. Within this framework, the impacts are anticipated to fundamentally affect both teacher-student and student-

student relationships [19]. Human capabilities and info-communication technologies are now undergoing a major transformation. As a result, the context of human cognition and society has changed, and human and digital capabilities can no longer be clearly separated [20] [21].

During an exploration of openness to AI collaboration, which involved specific and practical situational questions, students were asked to imagine the following scenarios: Computer algorithms teaching mathematics, foreign languages, and literature classes. A computer or "robot" speaking to them in a foreign language. Students contacting AI for help and advice when they encounter difficulties in their studies. In the case of mathematics classes, 24.7% of respondents could envision a computer algorithm conducting the class, while a similar proportion, 25.3%, found it difficult to imagine [22]. The lack of experience with such technology does not necessarily pose a barrier to its implementation [23].

3 AI in Education

Nowadays, there are several augmented, virtual reality-based or smart devices available, facilitating experiential learning and the learning process. Integration of these hardware components with modern elements, even with artificial intelligence-based applications, can open up further perspectives [24].

According to some authors, there are four areas where AI can be effectively used to achieve educational goals:

- Intelligent tutoring systems
- Personalization of the learning process (content, pace, sequence and difficulty level)
- Assessment through computer-adaptive evaluations
- Automation of administrative tasks (e.g. attendance management) [25]

According to Marr, AI can be utilized in education in four ways:

- Taking over repetitive tasks for teachers (such as administration and grading)
- Precisely tracking students' progress
- Personalizing learning, as current systems do not allow instructors to provide individualized learning experiences
- Making education more accessible through AI solutions, tools and global classrooms [26]

In another perspective, AI can be applied in education in various areas: automatic grading, repetitive reminders, teacher feedback, virtual teachers, personalized

learning, adaptive learning, augmented and virtual reality, vocabulary and knowledge matching, smart university and distance learning [27-29].

Teachers have also faced a number of challenges and drawbacks in the potential use of robotic learning and the use of AI in education in general [30]. Despite the numerous potential opportunities, schools and universities have been slow to adopt the listed AI solutions, and this hesitancy is only partly due to a lack of resources. A more significant underlying factor is the lack of trust in AI's applicability in education, which acts as a deterrent [31]. In the age of digital transformation, excluding technology from education is not only impossible, it would be a huge mistake [32].

From the educators' perspective, there is often resistance, fear of uncontrollable AI usage, and consequent discussions about restricting or outright banning such applications among students. Nowadays, some universities have completely prohibited the use of ChatGPT, while others advocate for its more comprehensive utilization [33].

According to a study, teachers believe that their personal presence and role in teaching are irreplaceable and cannot be substituted by AI. Although this is reflected in the student narratives, the majority of students perceive AI as a more unbiased evaluator than the teacher. They are more dismissive of AI in learning, teaching and explanatory activities in general. However, there is a consensus that widespread classroom use of AI technologies is something for the distant future [22].

A study examined the impact of generative AI tools such as ChatGPT or Google Bard on participants in higher education, particularly within the humanities and social sciences. It was found that these tools could lead to improvements in efficiency and democratize access to education, but they also raise trust issues. The authors suggest that stakeholders in higher education should engage in transparent communication about the expected effects of AI to swiftly establish a culture of proper usage [34].

While text-generating AIs cannot think, recent developments have enabled them to construct arguments, making their responses indistinguishable or hard to differentiate from those of humans [35-37]. The use of AI in university education poses a number of risks:

- It can jeopardise the trust that teachers have in their students
- Fear of fraud may lead to retrograde changes in teaching methods
- Students' belief in meaningfulness of learning may be compromised [34]

In order to prevent plagiarism in assignments, it is necessary to inform students early about the inappropriateness of such actions [38]. In the absence of an instructional prevention and interpretive framework, students may develop a sense of meaninglessness in learning and even lose the pleasure of discovery and self-improvement [39].

However, it is important not to overlook the positive impact that AI can have in alleviating the workload of instructors. AI can assist in the rapid and objective assessment of student assignments and exams, potentially including personalized feedback [40].

A study focuses on the practical aspects of the concrete applications of AI, such as curriculum design, lesson planning, classroom activities, or grading and assessment. It has been found that AI can relieve teachers' workload, as well as provide real-time content or responses that would take teachers longer to prepare. AI can also support students' independent learning by providing stress-free consultations and can be useful for differentiation. This paper encourages teachers to use AI in their teaching practice by presenting current possibilities [41].

In addition to teaching students the basics, AI programs can assist students in progressing and immediately respond to their queries, as well as provide regular feedback. Today's chatbots are already serving as models for AI teachers [42].

Research highlights the digital transformation in higher education in Hungary, reflecting on the findings of the OECD report [43] and shows how AI and digital tools are reshaping the educational landscape. Another study presents a framework for creating engaging online educational materials [44], which is essential for integrating AI into personalized learning experiences. Furthermore, transforming engineering pedagogy for the Fifth Industrial Revolution involves adapting to AI advancements and incorporating them into teaching methodologies [45].

The use of artificial intelligence is becoming increasingly indispensable for social science research because it allows for the processing of vast amounts of data and can provide predictions. It is recommended that AI applications also be utilized in university and research institute studies. However, the spread of AI might be hindered by the fact that free versions are only available with limited functionality, though AI-based applications are excellently suited for qualitative research on digitized materials [46].

4 Research and Methodology

In this study, the impact of AI development was examined based on the perceptions and experiences of educators. The objectives for using AI and the specific applications employed were explored. The contribution of AI to solving tasks and problems that arise in work settings was assessed, along with its usage purposes. The potential for future use was also considered, questioning which areas might benefit from AI implementation. Additionally, the experiences of educators with students' use of AI were specifically investigated. To examine the research questions, a survey was conducted using a questionnaire that was published on a digital platform (Google Forms) and distributed to instructors via the Neptun LMS.

The base population consisted of instructors from a higher education institution. The sampling for the investigation was full-scale. Out of 114 instructors queried, 53 responses were received. After evaluating the responses and cleaning the data, 41 evaluable responses remained.

The respondents included 23 men and 18 women. In terms of age distribution, the 40-54 age group accounted for 56.1% of the sample, totaling 23 respondents. There were 7 individuals (17.1%) under 40 years, and 11 individuals (27.8%) over 54 years. Most of the respondents live in urban areas (27 individuals, 65.9%), while 3 individuals (7.3%) are from the capital city, and 11 individuals (26.8%) come from rural areas to the university. 61% of the respondents (25) have a PhD, 36.6% (15) have a Master's degree, while 1 (2.4%) has a bachelor's degree. The distribution of respondents by field of specialization is illustrated in the graph below (Fig. 1).

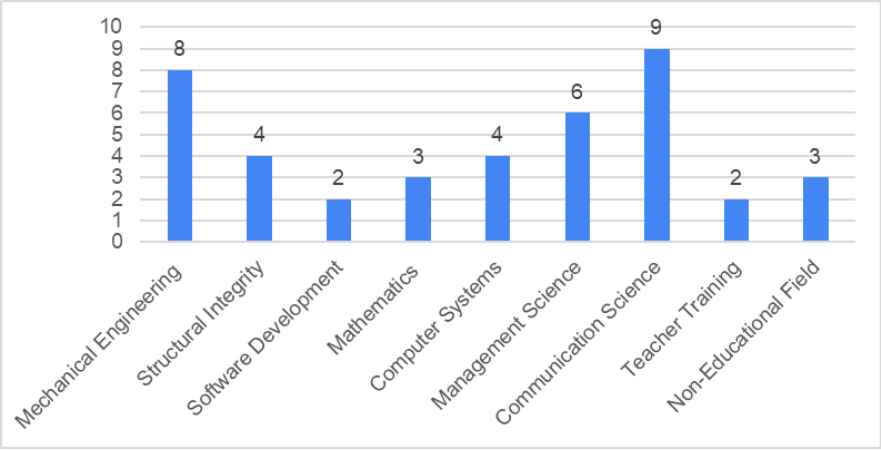

Figure 1
Distribution of respondents by field of specialization

As shown in the graph (Fig.1), 12 respondents are from the engineering field, 9 from computer science, 15 from social sciences, and 2 from teacher training. 3 non-teaching staff, i.e. laboratory technicians and departmental assistants involved in teaching, also responded.

5 Results and Discussion

Opinions among the respondents regarding the acceptance of artificial intelligence are divided. As illustrated by the graph below (Fig. 2), the majority of respondents are waiting to see the effects of the innovation. Seven individuals expressed enthusiasm for the opportunities presented by the new technology, while 14 actively

seek ways to utilize it. Only three individuals reported that they are not easily convinced about the application and its impacts.

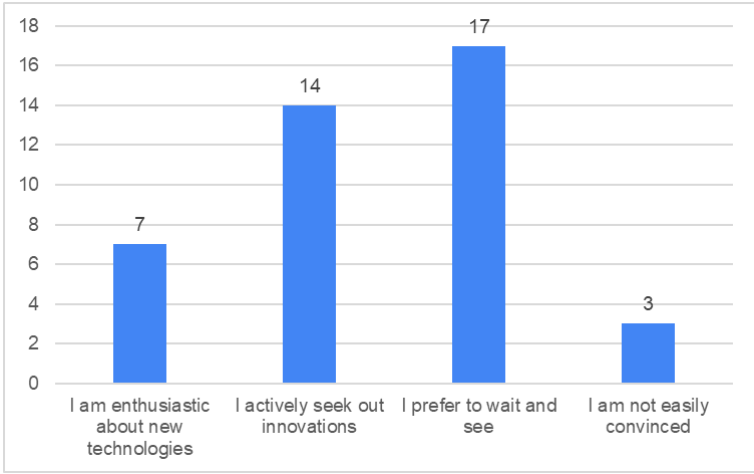

Figure 2
Attitudes Toward the Adoption of AI

Before exploring the use of AI in educational activities, respondents were asked whether they use AI outside of their workplace and for what purposes they incorporate it into their activities. The frequency of AI usage was assessed across three dimensions: work-related tasks, leisure activities, and for convenience purposes.

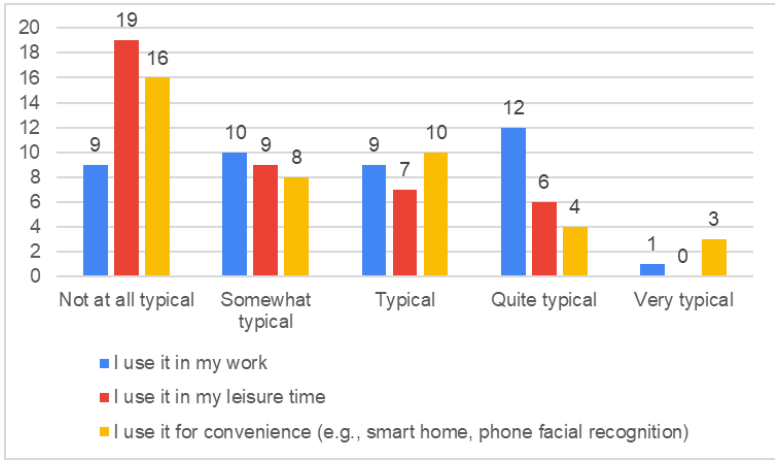

Figure 3
Use of AI-Based Technologies in Everyday Life

Based on the results, it can be concluded that the everyday use of AI is still relatively uncommon among educators (see Fig. 3). The majority of respondents use the capabilities offered by artificial intelligence infrequently or not at all in their daily lives. However, it is also evident that AI is favored for work-related tasks compared to other areas.

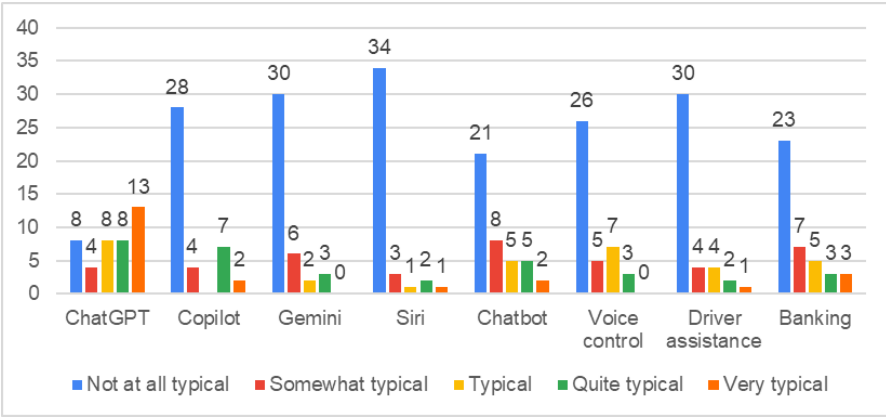

Figure 4
Use of AI-Based Technologies

Among the AI-based applications and services, ChatGPT and Chatbots are the most well-known and frequently used by the respondents. The use of other AI-based technologies is significantly less common, as illustrated in Figure 4.

Regarding the question on the use of AI-based technologies in the workplace, respondents basically identified workflows related to teaching, research and publishing activities as a more commonly used area. In addition to these, machine translation and source management were also frequently mentioned (Fig. 5). It can be seen that the use of AI is not yet widespread, but there are specific areas where its application is clearly established and well-known.

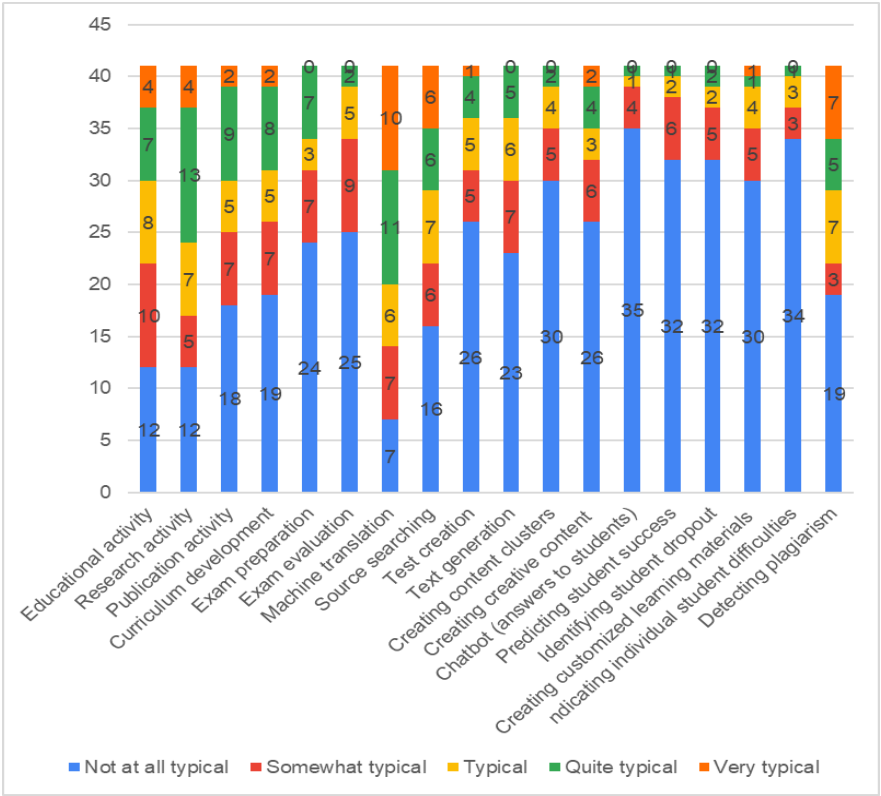

Figure 5
Use of AI-Based Technologies in the Workplace

It can also be seen (Fig. 6) that educators have identified areas where they plan to use the new technology in the future. Here again, sub-activities related to the teaching process and services supporting the research and publication process were the main areas of intention. Machine translation emerged as the most significant item for both currently applied and planned in the future AI-based technologies.

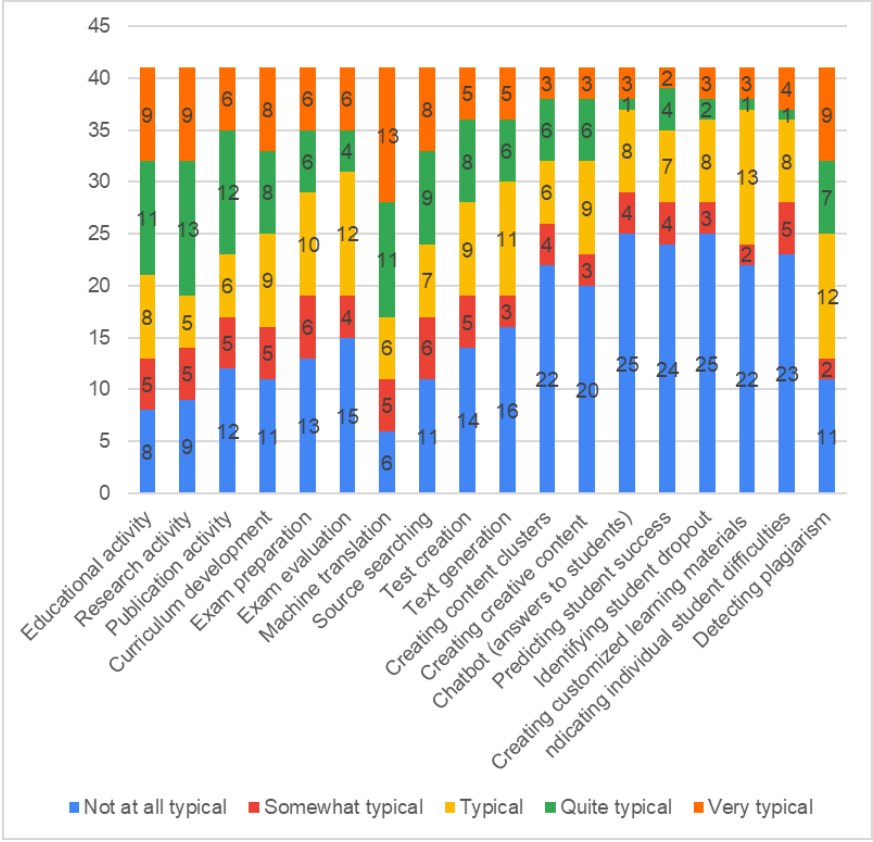

Figure 6
Future Use of AI-Based Technologies

In a more detailed analysis of the educational process, the majority of respondents consider artificial intelligence to be applicable and useful in all educational aspects (Fig. 7). Notably, AI is highlighted for its potential in information delivery, visualization, and creating simulations. Generally, respondents believe that artificial intelligence can (and will) be used in many areas of the educational process.

Regarding students' use of AI, the opinions of the respondent educators are divided. The majority have observed that students use new technological tools to complete their tasks. Two-thirds of the respondents see its use as a problem in principle, while in contrast, slightly more than half of the respondents indicated that they see it as an opportunity.

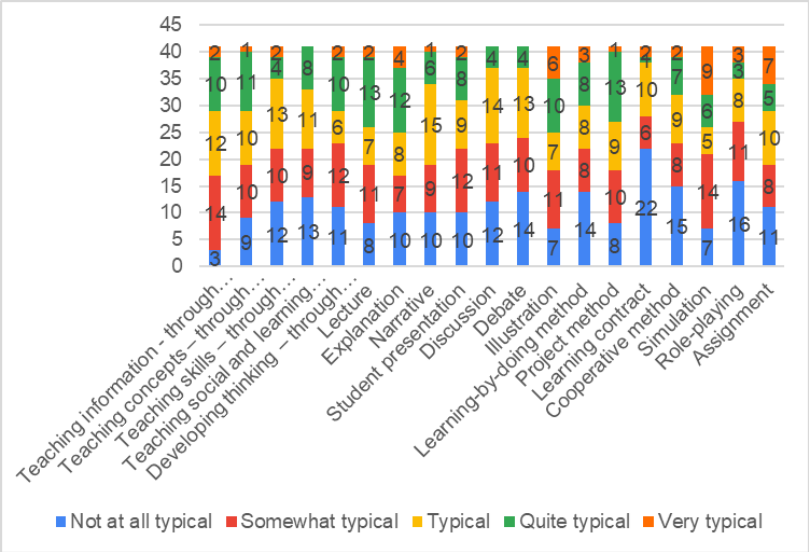

Figure 7
The Usability of AI in Various Educational Activities

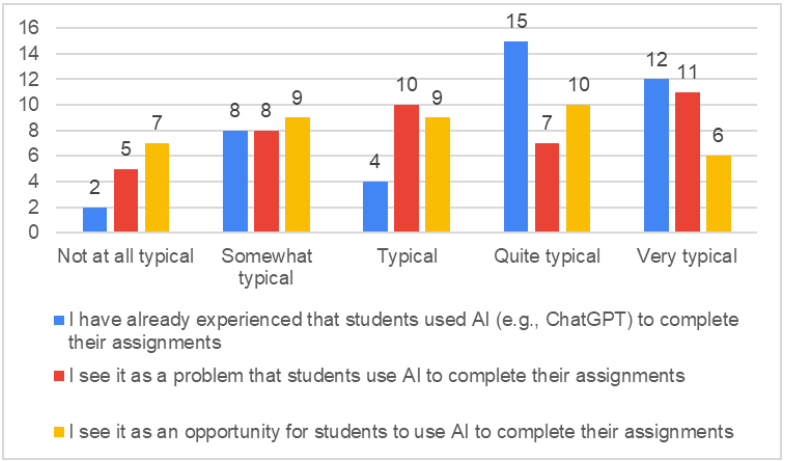

Figure 8
Student Use of AI

Conclusions

The results of this study echo numerous points noted in the cited literature and is based on the responses from university educators. The sampling procedure was full-scale, but it was necessary to send several reminders to the respondents about the importance of completing the questionnaire. Based on the feedback, the respondents

were distrustful of the anonymity of the survey, even though it was guaranteed. Surprisingly, this was particularly characteristic in the field of teacher training. Although fewer colleagues from some scientific fields participated in the survey, the diversity of the university's educational departments ensures that all departmental perspectives are represented in the findings. Since the survey was conducted during the initial phase of AI implementation at university, we did not investigate differences between scientific fields. This was also justified by the low representation of respondents in some fields (e.g., teacher training: 2 respondents). Outside of work, the majority of the educators do not typically use AI, which is reflected in the responses detailed for specific AI-based technologies. In this, reflecting on the literature background [33], ChatGPT also dominates. Although previous studies suggest that AI is expected to support activities [25] [26] within the educational field, such as research and publication efforts. These are indeed seen in university practice. However, curriculum development is not as prominently featured among the applications.

Here again, lack of experience is not necessarily a barrier to using the technology [23]. The educational intentions for the future show a strong shift from current application practices. However, the responses to the open-ended questions in the survey highlight a major obstacle: the dominance of paid applications, which poses a barrier to widespread adoption. Regarding students' use of AI, the risk factors and the assistance they utilize for completing assignments have also confirmed the findings of previous studies [13] [14].

Educators would expect AI to help with administration and evaluation processes in the future. This is especially driven by the perceived necessity to automate workloads due to the rising number of students. The issues of privacy and trust also featured prominently in respondents' comments, where the consistent application of the outlined European legislation may provide reassurance, but does not necessarily alleviate concerns. With the emergence of advanced AI, robots and other digital technologies are increasingly able to answer complex questions and guide those using them in education [47]. In fact, AI-driven platforms such as chatbots and virtual assistants are already being used in many educational settings to help students and teachers solve their questions and concerns. In contrast, most of our instructors, in line with the findings of an earlier study, place the use of AI technologies in the classroom in the distant future [17].

Moreover, robots and other forms of AI can offer advantages that human teachers may not be able to provide. The role and the integration of such technologies and tools in the teaching-learning process and their impact have been addressed by a number of national and international researchers. This research has also investigated the role of a number of pedagogical functions and their usefulness [48-53]. For instance, they can work around the clock and give consistent answers to the same questions, eliminating the variability and subjectivity that can occur with real teachers. Additionally, they utilize large amounts of data and advanced algorithms to tailor their responses to the needs and learning styles of individual students.

AI itself claims that, overall, human teachers play a vital role in education, but it is not correct to say that AI systems cannot provide a similar level of guidance and support. Reflecting on the literature, based on the responses of our instructors, it can be concluded that the responses of text-generating AIs are indistinguishable or difficult to distinguish from those of humans [35-37]. As AI continues to evolve, it is likely that technology will increasingly be used to supplement and enhance human teaching, if not to the extent of full substitutability [54].

Based on the available data, it can be concluded that the use of artificial intelligence in the examined higher education institution is still in its early stages. Educators are primarily characterized by a wait-and-see approach and the conscious use of familiar platforms. The attitude towards AI predicts a dynamic diffusion of this innovation, since, as the answers show, its primary use is in the workplace, with other areas of involvement appearing only second or third. In terms of the use of AI-based technologies, it can be seen that respondents do not use even the most widespread applications. ChatGPT emerged as the most familiar application, followed by Chatbot and Banking. Regarding the question about education, it was possible to compare the present and future (plans). The responses about the present are consistent with the trends observed in previous questions. However, the statements about future plans show a clear openness to new technology and outline its potential role in the educational process. Notably, machine translation emerged as the most prominent area both now and in the future.

A more detailed analysis of the educational process revealed that AI-supported information delivery, illustration, and simulation creation are becoming increasingly prominent. Overall, respondents believe that artificial intelligence can be applied in many areas of the educational process. The study also examined whether educators observe AI usage among students. The responses indicate that while educators are still in the early stages of adopting new technology, students widely and commonly use AI platforms. One of the reasons for this, is that flexibility is a major advantage of AI-based education [15]. An interesting result emerged regarding attitudes toward AI usage: while half of the respondents view it as a problem, the other half see it as an opportunity.

Overall, it can be said that although many areas of artificial intelligence are already accessible online – often for free – the examined group of university educators only partially utilize the opportunities offered by this new technology. In contrast, students – likely due to generational traits – frequently turn to AI for solving their tasks. Today's technological convergence and intertwining with human cognition creates new situations. In different educational situations, the focal points presented underline the complex nature of human-technology interactions.

Cognitive processes can evolve dynamically with existing info-communication tools, so that human capabilities can not only be extended to these tools, but can also be blended with the capabilities of any artificial cognitive system in the future.

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