

# THE APPLICATION OF ARTIFICIAL INTELLIGENCE TOOLS IN HIGHER EDUCATION: OPPORTUNITIES AND CHALLENGES

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**Abstract.** *The impact of Artificial Intelligence (AI) is visible in both the workplace and in education. The progress in AI usage brings about changes and new opportunities for higher education as a whole, across various professional domains. The implications of AI's impact pose a challenge for higher education institutions because students need to be prepared for professional careers, taking into account both the opportunities and offerings created by AI. The study and daily life with AI are widely discussed topics in various sectors, including education. The aim of the research is to provide an overview of the use of AI tools in higher education, particularly in fields like engineering and design, and to analyze the level of user readiness for their application. Research methods include theoretical aspects such as literature review and analysis of internet resources, as well as empirical methods like focus group discussions and analysis of expert interview data.*

*The research is based on 44 students, 4 lecturers in the field of Information and Communication Technology (ICT), and 1 representative from a company working with AI and Machine Learning (ML). The research period is in the autumn of 2023. The research results offer an overview of existing tools and demonstrate awareness of the impact and application possibilities of AI in studies, as well as the current level of user readiness for using AI tools. They also highlight potential research directions for integrating AI capabilities with the study process to assist teachers and students in understanding the latest AI opportunities, promoting preparedness, and considering AI challenges in the future.*

**Keywords:** *Artificial intelligence - AI; Artificial Intelligence in Education; ChatGPT; Higher education; Machine learning*

## Introduction

Artificial intelligence is a widely discussed topic, as evidenced by the guidelines developed by UNESCO, which call on governments to introduce regulations and provide teacher training for the use of AI in education (Miao & Wayne, 2023). The use of AI is also gaining significance in Latvia. On April 12, 2023, the Higher Education Council issued a statement on the use of artificial

intelligence tools in higher education and research, reaffirming the role of higher education leaders in this transformative process with the goal of integrating AI in education and research (Augstākās izglītības padome, 2023).

Engineering and design are present in the products we use in our daily lives. Artificial intelligence (AI) services are already becoming increasingly common in our daily lives. The potential of these AI services is also considered high in an industrial context (Bérubé et al., 2021). AI services in manufacturing are also known as industrial AI. Industrial artificial intelligence is defined as a 'systematic discipline focusing on the development, validation, deployment, and maintenance of AI solutions (in their various forms) for industrial applications with sustainable performance' (Peres et al., 2020). AI technologies can enhance resilience, support work processes, improve product quality, and thus enhance competitiveness. However, there is limited empirical research on the factors that influence the successful implementation and operation of industrial AI services as a whole. Particularly, little attention is paid to the factors of success (Kutz, Neuhüttler, Spilski, Lachmann, 2022).

Stanford Professor John McCarthy, who described it as 'the science and engineering of making intelligent machines', established the first definition of Artificial Intelligence in 1955 (McCarthy et al., 2006). However, during this period, there has been a digital revolution driven by both industrial reforms (Abuže & Ļubkina, 2021) and the COVID-19 pandemic (Vindača & Ļubkina, 2021), as well as the accessibility of tools like ChatGPT. As a result, AI is now defined as the ability of systems to correctly interpret external data, learn from that data, and utilize the acquired knowledge to achieve specific goals and perform tasks, using flexible adaptability (Kaplan & Haenlein, 2019). Artificial intelligence involves the simulation of human intelligence processes with machines, including computers (Burns et al., 2023).

The concept of AI is widely used in various industries; however, in this study, it is primarily viewed as AI in Education (AIED). Machine learning is a subfield of artificial intelligence capable of processing vast amounts of data and discovering characteristic patterns. Machine learning makes the process automatic for decision making and analyzed the individual student data (Asthana & Hazela, 2019).

There are still relatively few studies on the possibilities of AI in education. The aim of this article is to provide an overview of the use of artificial intelligence tools in higher education, particularly in fields like engineering and design, and to conduct an analysis of the level of user readiness for their application. This is done to assist teachers and students in exploring and understanding the latest AI opportunities, promoting an increase in readiness, while considering potential AI challenges in the future.

## Literature review

AI tools are increasingly shaping the landscape of higher education, transforming traditional teaching and learning methodologies. The International AIED Society (IAIED) was launched in 1997 and publishes the International Journal of AI in Education (Zawacki-Richter et al., 2019). IAIED is an interdisciplinary community in the fields of computer science, education, and psychology, with the goal of promoting research and development of interactive and adaptive learning environments (International AIED Society, n.d.). This association underscores the relevance and importance of the topic. In systematic literature review, Crompton & Burke (2023) have examined publications from 2016 to 2022, highlighting areas in education where AI is used, including (1) assessment/evaluation, (2) prediction, (3) AI assistants, (4) intelligent tutoring systems, and (5) student learning management.

As one of the first AI tools available to the wider public, ChatGPT, a chatbot, rapidly gained global popularity (OpenAI, 2022). An AI chatbot is software that utilizes artificial intelligence to communicate with people through text or voice interactions. Chatbots can simulate human dialogues by providing responses to questions and performing specific tasks. They are widely used in various industries and tasks, including education. AI chatbots have the ability to learn from previous communication experiences, allowing them to become increasingly effective and adaptable to people's needs (Madhu et al., 2017). A summary of chatbots is available in Table 1.

*Table 1 AI chatbots (made by authors)*

AI tool	Cost	Usage
ChatGPT <a href="https://chat.openai.com/">https://chat.openai.com/</a>	GPT-3.5 – free GPT-4 – paid model	Chatbot – content creation, translation, writing code, debugging etc. (Stephens et al., 2023).
Google Bard <a href="https://bard.google.com/">https://bard.google.com/</a>	Free	Language Model for Dialogue Applications – LaMDA, explore creative ideas (Stephens et al., 2023).
Bing Chat <a href="https://www.bing.com/">https://www.bing.com/</a>	Free	OpenAI GPT-4 chatbot; in the responses, references are also provided to the sources from which the generated text is taken (Stephens et al., 2023).

Researches emphasize the positive impact of ChatGPT (available to the wider public since December 2022) on the study process, stimulating the transformation of higher education (Dai et al., 2023; Schön et al., 2023). With the help of this tool, learning analytics is improved, idea generation is facilitated, and educational accessibility is expanded. This tool provides real-time responses, which is a crucial aspect for students as it offers immediate feedback.

ChatGPT's user interface enables communication in a conversational manner initiated by the user. Consequently, students need a set of skills to effectively engage in dialogues with the chatbot (Dai et al., 2023). However, ChatGPT may not inherently possess originality, human intuition, or critical thinking when generating ideas. In such cases, ChatGPT's output can serve as a tool to encourage and facilitate idea formation. Nonetheless, students will need to rely on their knowledge and judgment to assess the output and generate fresh and innovative ideas (Dai et al., 2023). On the other hand, Bard, developed by Google (Schön et al., 2023), initially launched in beta version in the United States and the United Kingdom. Since July 2023, it has become available in European countries as well (Stephens et al., 2023). Furthermore, Google Bard made a significant announcement on July 13, 2023, introducing a major update that permits the utilization of images in conjunction with text. This enhanced tool can analyze visual content, offering descriptions such as image captions and responding to queries by leveraging visual information (Qin et al., 2023).

*Table 2 AI research tools (made by authors)*

<b>AI tool</b>	<b>Cost</b>	<b>Usage</b>
Consensus <a href="https://consensus.app/">https://consensus.app/</a>	Various plans (Free, Premium, Enterprise)	Search engine that uses AI to obtain answers from research papers (Consensus, 2023).
Elicit.org <a href="https://elicit.org">https://elicit.org</a>	Various plans (Free, Pay as you go, Enterprise)	Developed by Ought, the program is capable of automating time-consuming research tasks, such as article summarization, data extraction, and synthesis (Whitfield & Hofmann, 2023).
Scite.ai <a href="https://scite.ai">https://scite.ai</a>	Paid	A web browser tool based on machine learning algorithms that allows for easily visualizing how articles are cited in other papers, whether these citations support or express differing opinions, thus confirming the article's impact (Brody, 2021; Bakker et al., 2023; Nicholson et al., 2021).
Research Rabbit <a href="https://www.researchrabbit.ai/">https://www.researchrabbit.ai/</a>	Free	A web citation-based literature mapping tool. The purpose of such a tool is to optimize the time spent searching for references when starting to plan research or conducting a literature review (University at Buffalo, n.d.).
ChatPDF <a href="https://www.chatpdf.com/">https://www.chatpdf.com/</a>	Various plans (Free, Paid)	Assists in reading PDF files using ChatGPT and effortlessly comprehending and analyzing PDF files (Zoew, 2023).

Research plays a significant role in higher education, and it is argued that research and studies should be closely integrated. Research can assist students in developing critical thinking, effective analysis, research, and communication

skills, which are in high demand on a global scale (University of Skovde, 2016; Jensen & Dikilitas, 2023). Therefore, AI tools designed to support research are reviewed, see Table 2.

AI is not a competitor to educators, it is a valuable tool capable of performing and enhancing a wide range of operations carried out at universities, facilitating the organization of an effective educational process. The effective use of AI technologies in higher education allows for the selection of the most optimal teaching strategies tailored to students' individual abilities and needs, as well as to the requirements of the job market (Dilmurod & Fazliddin, 2021). AI tools are essential in education because they can help improve the learning experience and promote student engagement. For instance, AI can assist in personalizing educational programs to match students' needs and abilities, as well as provide students with feedback on their performance (UNESCO, n.d.). Table 3 summarizes some of the AI tools in education.

*Table 3 AI tools for education (made by authors)*

<b>AI tool</b>	<b>Cost</b>	<b>Usage</b>
Gradescope <a href="https://www.gradescope.com/">https://www.gradescope.com/</a>	Paid	The tool enables students to assess each other while simultaneously providing feedback, often a time-consuming task without AI tools. Gradescope relies on a combination of machine learning (ML) and AI (McFarland, 2023).
Fetchy <a href="https://www.fetchy.com/">https://www.fetchy.com/</a>	Paid	AI virtual assistant for educators. From classrooms to homeschooling (Fetchy, 2023).
Plaito <a href="https://www.plaito.ai/">https://www.plaito.ai/</a>	Various plans (Free, Paid)	AI-powered learning platform that helps students learn more effectively (Plaito, 2023).

AI image editing tools have become a relevant solution in the field of education, as they can assist students and educators in improving the quality and reducing the time required for manual image editing. AI Tools Arena has compiled AI tools for various industries and tasks, including animation generator, automation, business, chatbot, copywriting, education, entertainment, finance, image editor, image generator, etc. (AI Tools Arena, 2023b) (see Table 4).

Table 4 *AI tools for image editing and generation (made by authors)*

Title	Cost	Usage
Cutout AI <a href="https://www.cutout.pro/">https://www.cutout.pro/</a>	Various plans (Free, Paid)	An AI-based platform that simplifies photo and video editing (AI Tools Arena, 2023a).
Fyilm.ai <a href="https://fyilm.ai/">https://fyilm.ai/</a>	Various plans (Free, Lite, Pro, Team)	An AI-based colour grading platform. Colour classification is one of the most important aspects of filmmaking and photography (Fyilm.ai, 2021).
MidJourney <a href="https://www.midjourney.com">https://www.midjourney.com</a>	Paid	Generative AI tool for crafting images from text inputs (Midjourney, n.d.).
Dall-E <a href="https://openai.com/dall-e-2">https://openai.com/dall-e-2</a> <a href="https://www.bing.com/images/create">https://www.bing.com/images/create</a>	Paid, Free in Bing Chat	Text-to-image model developed by OpenAI using deep learning methodologies to generate digital images from natural language descriptions (Dall·E 2, n.d.).

Using Google Trends, a graph was created (see Figure 1) that illustrates the global interest over a year (10.09.2022 – 09.30.2023) in AI terms - ChatGPT, Bard, Bing Chat, Consensus, and AI. The *Google Trends Explore tool* is indexed and normalized. Indexing entails the utilization of data sourced from a representative, unbiased sample of Google searches, thereby precluding the availability of precise numerical figures for specific terms or topics. To address this limitation and assign meaningful values to terms, a scale from 1 to 100 is employed, with 100 representing the highest level of search interest within the chosen time and location. Normalization is the methodology used to gauge search interest in a given topic or query. Rather than focusing on the absolute number of searches, this process analyzes the proportion of searches related to that particular topic concerning all searches conducted during the specified time and location (Google, n.d.).

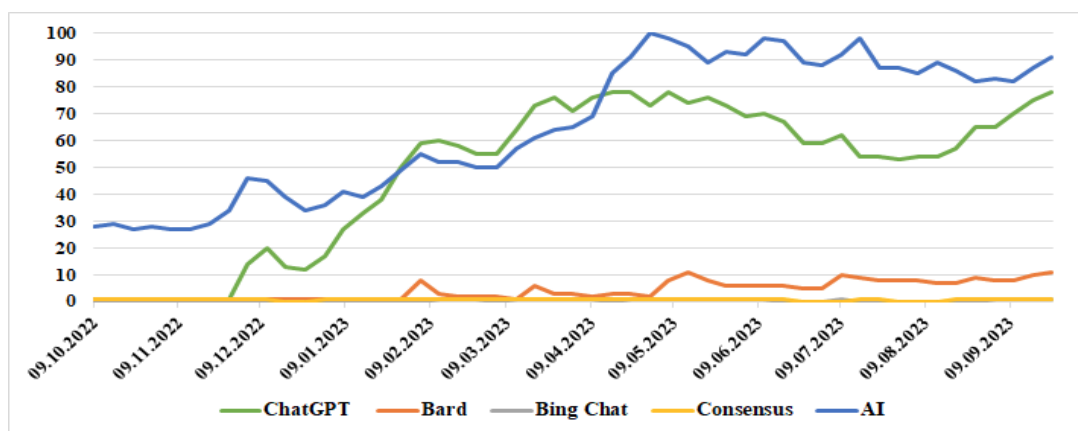


Figure 1 *Interest during the last year (09.10.2022 - 30.09.2023) in AI and its tools in the world (Generated with Google Trends by authors)*

The opportunities for using AI tools are particularly crucial in design and engineering studies because, quite often, traditional product design methods fail to deliver the desired results due to subjectivity, limited research time, and data constraints. Thus, advancements in AI and big data open up possibilities for employing AI-driven product design methodologies, with a significant impact on engineering and product design. AI does not replace traditional engineering and design education, which provides students with a strong foundation in general principles and techniques, but integrating AI into education in these areas offers several advantages: the ability to automate repetitive tasks, the capacity to analyze data, such as user data, and AI assistance in generating ideas using machine learning algorithms. This saves time and allows a focus on more creative aspects. Overall, AI and traditional engineering and design education complement each other successfully.

As an example, the opinion of design educators how AI is being integrated into the higher education system and what they are doing to ensure it is ethically and responsibly used (see Table 5).

*Table 5 New principles for how AI could be used ethically in universities have been published by the Russell Group institutions (Bamford, 2023)*

Design educators	Opinion on AI
University of Leeds associate professor in graphic design Dr Catherine Stones	There are certainly new creative skills to teach, such as ‘Prompt Engineering’. Students though still need high levels of visual literacy to interpret and curate AI generated images. Vital critical skills rely on an excellent grounding in design knowledge, practice and understanding. Design has a long history of embracing technological change. I believe the answer is to support staff and students to learn, question and stay AI-agile.
Ravensbourne University London associate professor and head of Creative Lab Derek Yates	This is a transformative moment, and it brings with it risk and opportunity in equal measure. Yes, we need to be aware of the risk, but we also need to embrace the full range of opportunities. My feeling is that AI has the potential to open up our industries to a much wider range of voices. The importance that traditional creative craft skills play in creative education often provides a barrier to those whose upbringing has not valued those skills. In the new world of AI if you’ve got something to say, you won’t need to be able to draw or use cameras to give your ideas form. As educators we will need to learn to harness and shape this raw creativity and I wholeheartedly embrace that challenge.”
Kingston University associate professor and acting head of School of Design Rachel Gannon	At the centre of the discussions on the impact of AI on design education are AI Image generation tools (e.g. MidJourney and Dall-E). However, the final outcome of any design project forms just a limited part of a wider process. Design thinking, criticality, imaginative extension, speculation, observation, storytelling and empathy are just a few of the skills employed by designers that are, for now at least, unreproducible by AI.

Manchester Metropolitan University deputy head of design David Grimshaw and reader in design Ian Whadcock	Ultimately AI is a tool, and as with all tools it will demand students and staff to develop their skills and judgement in its application. As a quantitative not qualitative tool, students will need to use their knowledge of wider contextual social, environmental, and functional issues to ask AI the right questions. This knowledge coupled with aesthetic judgement will help them develop high quality, original and individual outputs. It is this knowledge based, human, and qualitative approach that is central to design education, and as such AI will support this process and raise standards even higher.”
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In general, it can be seen that opinions vary, but the unifying aspect is the readiness to accept this challenge, the necessity of deep expertise in the field of study, the required skills in the design thinking process, which, at least for now, AI cannot provide, as well as support to create a high level of proficiency in working with AI.

### Methodology

The research aim is to analyze the aspects of AI tool usage in higher education and to conduct an analysis of the user readiness level for their application. Research methods: empirical – focus group discussions, expert interview data analysis, online survey.

Research basis: 44 students of Rezekne Academy of Technologies from various study programs “Fashion Design and Technology”, “Interior Design”, “Design”, “Primary Education Teacher”, “Programming and computer network administration”, “Engineer of Programming”, “Laser Technologies”, “Modelling of Socio-Technical Systems”; research period: autumn of 2023. Thus, representing all levels of study and various courses. Of the participants, 18 were male, and 26 were female, with an average age of 24.61 (mean = 24.61, SD = 7.87).

Qualitative data processing and analysis methods are used. Collection of qualitative data is ensured by 3 focus group discussions (length 1 hours) in student groups, performing the assessment of AI tools using in education process. The respondents assess current issues in AI - their knowledge in using AI tools both in everyday life and in the educational process, expressing their opinion on the opportunities and challenges of implementing AI in education.

Five experts (4 lecturers and 1 representative from a company that works with AI and ML) take part in the research. The selection of experts is determined by their corresponding academic and professional competency. Expert interviews are conducted using a questionnaire which includes 19 questions and the data obtained are summarized and analyzed.

The content of discussions and interviews is structured according to the functional, ergonomic, and service components of the requirements for obtaining



results. Focus group discussions were held face-to-face, recorded, then transcribed and analysed. After the focus group discussions, a survey was also conducted to collect quantitative data. Quantitative data were collected using the online platform QuestionPro, evaluated on a 5-point Likert scale, and for data analysis, only descriptive statistics were utilized with SPSS and Microsoft Excel programs.

### Research results

Analyzing the obtained opinions and data, it can be concluded that students highly rate their knowledge of AI with an average value of 4,52 on a 5-point Likert scale (mean = 4,52, median = 5,00, SD = 0,70). On the other hand, the concept of machine learning is rated slightly lower with an average value of 3,45, which is understandable since the term is specific to the IT industry (mean = 3,45, median = 4,00, SD = 1,40). Although some students admit that the concept of machine learning is unfamiliar, others have heard of it and can explain it to some extent. Focus group discussion participant's opinion about ML and AI.

*ML, in my understanding, is a data-analyzing framework that can provide summary information about collected data. AI, or artificial intelligence, is attributed with the characteristics of human intelligence. I would say that if ML is more of the right, analytical hemisphere of the brain, then AI is the left, creative and somewhat unpredictable hemisphere of the brain.*

Participants in the focus group discussion were asked a question about the use of AI in everyday life, with a mean value of 3,70 on a 5-point Likert scale (mean = 3.70, median = 4.00, SD = 1.44). On the other hand, ICT students admitted that they have learned AI as part of the study course.

Students note that they use AI for both work-related and daily tasks, as well as for their studies, employing AI tools for information retrieval, translation, learning, image generation, optimizing device parameters, text-to-speech, chatbot use, and idea generation. However, not all students have tried to use AI tools yet, and therefore, they lack any experience in working with them.

In the focus group discussions, participants were asked to evaluate AI tools described previously, and the most frequently used ones are ChatGPT, Google Bard, with some having used Bing Chat, Consensus, ChatPDF, and Plaito. However, in most cases, the tools presented are either unfamiliar or not in use (see Figure 2).

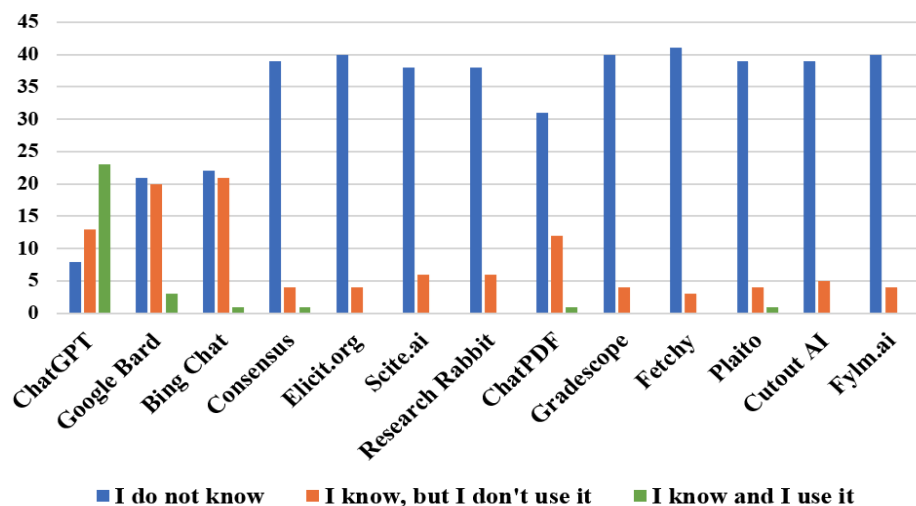


Figure 2 Relative distribution of the students self-evaluation of AI tools using (made by authors)

In the focus group discussions, other AI tools were also mentioned, which were not initially included in the study, such as *GitHub CoPilot*, which is useful for programmers, and *Phind*, a search engine and programmer's assistant that can be used in conjunction with the *VS Code* extension (Phind, n.d.).

The majority of students believe that AI technologies can enhance the study process, with an average score of 3,95 on the Likert 5-point scale (mean = 3,95, median = 4,00, SD = 0,83). In the expert group, support is not unambiguously expressed; however, it is higher compared to students, with an average score of 4,20 on the Likert 5-point scale (mean = 4,20, median = 5,00, SD = 1,10). Examples of students' experiences with AI use in the educational process were summarized:

- Get detailed information;
- Summarize information;
- Ask supplementary questions to the AI;
- Create original, unique tasks;
- Create presentations, visual materials;
- Obtain substantial amounts of information sources;
- Get information faster and more conveniently;
- Support tool for task-solving, problem-solving;
- Process and collect information;
- Find errors;
- Generate texts, ideas, images;
- Automate tasks;
- Prepare projects.

Students acknowledge that AI tools are successful sources of inspiration for generating new ideas and perform excellently with substantial amounts of information, thus enhancing productivity. The group of experts also concurs with

these educational enhancements through the use of AI tools. Experts emphasize that AI tools provide a personalized approach to knowledge acquisition. Industry expert's perspective on AI usage:

*ChatGPT helps practically learn programming and code testing. With ChatGPT, I can discuss scientific discoveries, collaboratively develop hypotheses, and experimental plans. With the help of ChatGPT, I have developed a ChatGPT-based robot that assists me in managing operational matters at my company, such as determining the status of various tasks, delegating assignments, and tracking their progress.*

Recommendations from student and expert focus group discussions on the use of AI in the educational process.

- Do not prohibit the use of AI but encourage collaboration and a critical attitude towards AI-generated ideas.
- Organize informative events, possibly in the form of courses, on the possibilities offered by AI and its use in the educational process, so that students have the competence to use AI tools.
- Provide competitive access to AI tools during studies.
- Recommendations at the ministry level on how educators can use AI tools and develop recommendations for students.
- Verify the correctness of AI ideas/texts by checking the information themselves.
- Motivate students to use AI tools, for example, by preparing their own research papers.
- Focus more on the development of human natural abilities rather than superficial use of IT.

Students rate their knowledge and skills for using AI technologies in the study process as average, with a mean value of 2,95 on a Likert 5-point scale (mean = 2,95, median = 3,00, SD = 1,38), which is also confirmed by descriptive statistics for the question "Do you feel the need to supplement your knowledge and skills for using AI technologies in the study process if there were such a need?" where the mean value is 4,00 on a Likert 5-point scale (mean = 4,00 median = 4,00, SD = 0,94).

Researchers see both opportunities and challenges in the use of AI in education. However, education policymakers must not ignore the need for AI integration in higher education, as students need to be competent in working with AI according to their chosen study programs. Furthermore, ensuring that the latest technologies, including AI, are available to all students helps reduce educational and professional inequalities while promoting greater social equity (Dai et al., 2023).

Meanwhile, the opportunities for enhancing the educational process with AI have been highly appreciated, with an average score of 4,27 on the Likert 5-point scale (mean = 4,27, median = 4,00, SD = 0,85), while the challenges have been

comparatively rated lower, with an average score of 2,72 on the Likert 5-point scale (mean = 2,72, median = 3,00, SD = 1,09). Focus group discussion participants and experts expressed their opinion on the implementation of AI tools in the higher education process, opportunities and challenges are summarized in Table 6.

*Table 6 Opportunities and challenges of implementing AI tools in higher education processes (made by authors)*

<b>Opportunities</b>	<b>Challenges</b>
Wide range of materials	Information inaccuracy/false news
Promotion of development	Excessive reliance on AI tools
Individualized approach	Student self-assessment deficit, unethical use
Get new information	Incorrect text interpretation
Acceleration of work	Lack of critical thinking
Data/information processing, analysis	Lack of communication
Collective creation of new knowledge	Inability to independently analyze information, narrowing of the field of vision, and a tendency to rely on technology rather than one's own mental abilities.

## **Conclusions**

ChatGPT can be considered innovative in the educational process, prohibiting or attempting to control/restrict it would not be effective. It is necessary to focus on its use in the educational process, preparing both students and lecturers for upcoming changes and challenges in the workplace.

Researchers and educational institutions need to understand the positive and negative factors influencing the use of AI. The current research results add to the knowledge in this field. However, further research is needed to better understand the factors affecting the use of AI tools, such as the relationships and dependencies among these factors and their relative significance.

Summarizing the responses provided in the focus group discussions, respondents/students acknowledge that AI tools are successful support mechanisms in education and studies. They serve as sources of inspiration for generating new ideas, work excellently with large amounts of information, thereby enhancing productivity. The expert group agrees with these improvements in education through the use of AI tools and emphasizes that AI tools provide a personalized approach to knowledge acquisition. Overall, experts are unanimous that the integration of AI into the education process will create opportunities to develop unique practical tasks and provide individualized access. However, it also presents challenges in balancing technology integration in education without losing the human factor. In summary, AI tools can enhance the

learning process, but there is a need to supplement knowledge and skills for the use of AI technology.

Interviews and discussions provided insights into respondents' views on the opportunities and challenges of AI. It should also be noted that the sample in this study is limited: AI experts and potential users in the field of engineering and design education. All individuals involved in the use of AI capabilities, especially end-users, should be interviewed in future research to obtain a more comprehensive and in-depth understanding. Additionally, by utilizing different research methods, further supplementary data could be obtained for analysis.

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