Identifying the opportunities and challenges of artificial intelligence in higher education: a qualitative study

Fateme Jafari and Ahmad Keykha

Department of Educational Administration and Planning, Faculty of Psychology and Education, The University of Tehran, Tehran, Iran

Abstract

Purpose – This research was developed to identify artificial intelligence (AI) opportunities and challenges in higher education.

Design/methodology/approach – This qualitative research was developed using the six-step thematic analysis method (Braun and Clark, 2006). Participants in this study were AI PhD students from Tehran University in 2022–2023. Purposive sampling was used to select the participants; a total of 15 AI PhD students, who were experts in this field, were selected and interviews were conducted.

Findings – The authors considered the opportunities that AI creates for higher education in eight secondary subthemes (for faculty members, for students, in the teaching and learning process, for assessment, the development of educational structures, the development of research structures, the development of management structures and the development of academic culture). Correspondingly, the authors identified and categorized the challenges that AI creates for higher education.

Research limitations/implications – Concerning the intended research, several limitations are significant. First, the statistical population was limited, and only people with characteristics such as being PhD students, studying at Tehran University and being experts in AI could be considered the statistical population. Second, caution should be exercised when generalizing the results due to the limited statistical population (PhD students from Tehran University). Third, the problem of accessing some students due to their participation in research grants, academic immigration, etc.

Originality/value – The innovation of the current research is that the authors identified the opportunities and challenges that AI creates for higher education at different levels. The findings of this study also contribute to the enrichment of existing knowledge in the field regarding the effects of AI on the future of higher education, as researchers need more understanding of AI developments in the future of higher education.

Keywords Artificial intelligence, AI in higher education, The future of higher education, ChatGPT, Educational revolution

Paper type Research paper

1. Introduction

Artificial intelligence (AI) has a long history, approximately 70 years (Dhawan and Batra, 2020), and has become a crucial component of the fourth industrial revolution (Yau et al., 2023). This transformative technology has permeated various aspects of human life, including medicine, psychology, and education (Su et al., 2023). AI has become indispensable for educational institutions and universities, shaping them into integral components of societal development (Aldosari, 2020). Universities have evolved beyond their traditional roles of preserving heritage and imparting knowledge and must now embrace technological advancements, forging innovative teaching and learning methods (Morin, 2018). This era is marked by unprecedented uncertainty in higher education (HE). AI has proliferated across society, rendering traditional knowledge and skills obsolete (Akour and Alenezi, 2022). The future of higher education is closely related to the advancement of new technologies and intelligent machines. The rise of AI presents both opportunities and challenges in higher education, leading to changes in institutional governance (Jain and Jain, 2019). Some of the
opportunities that AI offers include personalized learning, collaborative AI-assisted learning, improved research quality, individualized feedback, adaptive learning, and automated assessments. However, some challenges need to be addressed, such as privacy concerns, data security, digital illiteracy, technology costs, implementation issues, equity concerns, and infrastructure limitations (Rasul et al., 2023).

A significant advancement in AI for higher education is ChatGPT, which OpenAI introduced on November 30, 2022 (Kalla and Smith, 2023). ChatGPT is a versatile tool that offers human-like responses and multi-lingual capabilities, including colloquial and standard language usage (Borji, 2023). Its adoption of this technology in education has generated both hopes and concerns. Universities grapple with its potential opportunities and challenges. For example, the Political Science Department at Sciences Po, Paris, became the first French university to prohibit AI and ChatGPT due to fears of exam plagiarism. In 2023, American students demonstrated proficiency using ChatGPT in exams, validating these concerns (Weimann-Sandig, 2023).

With the rapid successive developments in AI in HE, it is impossible to predict its future with certainty. Decision-makers must constantly monitor emerging challenges and opportunities and plan and act accordingly. Prohibition is ineffective, as HE systems will inevitably be affected by this technology, whether they like it or not. Technology growth is unstoppable, and these developments have only accelerated. Therefore, we must adapt to the current conditions. This study aims to identify AI opportunities and challenges in HE. To achieve this goal, two questions have been designed.

1. What are the most critical opportunities that AI provides for HE?
2. What are the most critical challenges that AI provides for HE?

2. Literature review

2.1 Artificial intelligence in education

AI, a transformative force, has significantly impacted education (Pence, 2019; Zawacki-Richters et al., 2019). Its growing presence in education was highlighted in the 2018 Horizon Report as a significant development (Educause, 2018). AI encompasses a wide range of techniques used to create intelligent machines that can understand their surroundings and make decisions (Gimpel et al., 2023). Some typical applications of AI include machine learning (ML) and deep learning (DL) (Salas-Pilco and Yang, 2022). Figure 1 illustrates these techniques’ interconnectedness while highlighting their distinctions (Bozkurt et al., 2021).

AI: The concept of AI dates back to 1950, when Alan Turing proposed the idea that machines might emulate human behavior (Turing, 1950). In 1956, a conference at Dartmouth University formally introduced the term AI (Berente et al., 2021; McCarthy’s et al., 2006 definition characterizes AI as creating machines that mimic human intelligence (McCarthy et al., 2006; Russell, 2010; Ahmad et al., 2021; Popenici and Kerr, 2017; Berente et al., 2021). Broadly, AI can be described as the ability of computers to function like intelligent humans to improve society (Dhawan and Batra, 2020).

ML: ML emerged soon after the inception of AI and was defined by Arthur Samuel as the ability to learn without explicit programming, serving as a means to achieve AI (UNESCO, 2023).

DL: DL, a subset of ML, employs artificial neural networks through layers of interconnected nodes to simulate the human brain (Cheng et al., 2018).

Understanding AI involves categorizing it based on capabilities, leading to three classifications (O’Carrol, 2020):
ANI (Artificial Narrow Intelligence): This is the AI achieved by humanity, referred to as "weak AI."

AGI (Artificial General Intelligence): If achieved, it would interact with human intelligence (UNESCO, 2023).

ASI (Artificial Super Intelligence): The last tier surpasses human capabilities (O’Carroll, 2020), offering significant investment potential.

AI adoption varies across different industries, including manufacturing, healthcare, finance, e-commerce, and education. In the manufacturing sector, AI is used for tasks such as product design, workforce planning, quality improvement, and more. In healthcare, it supports medical staff, drug discovery, and disease detection. The financial technology sector also utilizes AI for personal investment, loan processing, and banking operations organizations. E-commerce benefits from AI for consumer behavior analysis, marketing, and virtual assistants. However, despite its potential, the education sector has been slower to adopt AI (Bughin et al., 2017). AI can potentially impact educational management and the teaching-learning experience (Dhawan and Batra, 2020).

The future of AI is constantly evolving and is expected to have a significant impact on various domains, promising transformative developments (see Figure 2). The field of AI is rapidly evolving, and its future developments are poised to make a significant impact across various domains, as highlighted by Ballant (2018).

Baker et al. (2019) categorize AI in education into three general approaches based on its implementation (tools): inclusive-oriented, educator-oriented, and institution-oriented. The inclusive-oriented approach focuses on learners and utilizes intelligent or adaptive educational systems. These tools are designed to tailor materials to individual learner characteristics, assess strengths and weaknesses, and provide automatic feedback. On the
other hand, the educator-oriented approach is centered on teachers and aims to reduce their workload, provide learner-related information, and promote classroom innovation. Lastly, the institution-oriented approach is beneficial for educational institutions as it provides decision-making information (Baker et al., 2019).

2.2 Research background

In 2023, Rasul and colleagues conducted a study titled "ChatGPT in Higher Education: Opportunities and Challenges and the Future Research Path." ChatGPT is a valuable AI tool for education. The study identified five opportunities: adaptive learning, personalized feedback, research support, administrative support automation, and creative assessments. The challenges identified in the study include ethics (knowledge gaps between students, copyright issues, information validation, and potential for misuse), evaluating graduates' abilities, using fake information in data processing, and assessing learners' results. In another 2023 study by Su and colleagues, titled “Using AI in Early Childhood Education,” the authors explored challenges and opportunities. They analyzed sixteen articles published between 2016 and 2022. The challenges identified in this study include teacher AI literacy and curriculum design, while the opportunities focus on enhancing children’s AI literacy. Qin and Wang (2022) presented “Opportunities, Challenges, and Solutions for Using Artificial Intelligence in Education”. This article divided opportunities into three categories from users' perspectives: learners, educators, and administrators. The opportunities identified in this study include personalized learning, targeted training, and decision-making support. The challenges discussed involve incomplete algorithms, data shortages, and technical dependence, and the authors propose solutions to address these challenges.

In 2022, Çelik et al. conducted a study entitled “Opportunities and Challenges of AI for Teachers,” which categorized opportunities into three main areas: planning, implementation, and evaluation. Concerning planning, opportunities such as providing background information and making decisions regarding teaching content were identified. Implementation supports timely monitoring and providing feedback, which can reduce teacher workload. Evaluation provides better assessment, automatic evaluation, and feedback on exercise effectiveness. However, the study also identified several challenges, including AI algorithms’ credibility, AI technical limitations, AI technical infrastructure in schools, AI inefficiency for evaluation, teacher knowledge and interest, AI slow feedback, and adaptive feedback with limited AI. Another study by Akinwalere and Ivanov in 2022 about “AI in Higher Education” explored opportunities such as smart campuses, use in research, teacher collaboration, personalized learning, global access, and administrative activity automation. However, the study highlighted potential challenges, including adverse consequences, comprehensiveness, accuracy, and implementation. Based on these findings, the researchers made recommendations for using AI in HE.

Similarly, Owoc et al. (2019) conducted a study on “AI Technologies in Education,” which identified opportunities such as automatic grading, interval repetition, feedback loops for teachers, AI as an assistant in the classroom, and personalized learning. However, the study also noted strategy, organizational maturity, data governance, and infrastructure challenges. Dhawan and Batra's 2020 study, “AI in Higher Education," found opportunities for AI in personal learning, skill development, lifelong communication, collaborative learning, security, information sharing, and AI cooperation in research. Challenges encompass privacy, technology costs, digital illiteracy, inexperience, technology’s raw nature, and implementation issues.

3. Methodology

It is clear that AI is already adding value to HE. AI provides HE institutions with a long list of opportunities and challenges. In decision-makers’ opinion, they should constantly monitor
emerging challenges and opportunities and then plan and act accordingly. Therefore, this study was developed to identify AI opportunities and challenges in HE.

3.1 Research design
This research is qualitative; qualitative research seeks to answer three types of questions about a phenomenon: “how”, “why”, and “what” (Thorogood and Green, 2018). In these studies, the data are words (textual data) (Hennink et al., 2020). Data collected in qualitative research are collected through interviews, observations, or focus groups (Haven and Van Grootel, 2019). Noticeably, two types of paradigms are used in these studies: interpretive and positivist paradigms (Hennink et al., 2020).

This qualitative research was developed using the thematic analysis method. In particular, Braun and Clarke (2006) utilized thematic analysis in this research. Thematic analysis is a flexible, widely used qualitative analytical method. Thematic analysis is a method for identifying, analyzing, and reporting patterns (themes) within data (Braun and Clarke, 2006).

3.2 Population and sampling
The participants of this study were AI PhD students at Tehran University in 2022–2023. Purposive sampling was used to select the participants; this is a kind of sampling that selects appropriate participants with useful information (Kelly et al., 2010). Purposive sampling ensures that the selected cases are suitable for research (Robinson, 2014). Therefore, students who had sufficient knowledge of the subject were chosen. The rule of theoretical saturation was used to determine the sample size. Therefore, after interviewing 15 participants, no new classes were added to the previous classes. In Figure 3, the distribution diagram of the participants is shown based on gender.

Based on the demographic information collected from the participants, 13 (86%) of the participants in the interview were male and 2 (14%) were female. The following diagram in Figure 4 represents the distribution of participants by age.

Based on Figure 4 above, the most frequent age group of the interviewees was 30–39 years old, which included nine interviewers. The next most frequent age groups were 20–29 and 40–49 years old, with frequencies of 5 and 1, respectively.

3.3 Data collection
The data collection tool was a semi-structured interview in which all respondents were asked the same questions but were free to give their answers however they wanted. The average duration of the interviews was between 30 and 50 min. These questions are listed as follows:

![Figure 3. Distribution of participants by gender](Source(s): Authors’ own work)
Q1. What are the opportunities for using artificial intelligence in higher education for faculty members?

Q2. What are the opportunities for using artificial intelligence in higher education for students?

Q3. What are the challenges of using artificial intelligence in higher education for faculty members?

Q4. What are the challenges of using artificial intelligence in higher education for students?

3.4 Data analysis
This qualitative research was developed using the thematic analysis method. In particular, Baron and Clarke (2006) utilized thematic analysis in this research. The data analysis process included five steps described in Table 1 below.

3.5 Reliability and validity
Indeed, despite the fact that reliability and validity have traditionally been associated with quantitative studies, they have also been applied to qualitative studies (Hansen and Husmoen, 2016). Guaranteeing reliability and validity is essential for qualitative data due to potential risks for participants (Gururajan et al., 2014).

To validate the data, the member-checking strategy was used (Birt et al., 2016). Therefore, after data analysis, three to five participants were randomly selected, and the results of the data analysis were reported to them and approved and reviewed. For ethical considerations, the following measures were taken: (1) introducing oneself to the participants in the study and explaining the research objectives; (2) obtaining informed consent from participants; (3) giving the participants the right to decide whether to continue or withdraw from the study; and (4) giving assurance to the participants regarding the confidentiality of their information and not using their names and personal and private details in the study.

3.6 Ethics in research
In order to comply with research ethics, the participants were aware that the conversations were being recorded during the session and that the recorded voices were only available to the researcher and his colleagues in this study and would not be accessible by others in any
3.6.1 Findings. 3.6.1.1 Section 1: most important opportunities that artificial intelligence provides for higher education. After extracting the key concepts through repeated iterations, the key concepts were classified according to similarities and differences. The result of this analysis is represented in appendix Table A1. Based on the table, two primary subthemes have been obtained under the titles “Creating Opportunities at the Classroom Level” and “Creating Opportunities at the University Level”. Secondary subthemes related to creating opportunities at the classroom level include opportunities created for faculty members (43 concepts), opportunities created for students (25 concepts), opportunities created in the teaching-learning process (22 concepts), and opportunities created for evaluation (36 concepts). Concerning the primary subtheme of creating opportunities at the university level, four secondary subthemes under the titles of development of educational structures (26 concepts), development of research structures (23 concepts), development of management structures (27 concepts), and development of university culture (5 concepts) were identified. In this research, a total of two primary subthemes, eight secondary subthemes, and 207 concepts were obtained (Appendix).

3.6.1.2 Section 2: the most important challenges of AI in HE. Similar concepts were grouped into higher (more abstract) categories based on their similarities and differences, as in the previous section. Table A2 in Appendix shows that two primary subthemes were obtained under the titles “Challenges at the Classroom Level” and “Challenges at the University Level”. Secondary subthemes related to challenges at the classroom level include challenges for faculty members (11 concepts), challenges for students (9 concepts), challenges
4. Results and discussion

AI has become prevalent in all sectors, including higher education. It can be argued that AI is currently one of the most influential drivers of change in the field of HE. This technology has the potential to enhance education quality and accessibility, potentially leading to a transformation in management, teaching, and learning methods. However, the successful integration of AI in HE requires careful and innovative implementation. With its advanced algorithms, AI can expand human intelligence limits, making it an integral part of the future of HE.

The research aims to explore the impact of AI on higher education (HE), focusing on opportunities and challenges. These opportunities can be categorized into classroom-level and university-level benefits. At the classroom level, opportunities encompass faculty members, students, teaching, learning processes, and assessment. For faculty members, AI can provide personalized exams and reduce their workload. As one participant noted, “We can design individualized exams and save time.” “AI can also automate certain tasks, like polls, reducing faculty workload. Continuous access to AI equates to a 24-h teacher.” AI improves class quality, content relevance, and engagement. Among the studies that have mentioned the achievements of AI for faculty members, we can mention Nagro (2021) and Alhwaiti (2023). The use of AI by faculty members in HE enhances the development of educational goals, educational program design, the implementation of curriculum goals, and the enhancement of curriculum processes (Pedro et al., 2019). The potential of AI is evident in its ability to provide customized exams and content, efficient task automation, and continuous support for faculty and students. This research aims to delve into the transformative potential of AI in HE, shedding light on its numerous opportunities for improvement, innovation, and personalization.

As a university professor, it is crucial to foster student opportunities. Interview Code 4 highlights the versatility of AI in various fields. For instance, in the realm of language, AI aids in text assessment, identifying grammatical errors, and enhancing writing quality. It can also generate concise topic summaries, tailoring responses to specific references, thereby saving valuable time (Interview Code 4). Similarly, with the help of AI, students can have a digital profile that can be used to assign personalized training, such as a private tutor, leading to increased productivity inside and outside the classroom (Chassignol et al., 2018). AI’s impact on education extends to note-taking; students can utilize tools for efficient note capture, eliminating the need to juggle listening and writing in class (Interview Code 11). Among the studies that have mentioned the achievements of AI for faculty members, we can mention Rasul et al. (2023), Owoc et al. (2019), and Dhawan and Batra (2020). Furthermore, AI systems enhance the teaching and learning process by providing high-quality educational content through learner analysis and data mining (Cheng et al., 2018). In summary, AI empowers students and educators alike, offering diverse benefits across the educational spectrum.

Creating opportunities for students, for example, interview code quote (4): “It is effective in any field. For example, in relation to language, a person can write a text, and AI can score the way of writing, catch grammatical mistakes, etc.”. An example quotation from the interview Code 4: “For example, it can summarize a certain topic for you; AI will answer you in a specific way according to a specific reference, which can help a lot and save time.” An example of the quotation from the interview Code 11: “There are tools that help learners take notes during the education process.”
process, and there is no need for students in the class to listen and take notes; they should just listen.” Among the studies that have mentioned the achievements of AI for students, we can mention Rasul et al. (2023), Owoc et al. (2019), and Dhawan and Batra (2020). With the help of AI, students can have a digital profile that can be used to assign personalized training, such as a private tutor, leading to increased productivity both inside and outside the classroom (Chassignol et al., 2018). Creating opportunities in the teaching and learning process, for example, interview code quote (5): “In the learning process, the learner seeks to learn something and spends time, but if they search in search engines, they will easily find the most recent and relevant ones.” AI systems provide high-quality educational content through learner analysis and data mining, thus supporting the entire teaching and learning process (Cheng et al., 2018). AI facilitates simulation-based learning in various fields, like medicine (e.g. brain surgery for medical students) (Qin and Wang, 2022; Celik et al., 2022; Ullah and Arshad, 2022; Zhang, 2022). “It revolutionizes assessment methods by rendering traditional methods obsolete, allowing AI-driven exam and exercise solutions” (Interviewee 7). “Additionally, AI assists professors in pinpointing students’ strengths and weaknesses by analyzing feedback and performance data” (Interviewee 3). It also enhances fairness in exam corrections through AI-driven criteria (Interviewee 11) and has transformed evaluation processes, leveraging reliable data for multifaceted knowledge evaluation (Cope et al., 2021). AI has opened new educational horizons, revolutionizing both teaching and assessment methodologies.

Regarding opportunities at the university level, four categories have been identified: the development of the educational structure, the development of the research structure, the development of the management structure, and the development of academic culture. Similarly, the identified challenges can be analyzed in two general categories: challenges at the classroom level and challenges at the university level.

Creating educational opportunities with AI integration into the metaverse or value-added reality can create a strong learning environment (interview quote 12). AI simplifies education (interview quote 5) and offers new content formats (interview quote 3). Implementing quality assurance systems with AI can revolutionize education (interview quote 8). AI’s achievements in educational development are evident in studies by Dhawan and Batra (2020), Akinwalere and Ivanov (2022), and Celik et al. (2022). The development of AI has had a significant impact on the teaching and learning process, leading to changes in teaching methods and revolutionizing education (Xue and Wang, 2022). AI streamlines research with automated background checks, summarization, and problem-solving (interview quotes 1, 12). It interprets research findings (interview quote 14) and aids in analyzing research structures (Rasul et al., 2023; Dhawan and Batra, 2020; Akinwalere and Ivanov, 2022). AI is highly effective at analyzing and categorizing articles, saving time and effort for students, and producing higher-quality work (Solangi et al., 2018). AI’s role in management structures promotes efficient control and green university practices (interview quotes 4, 8). Its impact on management is reflected in studies by Qin and Wang (2022) and Sharma et al. (2019). The use of AI technology enables human-machine cooperative decision-making in HE institutions (Liu et al., 2018). To develop an academic culture, cultural rules must be established for AI use, respecting intellectual rights (interview quote 14). The cultural shift driven by AI is inevitable (interview quote 8). As with past innovations, societal norms evolve (interview quote 14).

The challenges at the classroom level include those created for faculty members, for students, for the teaching-learning process, and for evaluation. The challenges at the university level also include developing educational structures, research structures, management structures, and university culture.

Faculty challenges include outdated AI knowledge (Code 4), a lack of AI skills (Code 10), and difficulties with AI (Code 11) (Su et al., 2023; Celik et al., 2022; Dhawan and Batra, 2020). Despite the positive attitudes of faculty members towards the use of AI in education, their level of preparedness to use this technology is only moderate. This is due to factors such as
lack of knowledge, limited resources, and ineffective use (Alnasib, 2023). Student issues encompass AI-replacing thinking (Code 3), over-trust in AI-generated content (Code 7), and unequal access (Code 2) (Akinwalere and Ivanov, 2022; Dhawan and Batra, 2020). In the educational process, content is often presented electronically, resulting in a passive learning experience for students. Additionally, there is a lack of understanding about the interaction between humans and computers (Liu et al., 2022). Teaching and learning face AI accuracy (Code 2) and human-AI differences (Code 5) issues (Su et al., 2023; Akinwalere and Ivanov, 2022). Numerous studies have shown that AI cannot replace the role of a teacher, and the way AI technologies function is vastly different from human intelligence (Cope et al., 2021).

Evaluation challenges involve cheating (Code 4) and AI learning reliability (Code 2) (Celik et al., 2022; Dhawan and Batra, 2020). The evaluation conducted by AI may not reflect students’ knowledge and skills accurately (Swiecki et al., 2022).

The challenge of developing educational structures includes the need to review and verify AI-generated content (7) and the potential for educational injustice when students lack access to technology (12) (Rasul et al., 2023; Akinwalere and Ivanov, 2022). One of the challenges in education is the rise of fraudulent activities and the resource limitations to detect them (UNESCO, 2023). In research, distinguishing between AI and human work is a major challenge (1), and AI can lead to research plagiarism (7). AI challenges in management structures involve financial burdens (8) and the absence of anti-fraud laws (15) (Owoc et al., 2019; Tao et al., 2019). The use of AI in research may lead to issues such as difficulties in conducting literature searches, potentially excluding essential studies or including irrelevant ones (Chubb et al., 2022). Developing academic culture is hindered by professors’ resistance to AI (13) and concerns about its impact on national and cultural identity (8) (Mohammed, 2018). Limited AI availability in some countries due to specific laws and concerns about equal access due to speed and Internet costs pose challenges (UNESCO, 2023).

5. Future research directions
We suggest that future researchers identify challenges and opportunities by using hierarchical statistical methods from the perspective of experts. It is recommended that future researchers do a comparative study of the identified challenges and opportunities of AI in different countries according to their perception of their environment.

6. Research limitations
Concerning the intended research, several limitations are significant. First, the statistical population was limited, and only people with characteristics such as being Ph.D. students, studying at Tehran University, and being experts in the field of artificial intelligence could be considered the statistical population. Second, caution should be exercised when generalizing the results due to the limited statistical population (PhD students of Tehran University). Third, the problem of accessing some students due to their participation in research grants, academic immigration, etc.

7. Practical suggestions and policy recommendations
(1) Holding empowerment courses for faculty members and students in order to improve computer capability and adaptability to prepare for the future
(2) Formulating laws at the level of higher education and universities in the field of using new technologies such as Chat GPT for more effective monitoring and follow-up of violations
(3) Changing the assessment mechanisms of students and adapting and accepting new methods according to the unique structure of artificial intelligence

(4) Developing universities’ hardware and software infrastructure and realizing smart universities to prepare for the digital future

(5) Redefining the laws related to intellectual property laws and patents according to the changes brought about by the evolution of artificial intelligence

(6) Making small changes to change the norms of the academic culture to accept technological developments

References


<table>
<thead>
<tr>
<th>Primary subtheme</th>
<th>Secondary subtheme</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating opportunities at the classroom level</td>
<td>Opportunities created for faculty members</td>
<td>Helping to investigate plagiarism more closely in students’ educational activities (1); Helping to investigate academic plagiarism in students’ research activities (13); Use as a teaching assistant (4:3:2:1); Helping to better transfer course concepts (4:3:11:1); Developing teaching resources (4:1); Helping in the realization of goals and lesson topics (1); Helping to organize educational activities in laboratory environments (1); Better identifying students’ weaknesses and strengths (13:11:2:9); Analysis of students’ mental state in class (1); Reducing workload (1); updating tasks (1); Helping to correct handwriting (1); Having a reminder role (2); Helping to monitor educational and laboratory activities (2); Helping to identify students’ errors (2); Helping to manage time (3:31:29); Speed up performance (2); Helping to provide more targeted teaching materials (3); Identifying strengths and weaknesses at the beginning of the semester (3); Assisting in the preparation of course content (3); Choosing up-to-date teaching styles (3); Compilation of the course outline using ChatGPT (4:1); Updating and developing the course outline (4); Identifying strengths and weaknesses in the course outline (1); Designing the course outline (4); Helping to identify the latest topics related to the field of teaching (5); Developing search skills (5); Helping to change performance towards improvement (5); Designing more practical examples in education (6); Creating creativity in teaching (6); Helping to choose useful educational resources (6); Having a complementary role in presenting materials (6); Giving immediate feedback to the student after solving problem (7); Helping ChatGPT in editing article (9); Helping ChatGPT in designing exercises and homework (11:9); Using smart attendance system (13:9); Better management of classes with high student population (9:11); Developing teaching aid tools (11); Providing creative ideas for teaching (11); Helping to provide useful educational information (12); Reduce the presence of professors in the university (13); Assist in automatic monitoring of students’ work (13); Using fraud detection systems in exercises (13)</td>
</tr>
<tr>
<td>Opportunities created for students</td>
<td>Using for problem solving (9); Using as a tutor (2:11); Reducing workload of students (1); Helping students who are falling behind in academic subjects compared to other students (1); Answering students’ questions outside the classroom environment (2:11:13); Providing more access to chatbots for students (2); Helping with better time management (11:4:2); Helping to increase the speed of performance (2); Educational personalization (9:7:3); Helping to develop other skills by providing educational resources (4); Providing editorial and grammatical assistance in writing (4); Helping with summarizing (4:7); Helping to complete homework (4); Assistance in finding resources (4); Helping to identify the field of interest (9); Helping to learn software (9); Helping to choose the subject of thesis and essay (9); Helping to review different topics and chapters of a lesson (7); Designing personal exercises (7); Helping to search for essays and theses (11); Helping to take better notes in lessons (11); Helping to better study articles (11); Helping to summarize the contents more accurately (11); Helping students to make a better class presentation (such as Power Point design, etc.) (11); Helping to conduct more targeted and faster searches (11)</td>
<td></td>
</tr>
<tr>
<td>Opportunities created in the teaching and learning process</td>
<td>Developing interactions between students and professors (1); Practical learning (1); Preparing a database of students’ status (15:1:1); Analysis of factors affecting students’ performance (1); Paying attention to individual learning styles and differences (1:3:5:9); Helping teachers to know themselves better in the teaching process (3); More accurate recognition of students’ skills (3); Using advanced visual expressions in the classroom (3:5:9); The role of facilitator in learning (3); Helping to learn unknown concepts faster (9); helping to synthesize information for more sustainable learning (9); Helping to learn concepts more deeply (9); Making the classroom environment more attractive (9); Dynamicizing the classroom environment (9); Helping students focus (11); Helping to create a better atmosphere for questions and answers in the classroom (1:3:3); Using ChatGPT in teaching processes (6:2:1:4); Helping to create a learning simulation environment (6:1:4); Using smart systems to film the classroom to improve the learning process (9); more interactive learning (15); Emergence of new learning methods (15); Personalized learning (15)</td>
<td></td>
</tr>
<tr>
<td>Opportunities created for evaluation</td>
<td>Grouping and collectively evaluating of students (6); More accurately measuring student performance (6); Assisting in assessment to grade students (6); Helping to design new questions for training (6); More accurately assessing of class assignments (7); Diversifying test questions (7); Helping to conduct tests better (9:11); Using in correcting tests (13:19); Forming a database for frequently repeated questions (9); Designing online exam monitoring systems (9:11); Rapidly evaluating and grading of tests (9); Making the student evaluation process faster (9); Designing test questions according to each student’s ability (9:3:5); Saving test time (1); Saving time spent on question design (1:3:5:9); Helping to better distinguish between excellent and poor performance (1); Evaluation of students based on specific individual conditions (1); Better analysis of the causes of students’ academic failure (1); Setting questions with different degrees of difficulty (2:5:9); More realistically evaluating of students’ performance (3); Receiving continuous evaluation from students (5:7); Analyzing students’ academic progress based on time trends (5); Using ChatGPT in designing test questions (5:6); More detailed design of test questions (7:3); Helping to prevent cheating during testing (3); Helping to conduct cognitive assessment of students (3); Better evaluation in practical lessons (3); Improving the quality of test questions (4); Developing simulated tests (4); Helping to conduct a more accurate comparative assessment amongst students (4); Ranking tests performed (9); Preparing a test question bank and randomly selecting questions (9); Designing questions based on the degree of difficulty (9); Improving examination methods (9); improving methods of correcting exam papers (13)</td>
<td></td>
</tr>
</tbody>
</table>

Table A1: The most important AI opportunities for HE
<table>
<thead>
<tr>
<th>Primary subtheme</th>
<th>Secondary subtheme</th>
<th>Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating opportunities at the</td>
<td>Development of educational structures</td>
<td>Improving the quality of education (6:1); Improving educational efficiency (1); Defining new educational rules (1); providing more and better educational accountability (2); Providing new educational content (3); Diversifying educational content (3); Updating educational content (3:4); Providing free access to a large amount of educational resources (4); Reducing the amount and percentage of errors in carrying out educational activities (4); Simplifying the education process (5); Improving the style and patterns of education (5); Transforming the flow of education (6); Accelerating coordination between educational activities (9); Having a huge source of data for better education (10); Helping to ensure a more accurate quality of education (8); Producing educational content compatible with artificial intelligence (12); Using value-added reality in education (12); Using virtual reality in education (12); Using metaverse space in education (12); Visualizing and illustrating in education (12); Creating educational equality in access for all educational groups (12); Providing fast and timely educational support (12); Increasing the speed of educational efficiency (6:4); Optimizing the training process (5); Using gamification in the education process (1); Facilitating the process of producing educational content (15); Using big data in research (1); Helping to collect more data in research (1); Defining new research rules (1); Using Reinforcement Learning in research (1); Problem solving in research (1); Helping to choose and understand research topics (1); Helping to conduct more practical research (4); Providing background before reaching the final results of the research (e.g. the result of combining two materials) (4); Accelerating the research process (8:13); Concluding research contracts (8); Preparing huge research databases (12); Using as a research assistant (1); Using in research literature review and idea creation (5:4:1); Applying to existing research background (1); Helping to identify gaps in the research field under study (1); Helping to prioritize and prepare the timeline of research activities (1); Impacting intellectual property laws in the research field (1); Helping in the field of research execution and implementation (1); Guiding in the research process (1); Improving the research speed (1:2); Simplifying the research process (1); Publishing more recent research (8); Better conducting interdisciplinary and transdisciplinary research (13); Adjusting the optimal punishment and reward system according to the new conditions (1); Better identification of the weaknesses and strengths of human resources (1); Developing curriculum in the field of artificial intelligence for all disciplines (8); Developing educational advertisements using artificial intelligence (8); Revising university policies (8); Developing university industry communication policies (8); Increasing the awareness of university administrators (8); Updating the university’s management system (8); Reforming regulatory mechanisms (8); Amending university rules and regulations (8); Helping to create a green university (preserving environmental resources) (8:13); Helping to use resources optimally (8); Development of university revenue source (8); Developing targeted policies in the cultivation of specialized human resources (8); Recruiting expert human resources from other countries (8); Developing remote work activities (8); Developing international communication (8); Creating multinational job positions (8); Helping to develop the internationalization of the university (15:8); Encouraging effective activities based on artificial intelligence (8); Creating new laws in the field of intellectual property (12); Using as an assistant in management (8); Developing new job competencies for students (8); Creating new job skills in students (8); Revising old fields of study and updating of new fields of study (8); Accelerating administrative processes (13); Designing new laws in line with artificial intelligence technologies (15); Culturally accepting the university (8); Modifying the process of resisting change in academics (8); Changing the academics values (12); Creating new values in the university (12); Teaching the culture of using technology (15)</td>
</tr>
</tbody>
</table>

Note(s): The number in front of each concept indicates the number of the participant in the interview. **Source(s):** Authors’ own work
<table>
<thead>
<tr>
<th>Primary subtheme</th>
<th>Secondary subtheme</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges at the classroom level</td>
<td>Challenges for faculty members</td>
<td>The unpreparedness of professors in accepting new education systems (2:4); Low skill of professors in working with artificial intelligence (10:16:2:4); Creating unrealistic competition between professors (3); Increasing the gap between the professors who use this tool and those who do not (4); The outdated knowledge of some faculty members (4); Inadequacy with the presentation of some courses (6); Reduction of working group and team spirit (7); Making extensive changes in the form of class management (7); Assigning the responsibility of education to the artificial intelligence system (relieving the burden of the responsibility of education) (9); Low knowledge of some professors in using new technologies (13); One-dimensionality skills of some professors (13)</td>
</tr>
<tr>
<td>Challenges for students</td>
<td></td>
<td>Students’ low skill in working with artificial intelligence (2:15); Weakening students’ writing skills in education (3); Weakening students’ writing skills in research (3); Creating unrealistic competition between students (3); The student’s sense of independence from the teacher in the educational process (3); Reducing the spirit of student responsibility (4); Increasing the gap between students who use this tool and those who do not (4); Creating excessive trust in the content produced by artificial intelligence in students (7); Reducing the spirit of working in groups and teams (7)</td>
</tr>
<tr>
<td>Challenges in the teaching and learning process</td>
<td></td>
<td>Diminishing the role of teachers in the teaching process (1); Unreliability of ChatGPT responses (2); lack of supervision of ChatGPT responses and performance (2); Lack of human emotions in robots in human communication in the classroom (4:2); Loss of the social and communicative nature of education (2); Reduction of social and emotional relationships between professors and students (2:10); Out of reach and control of learning processes (4); The presence of bugs in the performance of artificial intelligence tools in the learning process (6); The lack of up-to-date information of some artificial intelligence tools in the learning process (6); Misdirection in the answers of ChatGPT (6): The loss of the concept of learning due to doing Exercises by ChatGPT (11); Loss of learning value (11); Doing homework and student projects without learning by artificial intelligence (2:1)</td>
</tr>
<tr>
<td>Challenges in Evaluation</td>
<td></td>
<td>The difficulty of recognizing the originality of work for evaluation (2:1); Lack of trust in some results (6:4); The possibility of deceiving artificial intelligence tools for assessment (4); Abuse in responding to projects and class assignments in assessment (9)</td>
</tr>
</tbody>
</table>

Table A2. Challenges of artificial intelligence for higher education (continued)
<table>
<thead>
<tr>
<th>Primary subtheme</th>
<th>Secondary subtheme</th>
<th>Concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>Challenges at the university</td>
<td>Challenges in educational structures</td>
<td>Increasing educational injustice among different groups (12); The difficulty of recognizing educational products by humans or artificial intelligence (2:1); The need for continuous review and verification of content produced by artificial intelligence (7)</td>
</tr>
<tr>
<td>level</td>
<td>Challenges in research structures</td>
<td>The difficulty of recognizing research products by humans or artificial intelligence (3:2:1); Academic plagiarism in researches (7:4:1); Changing instances of academic plagiarism (1); Lack of clear laws in the field of pursuing the resulting crimes (1); Reducing interactions in research processes (3)</td>
</tr>
<tr>
<td>Challenges in management</td>
<td>Challenges in management structures</td>
<td>Loss of some management functions (8); Expensiveness (8); The lack of up-to-date administrative systems in universities (13); The low level of facilities in some universities (13); Incompatibility of the current laws of universities with artificial intelligence (13); Difficulty of regulatory processes (14); Insufficient specialized training for human resources (15); Lack of a comprehensive punishment system for violations (15)</td>
</tr>
<tr>
<td>structures</td>
<td>Challenges in academic culture</td>
<td>Resistance to changing professors in accepting new technologies (6:10:13:11:4:2); Negative attitude of some academics towards artificial intelligence (4); Becoming bolder due to the generational difference between students and professors in the use of new technologies (2); Loss of cultural identity (8); Loss of national identity (8); Using negative personal views (such as racism) in the design and development of artificial intelligence tools (4); Existence of an inappropriate culture of use (14)</td>
</tr>
</tbody>
</table>

Table A2. Source(s): Authors’ own work

**Corresponding author**
Ahmad Keykha can be contacted at: ahmadkeykha@ut.ac.ir

For instructions on how to order reprints of this article, please visit our website: [www.emeraldgrouppublishing.com/licensing/reprints.htm](http://www.emeraldgrouppublishing.com/licensing/reprints.htm)
Or contact us for further details: permissions@emeraldinsight.com