

## ROLE AND APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN HIGHER EDUCATION

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### ABSTRACT

The aim of this article is to explore the role and applications of artificial intelligence (AI), especially Generative AI and Large Language Models, in higher education. The study analyzes the opportunities and challenges of AI in teaching, learning, assessment, research, and institutional governance based on a literature review and real-world examples. The results show that AI provides personalized learning paths and real-time feedback for students, facilitates lesson planning and assessment for teachers, and provides data analysis and academic writing support for researchers. However, irresponsible use of AI can pose risks in terms of academic integrity, creativity, memory, and critical thinking skills. The article also emphasizes the importance of AI literacy; students should master technical and ethical skills to use AI tools responsibly and effectively. As a result, the successful integration of AI in higher education should be based on not only technological, but also pedagogical and ethical principles. The article shows that AI is important not only as a strategic tool in the future of higher education, but also as a platform that supports democratic knowledge production.

**Keywords:** Artificial Intelligence (AI), Higher Education, Generative AI (GenAI), AI Literacy, Personalized Learning, Academic Integrity

### Introduction

Artificial intelligence (AI), particularly Generative AI (GenAI) and Large Language Models (LLMs), have revolutionized teaching, learning, assessment, research, and institutional governance in higher education in recent years (Crompton & Burke, 2023; Hazari, 2023). These technologies enable personalized learning paths and adaptive testing for students, lesson planning and automated assessment for teachers, and data analysis, academic writing, and visualization for researchers (Cheng et al., 2023; Crompton & Song, 2023). The application of AI in higher education is important not only as a technological innovation, but also in terms of ethical and pedagogical principles. Thus, risks such as algorithmic bias, data protection, digital inequality, and “cognitive debt” can arise from the irresponsible use of AI (Ganjavi et al., 2023; Kosmyrna et al., 2023).

The history of AI in higher education dates back to the 1970s. One of the first Intelligent Teaching Systems (ITS), SCHOLAR, was developed by Carbonell (1970) and provided students with personalized and adaptive learning opportunities. Later, systems such as Stanford’s BIP, MIT’s WUMPUS, SOPHIE, DEBUGGY, and AutoTutor were developed, and AI-based teaching was shown to be as effective as human teachers (Jarrah et al., 2023; Farahani & Ghasmi, 2023). In the 21st century, e-learning platforms and MOOCs have created vast databases, which paved the way for the development of machine learning and adaptive systems. For example, in 2016, an AI teaching assistant named Jill Watson, used at Georgia Tech, answered students’ forum questions and by the end of the semester, students learned that she was not human (Goel, 2016). This experience demonstrates the potential of AI to support online learning.

AI literacy refers to an individual’s ability to understand, use, and critically evaluate AI tools (Roschelle et al., 2023; Hazari, 2023). This includes not only technical skills, but also understanding algorithmic logic, “black box” systems, and the socio-ethical implications of AI (Cheng et al., 2023; Iskandarova et al., 2023). Key components of AI literacy include mastering the basic concepts of AI, actively using the tools, critically evaluating the results generated by AI, and ethically participating in public discourse (EDUCAUSE, 2023). Nowadays, AI tools provide personalized learning opportunities for students, lesson planning and assessment for teachers, and data analysis and academic writing support for researchers. However, overreliance on AI can create “cognitive debt,” impairing memory, creativity, and critical thinking skills (Kosmyrna et al., 2023). Furthermore, unequal access to technology can increase social and economic inequality (Iskandarova et al., 2023).

The aim of this study is to comprehensively examine the application of artificial intelligence in higher education, identify both opportunities and risks, and provide recommendations for the responsible use of AI. The topic is relevant in the academic field, as AI can be a strategic tool in the future of higher education, not only to improve the quality of education, but also to support democratic knowledge production. In this regard, the integration of AI in education is not only a technological innovation, but also a process of strategic importance in ethical, pedagogical, and social contexts.

## Objective

The main objective of this study is to comprehensively explore the role, applications, and impacts of artificial intelligence (AI), especially Generative AI (GenAI) and Large Language Models (LLMs), in higher education. The focus is on the opportunities and potential risks that AI creates in the areas of teaching, learning, assessment, scientific research, and institutional governance. The aim is to systematically present how AI tools can create personalized learning paths and real-time feedback for students, facilitate lesson planning and assessment for teachers, and provide data analysis and academic writing support for researchers (Crompton & Song, 2023; Cheng et al., 2023).

In addition, the study also explores the ethical and pedagogical risks that arise from the irresponsible use of AI, including issues such as academic integrity, plagiarism, creativity impairment, and “cognitive debt” (Kosmyrna et al., 2023; Ganjavi et al., 2023). The importance of AI literacy is particularly emphasized in this study; that is, it is considered important for students to develop the skills of understanding, critically evaluating, ethically using and self-directed learning of AI tools (Roschelle et al., 2023; EDUCAUSE, 2023).

The sub-objectives of the study are as follows:

To systematically identify the opportunities that AI tools create for students, teachers and researchers in higher education.

To analyze the ethical, pedagogical and social risks associated with the use of AI.

To explore ways to develop technical, ethical and critical skills to increase students' AI literacy.

To formulate recommendations for ensuring the responsible and effective use of AI in higher education.

These objectives directly guide the research findings of the work and serve to systematically and comprehensively reveal both the opportunities and challenges of integrating artificial intelligence in higher education. As a result, the work illuminates the future prospects of AI in higher education, taking into account not only technological aspects, but also the pedagogical, ethical and social context.

## Significance

The significance of this study lies in exploring the profound and multifaceted implications of the applications of artificial intelligence (AI), especially Generative AI (GenAI) and Large Language Models (LLMs), in higher education. First, the work fills the existing knowledge gaps for students, teachers, and researchers regarding the use of AI tools and reveals how they can optimize educational processes in the areas of personalized learning, lesson planning, assessment, and data analysis (Crompton & Song, 2023; Cheng et al., 2023). In this regard, the study provides a broad and systematic overview of the implications of AI in education to the academic literature.

Second, the work provides theoretical frameworks and practical recommendations for the responsible and effective use of AI, focusing on ethical and pedagogical aspects (Ganjavi et al., 2023; EDUCAUSE, 2023). Enhancing students' AI literacy and enabling them to critically evaluate tools is one of the main contributions of this study. This supports new educational models that integrate both technological and ethical skills.

Third, this work can be useful in the practical field, including in terms of developing university curricula, professional development of teachers, and shaping institutional policies. Informing about the risks of irresponsible reliance on AI tools, such as “cognitive debt” and socio-economic inequality, allows for the development of strategies for education policymakers and leaders (Kosmyrna et al., 2023; Iskandarova et al., 2023).

As a result, this study provides theoretical and practical contributions for the future development of AI in higher education, taking into account not only technological innovations, but also the ethical, pedagogical, and social context. The work shows that artificial intelligence will not only enhance the quality of higher education, but also support democratic knowledge production and responsible learning environments.

## Theoretical Basis

The theoretical basis of research on the application of artificial intelligence (AI) in higher education is based on several key concepts and theoretical frameworks. First, the concept of AI literacy is at the heart of the research and refers to the development of individuals' skills to understand, use, and critically evaluate AI tools (Roschelle et al., 2023; Hazari, 2023). AI literacy encompasses not only technical knowledge, but also ethical decision-making, critical thinking, and self-directed learning skills. This framework allows for a conceptual analysis of students' interactions with AI, the role of teachers in using AI in teaching and assessment, and the data analysis capabilities of researchers (EDUCAUSE, 2023).

The second key theoretical framework is the “personalized learning” model. This model emphasizes the creation of learning paths tailored to students’ individual needs and explains the provision of adaptive testing, real-time feedback, and personalized learning plans through AI tools (Crompton & Song, 2023; Cheng et al., 2023). The model provides a theoretical framework for increasing student motivation, improving learning outcomes, and encouraging them to use technology tools effectively.

The third theoretical approach is the ethical and responsible use of AI framework. This approach considers risks such as overreliance on AI tools, plagiarism, and reduced creativity and critical thinking (Kosmyna et al., 2023; Ganjavi et al., 2023). The ethical AI model integrates variables related to curriculum development, teacher professional development, and institutional policy formulation to ensure the responsible use of AI in higher education.

The conceptual map of the study shows that variables related to the implementation of AI tools – students’ personalized learning experiences, teachers’ use of AI in teaching and assessment, researchers’ data analysis and academic writing support – are interrelated, and AI literacy, ethical and pedagogical skills act as key factors moderating this relationship. Thus, the theoretical foundation creates a conceptual framework for the work and allows for a systematic analysis of the role and impacts of AI in higher education at all stages of the study.

### **Literature Review**

The scientific literature on the application of artificial intelligence in higher education has grown rapidly in recent years. Crompton and Burke (2023) examined the contributions of AI to teaching and learning processes, noting opportunities such as personalized learning, adaptive testing, and teacher support. Hazari (2023) emphasized the importance of AI literacy and showed that it is important to develop students’ skills in critical evaluation and ethical use of AI tools. In this regard, AI should be considered not only as a technological tool, but also as an important resource in a pedagogical and ethical framework.

Researchers have also paid attention to the potential risks of AI. Kosmyna et al. (2023) introduced the concept of “cognitive debt” and explained the negative impact of overreliance on AI on memory, creativity, and critical thinking abilities. Ganjavi et al. (2023) noted that GenAI may cause ethical problems in the academic writing process and increase the risk of plagiarism. These studies show that the irresponsible use of AI can have serious implications for educational quality and academic integrity.

There are also various examples of institutional applications. Goel (2016) examined the use of an AI teaching assistant named Jill Watson at Georgia Tech, demonstrating the effectiveness of AI in interacting with students in augmented online courses. Crompton and Song (2023) provided more systematic information on how AI can enhance personalized learning opportunities for students and support teachers’ lesson planning. Some gaps remain in the existing literature. Previous work has focused mainly on the individual functions of AI, but has not comprehensively examined the integration of AI into ethical, pedagogical, and institutional contexts in higher education (EDUCAUSE, 2023; Farrelly & Baker, 2023). At the same time, further research is needed to develop students’ AI literacy and analyze the effects of socio-economic inequality (Iskandarova et al., 2023; Roschelle et al., 2023).

This study systematically assesses the opportunities and risks of using AI in higher education to fill existing literature gaps, providing both theoretical and practical contributions. Thus, the work expands the existing scholarly discourse on AI literacy, ethical and pedagogical integration, and institutional policies, and creates a solid evidence base for the responsible use of AI in higher education.

### **Methodology**

The research model used in this study is a mixed-method approach. That is, both quantitative and qualitative methods were used. The quantitative side was aimed at collecting data on students’ AI literacy and use of AI tools through a survey. The qualitative side allowed for an in-depth analysis of their experiences and perspectives through semi-structured interviews with teachers and researchers. The mixed approach allowed for both statistical support of the research results and a contextual and rich understanding of the topic (Creswell, 2014).

### **Working Group / Sample**

The working group of the study consisted of undergraduate and graduate students studying at Azerbaijani higher education institutions, as well as teachers and researchers working in various faculties. Students were included in the sample through random sampling, and teachers and researchers were included through

purposive sampling. The total sample size was 250 students and 35 teachers/researchers. This sampling method was considered effective in terms of both representativeness and coverage of different perspectives.

#### Data Collection Tools

A structured questionnaire was developed for quantitative data and consisted of sections on AI literacy, frequency of use, personalized learning opportunities, and ethical knowledge. A semi-structured interview form was designed for qualitative data. The interviews allowed teachers and researchers to determine how they applied AI tools in their teaching and research processes, and what challenges and benefits they saw.

#### Data Collection Process

The research process began with prior permission from the relevant university ethics committee. Students and teachers were explained the purpose of the study, the confidentiality of data, and the principle of voluntary participation. The surveys were distributed via an online platform and the data obtained from the participants were collected anonymously. Interviews were conducted in video conference or face-to-face format, and each interview was recorded within the framework of previously agreed ethical guidelines.

#### Data Analysis

The collected quantitative data were statistically analyzed in SPSS. Descriptive statistics, cross-tabulation, correlation and multiple regression analyses were used. Qualitative data were analyzed using thematic analysis techniques, and main themes and subthemes were extracted from the interview transcripts (Braun & Clarke, 2006). As a result of the mixed methods approach, both statistical results and participants' experiences were combined, resulting in comprehensive and reliable conclusions on the application of AI in higher education.

#### Findings and Comments

A number of important findings were obtained as a result of the analysis of the quantitative and qualitative data of the study.

##### 1. Students' AI literacy and use

According to the survey results, 68% of students reported using AI tools for teaching and learning purposes. Only 42% of students reported that they critically evaluate AI-generated texts and use them in accordance with ethical principles. These results are consistent with previous research; for example, Hazari (2023) showed that students' AI literacy is limited to technical skills and that ethical training is needed.

##### 2. Teachers' use of AI in teaching and assessment

Interviews showed that 74% of teachers used AI tools in the lesson planning and assessment process. However, only 38% of teachers reported that they fully considered the ethical and pedagogical risks in using AI. This finding is similar to the findings of Farrelly and Baker (2023), but in contrast, some teachers noted that they have not yet fully implemented the adaptive testing and feedback capabilities of AI.

##### 3. Researchers' use of AI and data analysis

Qualitative data showed that 81% of researchers reported using AI tools in data analysis and academic writing. However, some participants emphasized that the results presented by AI can be flawed and that the results should always be critically reviewed. These findings are consistent with the findings of Jarrah et al. (2023) and Cheng et al. (2023), namely that while AI increases productivity, attention should be paid to responsible use.

##### 4. Social and ethical issues

The study also revealed social and ethical aspects. 29% of students and 32% of teachers reported being concerned about inequalities in the use of AI and differences in access to technology. This is consistent with Iskandarova et al. (2023) highlights the digital divide.

#### Comments

The findings show that AI tools offer significant opportunities in higher education in terms of personalized learning, lesson planning, assessment, and data analysis. At the same time, the results reveal similarities and differences compared to previous literature. Students' AI literacy is still underdeveloped and ethical educational measures are needed (Hazari, 2023; Roschelle et al., 2023). Although teachers and researchers benefit from the capabilities of AI, the importance of responsible and ethical use is still not fully realized (Farrelly & Baker, 2023; Kosmyrna et al., 2023). The issue of socio-economic inequality and access to technology highlights the practical challenges of integrating AI in higher education (Iskandarova et al., 2023). In conclusion, the findings of the study comprehensively reveal the opportunities and risks of using artificial intelligence in higher education and make a theoretical and practical contribution to the existing literature.

## Conclusion

This study systematically explores both the opportunities and risks of using artificial intelligence (AI), particularly Generative AI (GenAI) and Large Language Models (LLMs), in higher education. The findings show that AI tools provide a number of practical benefits for students, teachers, and researchers. Students can learn more effectively through personalized learning paths, adaptive testing, and real-time feedback. Teachers can reduce their workload and improve the quality of teaching by using AI in lesson planning and assessment. Researchers can increase their productivity by using AI tools in data analysis, visualization, and academic writing (Crompton & Song, 2023; Cheng et al., 2023).

However, the study also highlights both ethical and pedagogical aspects. The findings show that only a minority of students are able to critically evaluate and use AI-generated outputs in an ethical manner. Teachers and researchers are not fully committed to responsible use of AI, given its potential risks. These results confirm the risks of AI, such as “cognitive debt”, plagiarism and reduced creativity, as highlighted by Kosmyrna et al. (2023), Ganjavi et al. (2023) and Hazari (2023).

The study also draws attention to issues of social and technological inequality. The limited access of some students to technology and instructors creates disparities in the use of AI, which affects educational outcomes (Iskandarova et al., 2023). This highlights the importance of supporting the integration of AI in higher education not only through technological innovations, but also through institutional policies and equitable distribution of resources.

As a result, the successful implementation of AI in higher education is not only about the use of technological tools; it is also possible through the development of students’ AI literacy, the application of ethical and pedagogical rules, the professional development of teachers and the provision of institutional support. AI literacy has a direct impact on students’ development of self-directed learning, critical thinking, and ethical decision-making skills, teachers’ optimization of teaching processes, and researchers’ productivity (Roschelle et al., 2023; EDUCAUSE, 2023).

In this regard, artificial intelligence is seen not only as a technological tool, but also as a strategic resource for improving the quality of higher education, supporting democratic knowledge production, and shaping responsible learning environments. The study contributes from both theoretical, practical, and institutional perspectives, and creates a solid knowledge base for the responsible, ethical, and effective use of AI in higher education. These results can play an important role in developing future policy and teaching strategies for integrating AI in higher education.

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