# AI INTEGRATED LEARNING FRAMEWORK

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Empowering Educators for AI-Integrated Learning (EduAI)

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| Responsible Author(s)/Organization: | Gürel ÇETİN | Istanbul University |
| | Hatice ÇİFÇİ | İstanbul University |
| | Cem KARATAY | İstanbul University |

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## List of Abbreviations

| *Abbreviations* | *Meaning* |
|---|---|
| *AGI* | Artificial General Intelligence |
| *AI* | Artificial Intelligence |
| *ANI* | Artificial Narrow Intelligence |
| *AR* | Augmented Reality |
| *ARC* | Academic Resistance to Change |
| *ASI* | Artificial Super Intelligence |
| *Edutech* | Educational Technology |
| *GDPR* | General Data Protection Regulation |
| *HE* | Higher Education |
| *HEIs* | Higher Education Institutions |
| *ICT* | Information and Communications Technology |
| *IT* | Information Technology |
| *LMP* | Lean Portfolio Management |
| *LMS* | Learning Management Systems |
| *M* | Mean |
| *PA* | personal agency |
| *TAM* | Technology Acceptance Model |
| *TPACK* | Technological, Pedagogical, and Content Knowledge |
| *VR* | Virtual Reality |

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## Abstract

This framework explores the integration of Artificial Intelligence (AI) into higher education, providing a roadmap for educators and institutions to leverage AI tools effectively. It highlights the current state of AI in higher education, AI's potential to personalize learning, streamline administrative processes, and enhance teaching efficiency while addressing challenges such as AI literacy, ethical issues, data privacy, bias, and accessibility. By examining key AI tools, including chatbots, adaptive learning platforms, automated grading systems, and AI-powered simulations, the framework offers practical guidelines for ethical and inclusive adoption. The advantages, barriers, and transformative impact of AI in higher education are also discussed. The framework emphasizes the indispensable role of human oversight, ensuring that AI complements rather than replaces the human elements of education, providing various areas of training for a better integration of AI in higher education. Additionally, this document serves as a strategic guide for creating adaptive, innovative, and equitable educational ecosystems. It prepares educators for the demands of an AI-driven world by exploring possible transformations brought by AI and providing a roadmap for effective AI adoption.

## Executive Summary

This framework explores sustainable Artificial Intelligence (AI) integration in higher education (HE), focusing on empowering instructors—particularly in social sciences—with essential AI skills. The objective is to enhance teaching effectiveness, streamline tasks, and build AI literacy, preparing educators for future AI-enhanced environments. Designed to guide instructors in leveraging AI tools effectively, the framework focuses on the current state of AI integration in HE, building competencies, fostering innovation, and addressing real-world challenges and solutions in academia. There is also an urgent need for a conceptual framework in integration of AI for intellectual comprehension, based on empirical research informed by educators' perspectives. Due to challenges in aligning AI tools with teaching and learning objectives, this framework aims to position AI use in HE in a way that enables educators, students, and stakeholders to utilize these technologies successfully.

AI is defined as "*the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings*" (Russell & Norvig, 2021). In other words, AI is the simulation of human intelligence processes by machines, particularly computer systems, involving capabilities such as learning, reasoning, and self-correction (Nilsson,

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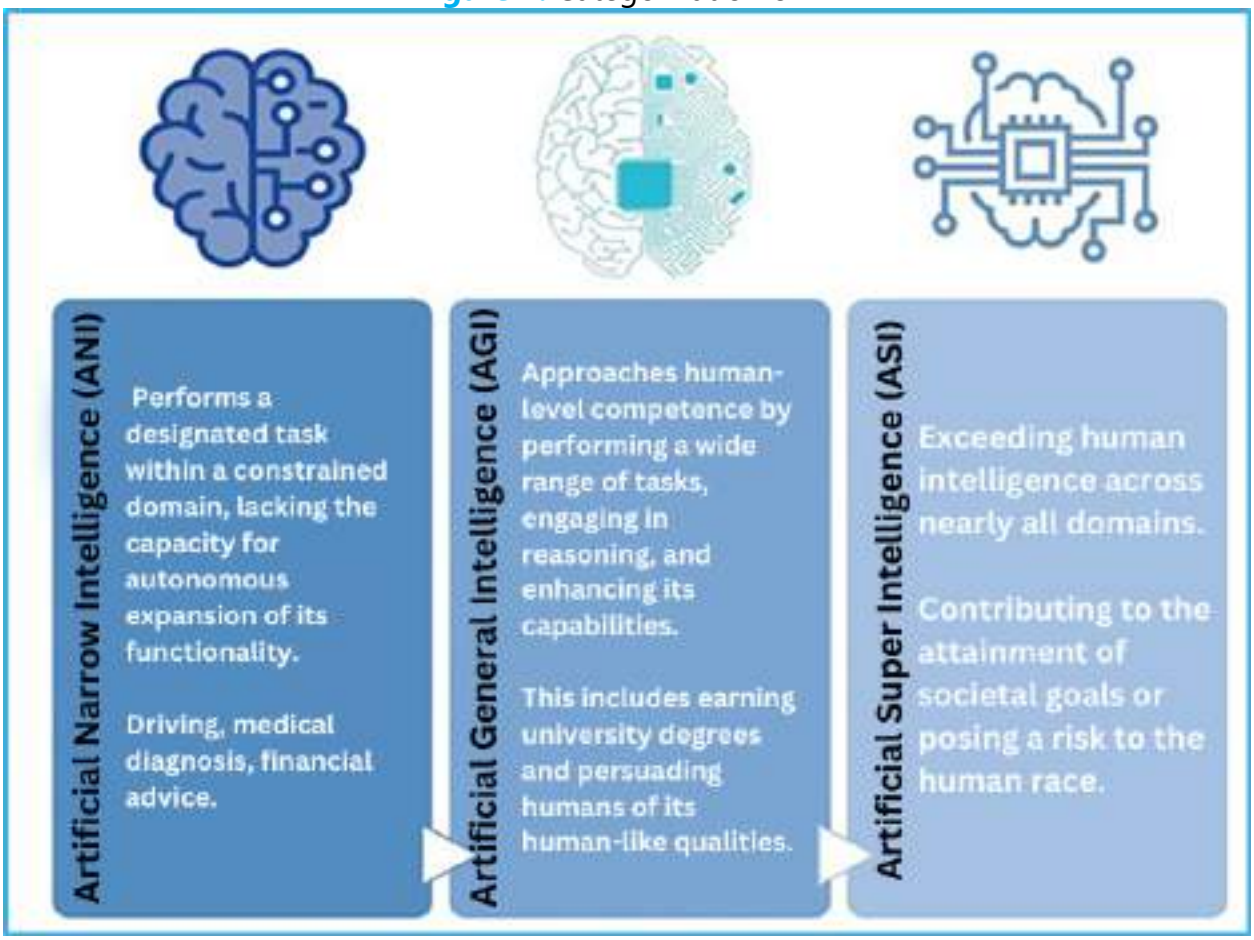
2014). AI can be categorized into three types: 1) Artificial Narrow Intelligence (ANI), which has a limited range of capabilities; 2) Artificial General Intelligence (AGI), which exhibits human-like cognitive abilities; and 3) Artificial Super Intelligence (ASI), which exceeds human intelligence.

**Figure 1.** Categorization of AI




To date, only ANI has been fully realized, and it typically focuses on specific tasks and applications where AI systems are designed to perform functions with a high degree of efficiency. AI implications generally involve machine learning, natural language processing, robotics, and computer vision and enable machines to learn from data, recognize patterns, and make decisions with minimal human intervention (Goodfellow et al., 2016). Adoption of AI is important for various sectors in obtaining valuable insights, gaining a competitive advantage, and developing the future workforce.

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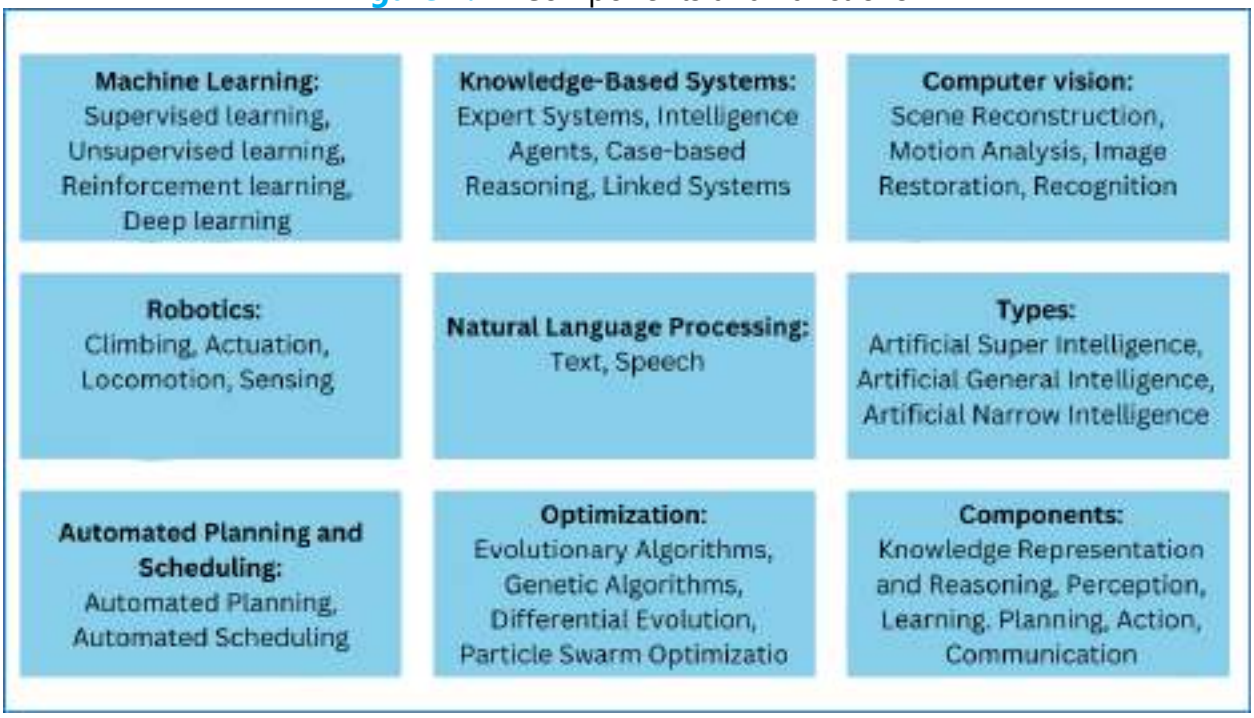
**Figure 2.** AI Components and Functions




**Source:** derived from Regona et al. (2022).

AI is a technology applied in various educational domains as well, particularly language, engineering, mathematics, and medical education. Its implications in HEIs can be explored around three main objectives: improving student experiences, research activities, and institutional processes. AI-based adaptive learning platforms and tools have the capacity to assess students' progress, customize course materials, and promote personalized learning, leading to effective learner and instructor outcomes (Zawacki-Richter et al., 2019). Nonetheless, the transdisciplinary participation of instructors from different disciplines, with different terminology, perceptions, and knowledge, may create challenges in explicitly embracing AI. Since scholars in the positive sciences are usually more familiar with developments in AI, the framework is also designed to address the needs and implications for the social sciences.

AI-enhanced adaptive learning platforms continuously collect and interpret learner data and change the learning course and environment according to the needs and abilities of the individual (Har Carnel, 2016; Ozen et al., 2017). Furthermore, many institutions are using AI in administrative processes ranging from admissions to course schedules,

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allowing staff to focus on more strategic rather than repetitive tasks (Marr, 2018). AI's role in data analytics also provides instructors and universities with insights into student behavior, optimizes resource allocation, and helps them make data-driven decisions in curriculum design and student support services (Schiff, 2020). In addition, AI in higher education teaching can provide various other services, such as automated assessment and grading, content creation and adaptation, plagiarism monitoring, ethical auditing, career guidance, and accessibility solutions for students with special needs. Advanced predictive analytics will also enable higher education instructors and administrators to identify student needs in advance and provide proactive solutions. Given the advances in AI technologies and the potential they provide, AI is expected to transform higher education in the future.

However, there are also ethical challenges—such as concerns over privacy, fairness, accountability, transparency, and safety—related to both its development and its implementation in education, which requires a deeper interdisciplinary collaboration (Eaton et al., 2018). The best example of such a challenge reflects the urgent need for the development of a standard framework as the essential model to support the trustable and effective use of AI in HE given the increasing significance of AI, driving transformations in education (Chu et al., 2022). AI integration also requires designing systems applicable to learners' needs while also improving AI literacy. These automated adaptive learning systems would then help enhance teaching efficiency, learning performance, and decision-making for instructors and institutions, while also offering students tailored academic guidance.

This report provides some strategic recommendations for instructors and higher education institutions to successfully integrate AI technology, focusing mainly on teaching, and provides readers with a comprehensive guide to the strategic, effective, and ethical use of AI in higher education. Adopting this framework in higher education will contribute to creating a flexible and modern educational environment, enhancing its effectiveness and responsiveness to students' needs.

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# AI and Higher Education Framework

## 1. Introduction

The notion of AI emerged in the 1940s and 1950s when various scholars, including philosophers, scientists, economists, and mathematicians, began exploring the idea of creating an artificial brain capable of independent thought and problem-solving. Throughout the 20th century, the term "AI" gained immense popularity in science fiction. By the 21st century, this concept transitioned from a theoretical idea to practical applications across various areas, including higher education (Cubric, 2020; Rana et al., 2024).

Higher education has faced rapid and unprecedented challenges due to the influence of AI (Jordan & Mitchell, 2015). The theoretical development of AI fell behind the speed of its diffusion into practice. In education particularly, service providers and educators face challenges adapting to systems that are extensively used by their customers—namely, the students. Many educators with background in social science disciplines lack training in AI and may exhibit technology aversion due to a limited understanding of how AI can support them in their work (Kizilcec, 2024).

As a result, universities have been compelled to adopt innovative approaches that challenge conventional ideas about how education should be delivered (Tabata & Johnsrud, 2008). However, the adaptation of AI to higher education is not a straightforward process (Dhawan & Batra, 2020). Thus, numerous challenges must be addressed in the integration of AI within higher education (Alordiah, 2023). There is a need for a framework that describes AI use in higher education, its advantages, challenges, and possible solutions from a bottom-up perspective in guiding instructors and HEIs to address these challenges.

Hence, the framework is designed based on empirical data gathered through interviews (26 informants) and questionnaires (295 participants) with higher education instructors. Qualitative data produced as transcripts of interview recordings were content analyzed, whereas quantitative data was used in various statistical analyses to drive conclusions. Supported by primary and up-to-date empirical data, the report offers a structured guide to help instructors leverage AI tools effectively across the teaching cycle. This structured approach ensures that the framework reflects real-world needs and provides actionable strategies for institutions. The methodological approach is further discussed in the next section.

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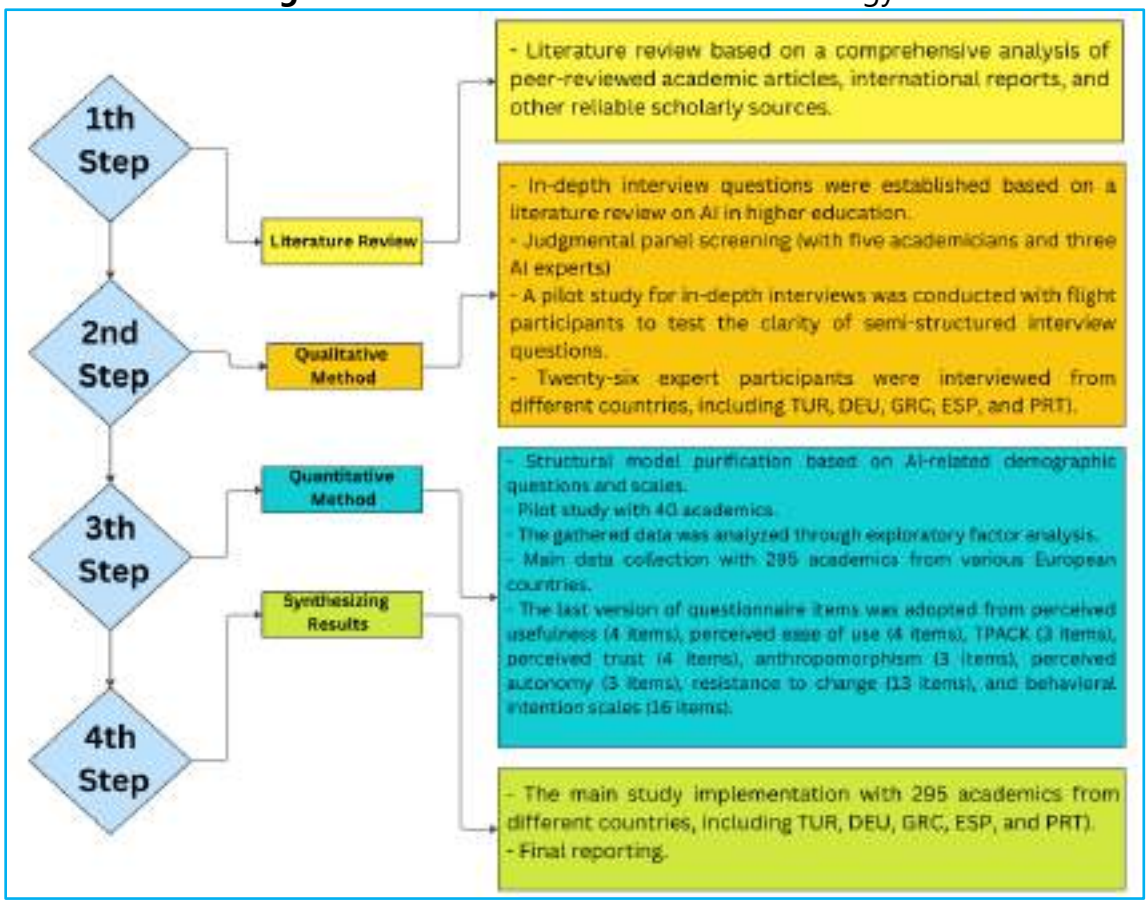
## 2. Methodology

This framework follows a multi-step methodological approach. In Step 1, a comprehensive literature review was conducted based on peer-reviewed academic articles, international reports, and other reliable sources to establish the theoretical foundation. While step 2 involves a qualitative method approach, step 3 integrates a quantitative approach. Finally, in Step 4, findings from both qualitative and quantitative phases were synthesized to provide a comprehensive understanding of the research topic. A detailed explanation of the qualitative and quantitative approaches will be provided in the following sections.

**Figure 3.** Overview of Research Methodology




### 2.1. Qualitative research phase

The qualitative research involves the investigation of the AI integration in HE settings through interviewing educators from five different countries (Türkiye, Germany, Spain,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Portugal, and Greece) based on purposive sampling. The interview questions (see Appendix A) were designed based on the literature review, which helps ensure that the questions elicit comprehensive answers from the educators' perspective. A total of 26 interviews were held, which were then analyzed through content analysis. To enhance the reliability of the findings, the coding procedure in the project was independently handled by three researchers through a consulting academic expert specializing in AI in HE, and several meetings were convened to discuss primary dimensions by all partners.

This phase adopts an exploratory approach. The semi-structured questions allowed for in-depth exploration and generation of a nuanced framework. By focusing on educators' perspectives through semi-structured interviews, this phase seeks to not only create initial themes (e.g., motivations, attitudes, behaviors, opportunities, barriers, tools, transformations) of AI usage within HE, but also to inform the survey that is to be used during the quantitative stage to measure the importance of these items.

### 2.2. Quantitative research phase

A quantitative research approach for descriptive and inferential analysis was also used to reveal the extent of educators' AI interaction. To gather data, an online self-completion questionnaire was constructed based both on theoretical constructs and findings of the content analysis during the qualitative stage. The data collection tool consisted of two parts, including demographics (e.g., sex, age, type of institution, year or experience, position, and prior AI experience) and multiple-item scale questions using the 5-point Likert-type scales (please see Appendix B). The construction of the questionnaire was guided by previous literature, theoretical models, the interview findings, as well as an audit check by scholars with expert background. In addition, a pilot test of the instrument was conducted on 40 cases to ensure content validity and clarity of items.

The sample included educators from different countries, especially Türkiye, Portugal, Greece, Germany, and Poland, utilizing both convenience and snowball sampling methods. The final data collection process was completed between Aug. and Dec., 2024. At the end of this process, 295 online questionnaires were collected. The data were later analyzed using descriptive (frequencies, measures of central tendency, and dispersion) and inferential (regression, reliability, and factor analysis) statistics in SPSS software. General information about the demographic background of the participants and their attitudes towards AI was also presented. All of the findings are discussed in related sections with theoretical support, findings, and discussions on each topic after a brief introduction.


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## 3. Education Technology

The rapid advancement of educational technology has been changing educational systems and methodologies. Innovative educational tools, platforms, and systems are designed to enhance the educational experience by improving the efficiency, accessibility, and effectiveness of teaching and learning processes (Cifci et al., 2024). In higher education, the adoption of educational technology has facilitated a more flexible, personalized, and data-driven approach to instruction, transforming traditional methods and enabling innovative strategies that cater to diverse student needs.

Educational technology operates as a conduit for imparting information, allowing for its efficient storage, transfer, and processing. These capabilities not only support teaching activities but also contribute to sustainable growth in educational practices by optimizing resources, automating administrative tasks, and fostering collaboration among educators and students. By leveraging digital applications, higher education institutions (HEIs) can also expand their reach, engage students in meaningful ways, and create a more adaptive learning environment.

Educational technology has evolved significantly over the past century, shifting from simple instructional aides to complex, data-driven platforms that transform how education is delivered, accessed, and personalized. The evolution of education technology reflects the integration of new tools, methodologies, and digital systems that enhance teaching effectiveness, accessibility, and engagement in higher education. This section explores the trajectory of educational technology, from its early forms to the advanced AI-powered tools shaping today's classrooms.

In its early stages, until the 1960s, educational technology involved simple tools and visual aids, such as blackboards, projectors, and films. These tools aimed to make lessons more interactive and engaging for students, helping educators present information visually and audibly to enhance comprehension. Early technology introduced the concept of visual learning and began to shift the focus from rote memorization to more interactive learning approaches (Tuma, 2021). The integration of audiovisual aids marked the first step toward dynamic teaching environments, setting the foundation for future technological innovations.

The introduction of computers into educational settings marked a turning point during the70s and 80s. Initially used in computer labs, these machines allowed students to access basic programming, typing exercises, and subject-specific tutorials. The first educational



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software was developed, and learning began to include digital elements. Computers enabled self-paced learning, allowing students to interact with content on individual levels (Selwyn, 2021). The presence of computers in classrooms signalled the beginning of personalized learning, as students could control their learning pace and review interactive content as needed.

With the advent and spread of the internet during the '90s and into the new millennium, educational technology expanded dramatically. E-learning platforms emerged, making it possible for students to access resources, courses, and learning materials online. This era also saw the development of Learning Management Systems (LMS) like Blackboard and Moodle, which became central to online and hybrid learning environments. The internet also facilitated remote education, allowing institutions to reach students globally and expand educational opportunities beyond physical campuses. Developments in ICT also introduced the concept of blended learning, where online resources complemented in-person classes, creating more flexible and accessible learning options (Rivers, 2021).

During 2010s mobile devices and cloud computing further transformed educational technology by reinforcing learning on the go. Smartphones, tablets, and laptops became essential tools for students, who could access content, collaborate with peers, and complete assignments from any location while cloud-based services (e.g., Google Drive) allowed for real-time updates, storage, and sharing of materials (Mathew, 2012). Cloud computing supported collaborative learning, as students and educators could easily work on shared documents and projects, fostering teamwork and engagement.

Since the 2020s, AI and adaptive learning platforms have represented the latest advancements in educational technology. AI-powered tools can analyse student data to provide personalized learning experiences, automate administrative tasks, and generate insights that guide instructional decisions. Adaptive learning systems, intelligent tutoring, and AI-driven analytics are now integral to modern higher education (Karatay et al., 2024). AI technology enables automating repetitive teaching tasks, developing instructional resources, real-time tracking of student progress, predictive analytics, and customized learning paths. This allows educators to address individual learning needs effectively, making education more responsive, efficient, and tailored to each student's pace and goals.

AI is revolutionizing education technology by enhancing the personalization, efficiency, and accessibility of learning experiences in higher education. Through adaptive learning



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platforms, AI-driven analytics, automated grading, and intelligent tutoring systems, AI enables institutions to create student-centred, data-informed environments that respond to individual learning needs and preferences. AI-powered tools also streamline administrative tasks, providing educators with more time to focus on instruction and mentorship, while supporting students with real-time feedback, customized resources, and tailored guidance. 75% of educators believe that by automating various tasks through AI, they are able to spend more time interacting with students (AAA, 2024).

As AI technology continues to evolve, its integration into educational technology holds the potential to redefine teaching and learning dynamics, making higher education more inclusive, responsive, and innovative. Institutions that embrace AI are better positioned to provide flexible, future-ready education that aligns with the demands of a digital world. Through ongoing research, collaboration, and ethical considerations, AI in education technology promises to shape a modern educational landscape that empowers educators, supports diverse learning paths, and prepares students for a competitive, technology-driven future and careers.

## 4. Current State of AI integration in higher education

As will be discussed in Section 2.5, AI is now used in multiple fields within the higher education setting. Moreover, numerous studies have recently emerged in the literature regarding the use of AI in higher education (Luan et al., 2020; Jianzheng and Xuwei, 2023; Jain and Raghuram, 2024). However, the resistance of academics to change in the adaptation of AI in higher education has often been overlooked.

The AI Index Report developed by Stanford University shows the statistics of AI programs and their availability in different types of programs, where master's level programs dominate with the percentage of 55.0%, followed by undergraduate programs with 39.8%, while the mere 5.3% of universities offer PhD programs in AI (Perrault & Clark, 2024). The AI in education market is projected to grow from $1 billion in 2023 to $6 billion by 2025, indicating a significant global shift towards AI-driven educational tools. Despite 78% of parents thinking that the use of AI in assignments constitutes cheating, 43% of college students and 51% of educators already use AI in various learning and teaching tasks (AAA, 2024).

Based on the empirical study, educators were more likely to adopt AI in their teaching and academic activities. For example, the highest evaluations were given to constructs like Behavioral Intention (M = 3.85), indicating that educators are inclined to incorporate them

into their teaching and academic activities. Regarding AI experience, 49.8% of educators defined themselves as intermediate, 26.8% as basic, and 10.5% as having advanced experience. Only about 5.8% of informants have no previous insight into AI, meaning that most educators are already acquainted with AI tools and ideas, with a fair number having real-life exposure to AI in education settings.

## 5. Attitudes and experiences towards AI integration in HE.

Prior experience with AI may influence academics' intentions to use these technologies and their resistance for adoption. Positive experiences with AI can enhance trust in this technology. Those with favorable past interactions may be more open to new tools, reducing their resistance to change and increasing their intention to use AI. On the other hand, negative experiences with AI may heighten resistance to change, leading to skepticism about new technologies and negatively affecting intentions to use AI (Alordiah, 2023; Kamalov et al., 2023). Furthermore, previous experience can ensure that academics possess the necessary knowledge and skills related to AI. Educational and training opportunities can also enhance instructors' willingness to use this technology (Ünal and Yıldırım, 2024) and reduce resistance to the change.

The ability of educators to successfully employ AI-based technologies, both technically and pedagogically, is critical for adoption. As a result, the Technological, Pedagogical, and Content Knowledge (TPACK) paradigm can serve as a basis for educators seeking to integrate AI technology into higher education. Hence educators' TPACK has a substantial effect on their intentions to use AI in the classroom. While several studies (e.g., An et al., 2023) have identified AI-TPACK as a valuable addition to technology acceptance models, recent research has discovered that TPACK has a direct and positive effect on educators' intentions to incorporate technology into their teaching practices (Jain et al., 2024). Technology integration in education also relates to various theories and concepts, including Technology Acceptance Model (TAM), Resistance to Change, Perceived Trust, Anthropomorphism, and Perceived Autonomy. These are further discussed below.

### 5.1. Technology Acceptance Model (TAM)

As a mature theory, the Technology Acceptance Model (TAM) widely explains how users come to accept and use technologies. In the context of AI adoption in education, TAM identifies two key determinants of technology acceptance, including perceived usefulness and perceived ease of use (Davis, 1989). Attitudes toward the advantages and disadvantages of AI, along with educators' affective attitudes toward AI tools—including feelings of anxiety, mistrust, or enthusiasm—influence teachers' plans for using these


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instruments in their practice. As mentioned by Kizilcec (2024), instructors' attitudes were noted to be of central importance in determining the adoption of AI tools in education, and AI integration success or failure depends on the perception that educators have towards artificial intelligence. Concerns about individual competence, fear of job displacement, and ethical concerns also affect AI adoption (Çelik et al., 2022). Hence, communication, training, and increasing support and commitment toward AI from the instructors are important to manage the resistance (Piderit, 2000). TAM stresses here that AI adoption can become a real problem when educators find it useless and hard to use; however, addressing emotional responses and providing adequate support is important to mitigate the resistance.

When AI tools are both perceived as useful and easy to use, educators are more likely to embrace them, making integration smoother and more effective. However, complexities or doubts about their utility could create barriers to adoption, underscoring the importance of designing AI tools that are accessible and aligned with educators' needs. For example, Perceived Usefulness reflects the potential benefits that educators perceive while using AI technologies to improve teaching practice.

Educators are more likely to adopt AI tools if they believe that AI can make teaching better, make tasks more effective, and improve the learning experience. In higher education, adoption of AI is driven by perceived usefulness, i.e., the perceived ability of AI to reduce workload and increase teaching efficiency. Likewise, Perceived Ease of Use explores how intuitive and user-friendly AI technologies are. The more AI tools are easy to learn and work with, the more likely educators are to use them in teaching. Flexible, adaptable and easy to use tools help counter resistance to adoption and ease of use directly correlates with educators' willingness to engage with new technologies.

Based on empirical data analysis, the Perceived Usefulness dimension reflects a generally positive outlook on the benefits of AI technologies from educators (see Appendix C). The highest-rated item, "In general, AI technologies are useful in higher education teaching" (M = 4.07), underscores their broad applicability. Items such as "The use of AI technologies improves the teaching practice" (M = 3.94) and "The use of AI technologies makes the teaching practice more effective" (M = 3.91) highlight their potential to enhance teaching quality and efficiency. While slightly lower, "The use of AI technologies makes it easier to carry out teaching tasks" (M = 3.89) suggests a consistent recognition of AI's utility in streamlining tasks. These findings demonstrate educators' acknowledgement of AI as an acceptable option to transform the educational experience. The perceived ease of use


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dimension also indicates that educators have a reasonable level of consensus about the usability of AI technology. The highest-rated item, "I find it flexible to interact with AI technologies" (M = 3.74), indicates a positive perception of flexibility. Other items, such as "I find it easy to interact with AI technologies" (M = 3.66) and "In general, AI technologies are easy to use" (M = 3.58), support this view. However, the lowest score, "Learning how to use AI technologies would be easy" (M = 3.51), suggests some challenges in acquiring AI-related skills. Overall, the findings indicate that, while educators usually find AI technology comprehensible and adaptable, there is a venue for improvement in providing enough training to make learning AI usage easier and more intuitive.

Moreover, the quantitative data analysis also demonstrates that Perceived Usefulness (Beta = 0.242, $p < 0.00$) was the strongest and most significant construct, indicating that educators' perceptions of AI tools' usefulness have a significant impact on their behavioral intentions towards them. Perceived Ease of Use (Beta = 0.204, $p < 0.00$) also significantly impacts behavioral intentions, indicating that educators are more inclined to embrace AI tools when they find them as easy to use (see Appendix D for detailed findings).

### 5.2. Resistance to Change

Resistance to change constitutes a substantial obstacle to the implementation of AI in educational environments. The tangible benefits of AI are evident, and educators have a favorable disposition towards the integration of AI in education, notwithstanding emotions like fear and worry, as well as cognitive concerns regarding ethical implications and the efficacy of AI. The ARM (Academic Resistance Model; Piderit, 2000) demonstrates how the cognitive, emotional, and intentional responses that people attribute to change contribute to the development of resistance. Concerning AI adoption in education, resistance may be in the form of fear of employment loss, moral issues, or because of the belief that AI will harm the quality of teaching (Bearman et al., 2023; Çelik et al., 2022). This resistance is not always irrational but is also based on real concerns for autonomy, ethics, and professionalism.

There can be different types of response to AI among instructors; the rational perception is where educators understand that AI can be helpful in their work, but there can also be negative emotional perceptions like mistrust, and fear of losing their job to AI. o this end, institutions should address these concerns and build trust by accurately communicating about the use of AI and providing training to help reverse educators' phobia of AI


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technology (Wang et al., 2023). By resolving cognitive and emotional aspects of AI implementation, it is possible to minimize resistance to AI among educators.

The Academic Resistance to Change (ARC) construct reflects varying educator attitudes toward AI adoption. Positive responses, such as "I have a good feeling about the changes AI technologies offer," suggest openness to AI as a tool for improvement. Statements like "I want to devote myself to the process of AI change" indicate a willingness to engage, driven by the belief that AI will enhance teaching. However, resistance is evident in items like "I am resistant towards AI technology change" and "I am reluctant to incorporate AI technology changes into my work," which reflect concerns about disruption. Educators who feel that "Most AI technology changes will have a negative effect on education" may view AI as a threat to established practices and their way of teaching. Despite this, items like "Future improvements will come with AI technology change" suggest that, with proper support, resistance can decrease. Overcoming these concerns involves demonstrating that AI is a tool to enhance, rather than replace, teaching practices.

The "Academic Resistance to Change" dimension reveals educators' mixed attitudes toward AI technologies (please see Appendix C). While "Future improvements will come with AI technology change" received a relatively high score (3.79), positive perceptions were generally low, with items like "I have a good feeling about the changes AI technologies offer" (2.19) and "The AI technologies change will improve work" (2.05) reflecting skepticism about AI's benefits. Resistance was evident in statements such as "I am resistant towards AI technology change" (2.27) and "I am reluctant to incorporate AI technology changes into my work" (2.37). Moderate willingness to engage was seen in "I want to devote myself to the process of AI change" (2.62) and "I am willing to make a significant investment" (2.58). Concerns persisted about AI's impact, with "Most AI technology changes will have a negative effect on education" (2.41) and "Most AI changes will only do a little good" (2.67) reflecting a cautious and skeptical outlook.

Furthermore, Academic Resistance to Change (Beta = -0.241, $p < 0.15$) also had significant negative effects on educators' behavioral intention. This result suggests that overcoming resistance to change may play a crucial role in improving educators' willingness to adopt and use AI tools in their educational practices (see Appendix D).

### 5.3. Technological Pedagogical Content Knowledge (AI-TPACK)

The AI-integrated TPACK (AI-TPACK) model adapts the original TPACK framework to include technological, pedagogical, and content knowledge. AI-TPACK focuses on using


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AI tools in teaching, whereby an educator does not only acknowledge the benefits of technology but also implements it in the classroom. Çelik (2023) argues that the AI-TPACK of an educator is critical, in the application of AI in learning, particularly in supporting the curriculum and the teaching strategies pursued. The more AI-TPACK level of teachers increase, their attitudes towards AI become more positive and the implementation of AI tools more effective (Wang et al., 2024). Educators who build technological, pedagogical, and content knowledge for AI will be better equipped to face the challenges that arise from incorporating AI in the classroom and are likely to exhibit favorable cognitive and emotional responses toward the use of AI in the teaching-learning process. Hence the self-collective construct of AI-TPACK is a strong antecedent of behavioral intention of educators to integrate AI technologies in learning (Bardaki and Alkan, 2019).

In AI adoption, TPACK is focused on utilizing technology and pedagogy in combination with AI tools in a way that supports teaching and learning outcomes. The TPACK framework assesses how well educators can incorporate AI technologies with teaching practices. Educators' confidence in combining AI with pedagogical strategies is measured by items such as 'I can combine technologies and teaching approaches using AI. "I can select AI technologies to use in teaching" highlights the importance of choosing the right AI tools for specific educational contexts. Lastly, "I can teach using AI technologies" indicates educators' competence in applying AI in their teaching. In short AI-TPACK focused on to what extend educators are competent in using AI technologies in their teaching. Based on these items, educators with technological, pedagogical, and content knowledge are better equipped in integrating AI into their teaching practices.

According to the analysis of empirical data, educators expressed confidence in their capacity to integrate AI into their teaching methods. The highest-rated query, "I can combine technologies and teaching approaches using AI," had a mean score of 3.86, suggesting a significant belief in their capacity to effectively combine AI with teaching techniques. Similarly, "I can select AI technologies to use in teaching" (3.81) and "I can teach using AI technologies" (3.73) were rated with reasonably high scores, indicating confidence in the use of AI for education. These findings indicate that instructors are prepared to adopt AI technologies into their teaching practices (see Appendix C).

In addition to this, Technological Pedagogical Content Knowledge (Beta = 0.145, $p < 0.01$) plays a significant role, underscoring the importance of educators' technological pedagogical content knowledge in the adoption of AI tools. This shows that there is an important relationship between the perceived proficiency with incorporating technology,


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as well as the teaching-learning content knowledge and the attitude toward using AI in practice. This framework proposes that an increase in the technical knowledge of teachers implementing TPACK will result in the favorable adoption of AI technologies in education (see Appendix D).

### 5.4. Perceived Trust

Concerns over ethics, privacy, transparency, and data security are other major challenges for AI integration. Even if instructors recognize the potential value of using AI in education, without trust, educators might avoid using AI (Khosravi et al., 2022). Educators are more likely to trust AI when such technology is honest and openly communicating, follows ethical standards, and shows positive performance (Crawford et al., 2023). Depending upon the perceived reliability and ethics in artificial intelligence, educators' cognitive, emotional, and behavioral attitudes are shaped. According to Bearman et al. (2023), trust is essential to reduce the level of skeptical views associated with the use of AI, especially in learning and teaching processes.

If educators believe that AI provides accurate, trustworthy, and reliable outputs, they would be more likely to integrate it into their teaching practices. Therefore, Perceived Trust reflects educators' confidence in the reliability and accuracy of AI technologies. Items like "I would have faith in the information provided by the AI technologies" and "The AI technologies would provide accurate information" emphasize the importance of trusting AI as a source of reliable and true content. Additionally, statements such as "The AI technologies would be trustworthy" and "The AI technologies would provide a reliable service" highlight the broader expectation that AI systems will perform consistently and meet users' needs.

The analysis of empirical data revealed that for the "Perceived Trust" dimension, educators encountered a moderate level of trust in the application of AI (please see Appendix C). The highest-rated item, "The AI technologies would provide a reliable service," had a mean of 3.27, demonstrating a rather strong feeling of trust in AI tools. Other items, such as "I would have faith in the information provided by the AI technologies" (3.12), "The AI technologies would provide accurate information" (3.09), and "The AI technologies would be trustworthy" (3.08), all received similar moderate ratings, pointing to cautious but generally positive attitudes towards the trustworthiness of AI technologies.

Furthermore, Perceived Truest (Beta = -0.041, p = 0.174) had no significant effect, revealing that trust in AI has no meaningful impact on educators' intentions to adopt AI

in their teaching. This indicates that, in this case, the level of trust educators place in AI technologies is not a strong determining factor in their intention to use these tools in the educational context, and they might still integrate AI tools even if they have limited trust in the outcomes (Appendix D).

### 5.5. Anthropomorphism

Anthropomorphism is the process of ascribing human qualities to non-human objects including AI systems and robots (Epley et al., 2007). Regarding AI tools in education, anthropomorphism can have a positive impact on to what extent these systems will be adopted by instructors. Tools that mimic human psychosocial (e.g. conversational) agents, personalized interactions or even emotion recognition improve educators' mental attitudes towards these technologies (Adam et al., 2021). Based on Araujo (2018), it is important that AI tools can make educators trust them and even consider them intelligent. Research in consumer behavior also confirms anthropomorph AI interfaces enhance user experiences (Cai et al., 2022). In educational contexts, the positive intentions toward AI systems' adoption could be higher if the AI systems have anthropomorphic characteristics (Bilquise et al., 2024). Hence, the extent and nature of human-like features in the AI tools can affect the perceptions of educators to use these technologies in classroom.

The preference for human-like qualities in AI suggests that educators are more likely to adopt technologies that feel intuitive, responsive, and engaging. The more AI systems can simulate human interaction, the more comfortable and confident educators may feel in using them for teaching. Items like "I want the AI technologies to be pleasant to interact with" and "I want the AI technologies to understand me easily" highlight educators' preference for AI systems that are friendly and responsive. These responses suggest that educators value AI technologies that are not only functional but also enjoyable to engage with. Items like "I want the AI technologies interaction to be human-like (similar to communicating with a real person)" further emphasize the desire for AI to mirror human interaction, making the experience more natural and relatable.

For the "Anthropomorphism" dimension as per empirical data analysis, educators expressed a preference for AI technologies that are more human-like and relatable (please see Appendix C). The highest-rated item, "I want AI technologies to understand me easily," had a mean score of 4.00, indicating a significant desire for AI tools to be intuitive and sensitive. Furthermore, "I want AI technologies to be pleasant to interact with" received a high mean of 3.94, highlighting that ease and pleasantness of interaction are also significant. However, the item "I want the AI technologies interaction to be human-like


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(similar to communicating with a real person)" had a somewhat lower mean of 3.61, representing that, while educators appreciate human-like interactions, they are not as important as the other features.

The analysis of empirical data also showed that Anthropomorphism (Beta = 0.137, $p < 0.02$) had significant positive effects, indicating the empathic qualities and the human-like characteristics and quality of interaction are important factors influencing educators' intention to use AI tools (see Appendix D).

### 5.6. Perceived Autonomy

The degree of AI integration in the teaching-learning process also depends on perceived autonomy concerning instructional technology. This concept stems from Self-Determination Theory and is defined by the extent to which individuals feel in control of their behaviors and choices. AI tools that save time, provide individualized feedback, or reduce the cognitive load of delivery can help educators feel more independent and productive by eliminating basic or repetitive activities inherent in the teaching process (Ng et al., 2022). Educators who perceive that AI enhances their classroom autonomy are more likely to adopt these technologies (Zawacki-Richter et al., 2019).

Educators' perceptions of AI's role in enhancing classroom autonomy can be explored by examining how they perceive control and freedom that AI technologies offer in their teaching practices. For instance, some educators may feel that AI technologies allow them to have greater control over how they teach, enabling them to adapt their instructional methods to better suit their individual needs. Additionally, AI could provide educators with the opportunity to express their true selves in the classroom, offering more flexibility in integrating their personal teaching style with technology-based resources. Additionally, AI tools may allow educators to access information more efficiently, streamline their search for relevant materials, and ultimately save time and increase productivity in their teaching activities. Therefore, AI tools that foster cooperation, feedback, and assessment enhance educators' self-determined motivation, promoting positive attitudes and behavioral intentions toward the use of AI in education.

According to empirical data analysis, educators were somewhat confident in the capabilities of AI technologies to provide autonomy in their teaching and academic activities concerning the "Perceived Autonomy" dimension (please see Appendix C). The item "I think using AI technologies would allow me to access information" scored the highest mean of 3.93, displaying that educators strongly believe AI can facilitate



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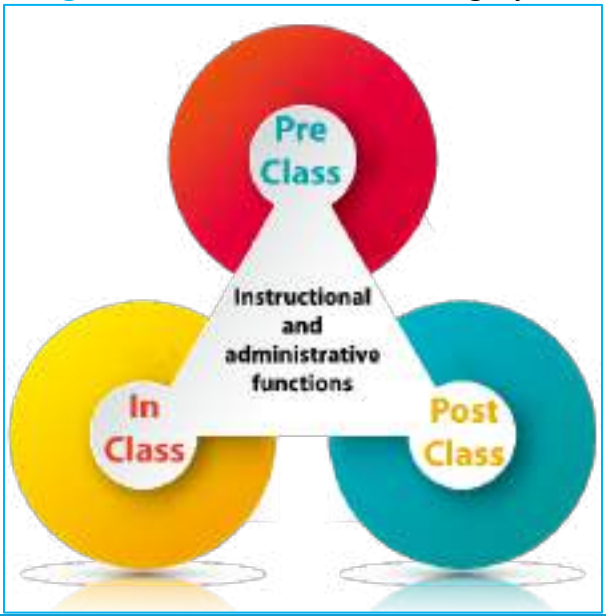
information access. The item "I think using AI technologies would allow me to control how I teach" received a mean rating of 3.54, displaying a moderate level of control. The item "I could express my true self when utilising AI technology-based information" had the lowest mean of 3.28, implying that participants may feel less autonomous in expressing their unique teaching style using AI technologies.

The empirical results also indicated that Perceived Autonomy did not exhibit a significant impact on educators' behavioral intention to utilize AI tools (Beta = 0.051, p = 0.655). This may be due to the limited impact of personal agency (PA) on educators' use of AI technologies and the fact that most of these AI tools are complex without transparent descriptions of how their algorithms work. Additional considerations, such perceived utility, user-friendliness, or institutional support, may exert a more substantial influence on adoption. Furthermore, external variables like institutional policies or peer influence may impact educators' adoption decisions more significantly than their personal sense of autonomy. Therefore, instructors might still adopt AI tools although they do not really feel in complete control (see Appendix D).

## 6. AI Enhanced Teaching Cycle

Integrating AI into the teaching cycle empowers instructors to improve the effectiveness of their teaching practices, saves time, and creates personalized learning experiences that enhance student engagement. By leveraging AI tools, instructors can develop students' AI literacy, preparing them for a future job market, increasingly shaped by digital transformation. The AI-enhanced teaching cycle can be organized into three main stages—pre-class, in-class, and post-class—each playing a critical role in supporting both instructional and administrative functions as presented in Figure 4.

**Figure 4.** AI Enhanced Teaching Cycle




| Pre-Class | In-Class | Post-Class |
|---|---|---|
| Generating Course Plans and Content | Enhancing Engagement with Audio-Visual Tools | Automated Grading and Feedback |
| Personalizing Learning Objectives | Automating Attendance and Participation Tracking | Performance Analysis and Targeted Support |
| Developing Instructional Materials | Real-Time Feedback and Adaptive Learning | Recording, Transcription, and Accessibility |
| Automating Administrative Preparations | Facilitating Group Work and Interactive Activities | Plagiarism Detection and Academic Integrity |
| | | Refining Teaching Strategies |
| | | Professional Development and Administrative Efficiency |

Figure 5 illustrates the current implementation of AI integration in teaching and research processes employing different AI technologies based on empirical study. The most common AI activity is detecting plagiarism (M: 3.27), followed by generating course content and materials (M: 2.94), and professional learning and development (M: 2.92). Practices with the lowest familiarity ratings are Assess the students' emotional state (M: 1.93) and Predict student performance (M: 2.06). Moderate popularity appears with activities such as creating in-class activities (M: 2.86), Data analysis (M: 2.84), and enhancing student experience in class (M: 2.77). The results indicate that participants are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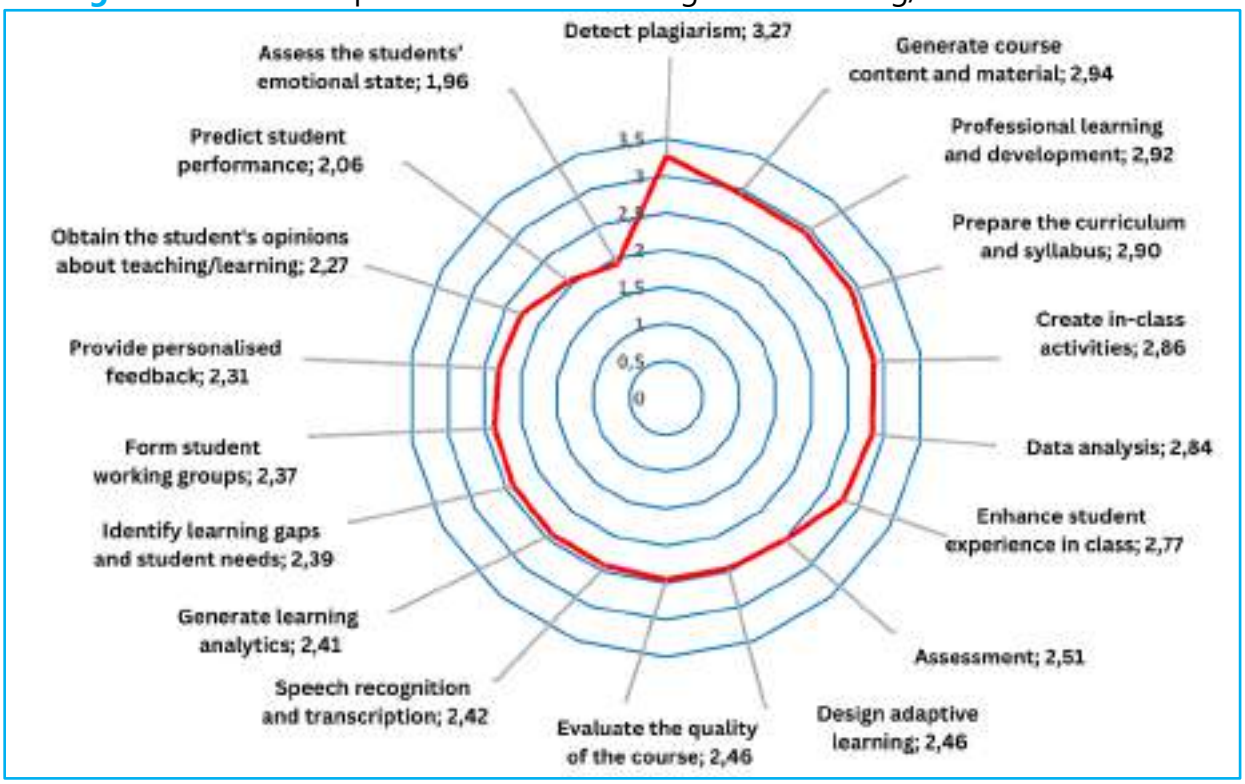
more familiar with systems related to academic integrity and course material generation, whereas emotional assessment and predictive analytics are usually overlooked (please see Appendix E).

**Figure 5.** Current Implementation of AI Integrated Teaching/Research Practices




## 6.1. Pre-Class

In the pre-class stage, AI tools assist instructors in preparing high-quality course materials and setting up effective instructional strategies. Through these AI-driven pre-class preparations, instructors can start each lesson with tailored, data-informed plans that support diverse learning needs, allowing them to focus more on meaningful interactions during in-class instruction. Key tasks in this phase include:

*Generating Course Plans and Content:* AI-powered systems, such as chatbots and content generation platforms, enable instructors to create detailed lesson outlines, syllabi, and learning outcomes. These tools streamline course planning by providing templates and automated suggestions that align with curriculum goals and learning objectives.

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*Personalizing Learning Objectives:* Adaptive AI tools can analyze student data, helping instructors set individualized learning objectives. For example, AI can assess student profiles, learning histories, and prior knowledge to suggest customized learning paths, ensuring that each student receives content suited to their pace and level.

*Developing Instructional Materials:* AI content creation tools can help instructors produce engaging visual aids, research summaries, and interactive presentation materials. By automating these tasks, AI saves instructors time while enhancing the quality of instructional resources, which can lead to better student engagement and comprehension.

*Automating Administrative Preparations:* AI systems can automate administrative tasks, such as organizing class rosters, setting up student profiles, and scheduling assignments. This reduces the workload on instructors and helps maintain organized course management.

### 6.2. In-Class

During the in-class phase, AI tools play an integral role in enhancing student engagement, monitoring participation, and providing real-time insights. By utilizing AI tools in the classroom, instructors can create a dynamic and interactive learning environment that actively involves students and supports diverse participation. This use of real-time data enables instructors to adapt their teaching approach to address varying comprehension levels and optimize learning experiences. Key functions of AI in this stage include:

*Enhancing Engagement with Audio-Visual Tools:* AI enables the use of interactive audio-visual materials, such as dynamic presentations, virtual simulations, and augmented reality elements, making complex topics more accessible and engaging. By stimulating student interest, these tools promote active participation and support diverse learning styles.

*Automating Attendance and Participation Tracking:* AI-driven systems can track attendance automatically and monitor student participation levels. These tools provide instructors with immediate information on student engagement, allowing them to make adjustments during class and address disengaged or absent students promptly.

*Real-Time Feedback and Adaptive Learning:* AI analytics platforms analyze student responses and emotional cues, providing real-time feedback on comprehension and engagement. If students appear confused or disengaged, AI tools can notify the instructor, enabling timely intervention and tailored instruction. This responsiveness improves both instructor effectiveness and student learning outcomes.

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*Facilitating Group Work and Interactive Activities:* AI systems can also automatically organize students into working groups based on their strengths, learning preferences, or performance levels. AI-powered quiz and polling tools can generate interactive activities, such as real-time quizzes or group challenges, promoting collaborative learning and peer-to-peer engagement.

### 6.3. Post-Class

In the post-class stage, AI tools aid in assessing and refining both student learning and instructional strategies. Through AI-enabled post-class activities, instructors can foster a more inclusive, responsive, and efficient learning environment that meets diverse student needs. The data collected at this stage provides valuable insights into both student learning outcomes and areas where instructional practices may be improved. Key applications of AI in this phase include:

*Automated Grading and Feedback:* AI-powered grading systems can prepare and assess assignments, quizzes, and exams, providing consistent and timely feedback. Automated grading not only reduces instructors' workload but also delivers immediate feedback to students, which can be particularly valuable in formative assessments where timely guidance is crucial for learning improvement.

*Performance Analysis and Targeted Support:* Learning analytics tools evaluate student performance data, identifying trends, strengths, and areas for improvement. AI systems help instructors track progress, recognize learning gaps, and develop tailored follow-up plans. These insights allow for more targeted support and intervention for students who may need additional help.

*Recording, Transcription, and Accessibility:* AI tools can record and transcribe lectures, making course materials accessible to students who may need to review content outside of class. This feature is especially beneficial for students with learning disabilities or language barriers, supporting an inclusive educational environment.

*Plagiarism Detection and Academic Integrity:* AI-driven plagiarism detection software ensures academic integrity by scanning student submissions for originality. This helps instructors maintain high standards in academic work and provides students with feedback on proper citation practices.

*Refining Teaching Strategies*: AI systems collect and analyze feedback from both student performance and engagement metrics. Instructors can use these insights to refine course

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content, instructional methods, and assessment strategies based on data-driven evidence, leading to continuous improvement in teaching effectiveness.

*Professional Development and Administrative Efficiency:* AI-based professional development platforms provide instructors with access to new teaching methods, AI literacy resources, and best practices. These platforms offer courses, certifications, and real-time guidance on integrating AI into instruction, helping educators stay updated on advancements and maintain pedagogical relevance. AI also automates routine administrative tasks, such as scheduling, email responses, and resource management, freeing up instructors to focus on teaching and student interaction. By reducing the time spent on non-instructional tasks, AI enhances overall productivity and supports a balanced workload.

In summary, the AI-enhanced teaching cycle—comprising pre-class, in-class, and post-class processes—transforms instructional methods, making teaching more effective, personalized, and efficient. By integrating AI tools, instructors can create an adaptive learning environment that meets the needs of diverse student populations while streamlining their own tasks and workflows, ultimately enhancing the overall quality of education in higher education institutions.

## 7. AI Teaching Cases in HE

AI is becoming a significant tool in the higher education environment, presenting a range of innovative solutions to facilitate education. From the intelligent analysis of students' feedback to the use of smart teaching assistants, the implications of AI in education are significant. The use of AI in the delivery of higher education has been transforming the teaching and learning landscape with numerous possibilities for both the institutions and the instructors. Technology contributes to learners' interactivity by personalizing teaching, reducing time spent on tedious tasks, and analyzing dynamic learning and teaching effectiveness. With the help of AI, the HEIs' can enhance the delivery of lectures, support student achievement, and design innovative teaching and learning environments. With the development of AI and improvements in its capacities, its impact on HE can only be expected to widen, providing innovative ways of improving learning outcomes besides encouraging learner-centered and inclusive learning for all students. In this section, several examples of AI utilization in higher learning institutions are discussed.

*Personalized Learning Pathways Through AI:* The main form of AI use in higher education is to develop learning paths for students that are customized for their needs. For example,


Microsoft offers advanced learning platforms based on Artificial Intelligence that identify the learner's performance in real-time and deliver an individualized sequence based on the student's learning pattern. This way, AI can assist the learner to get individual educational materials and recommendations, and that, in turn, will allow students to progress and focus on the major knowledge gaps.

*AI-Based Tutoring Systems and Chatbots:* Technology-assisted tutoring and automated chatbots are frequently used in higher education institutions especially where individual student attendance may be hard to monitor particularly in large enrollment classes. AI provides students with instant help and support to enquire or get clarifications or seek learning and study materials at their convenience. Chatbots using artificial intelligence can provide detailed and further explanations to the students even outside the class time without time constraints.

*AI-Enhanced Grading and Feedback Systems:* Grading and feedback are cumbersome activities for the instructors, more so when they teach large classes. AI can efficiently grade multiple-choice exams and provide feedback to students, saving educators time and allowing students to monitor their progress and enhance their learning. AI can also provide generic feedback on open-ended essay questions, making it easier for instructors to review and elaborate on the feedback when needed. While AI takes care of grading, educators would have more time to work on grading essays or other assignments that require more effort, which means a balanced approach to evaluation.

*AI in Curriculum Design and Course Development:* It is also worth mentioning that AI can help designing curriculum and course materials. According to AAA - All About AI, (2024), half of the teachers are now using AI for lesson planning, emphasizing AI's role in aiding educational planning and execution. AI programs can analyze and interpret large sets of education-related data, which can be used for identifying trends, assessing curricular content, and even predicting the programs' success. This provides instructors and HE administrators with opportunities to modify content earlier and design current and updated instructional materials in response to learners' performance and engagement. AI can also identify issues and topics where students may have problems, giving tutors an idea of the content they should include in their lectures.

*AI for Student Engagement and Retention:* Tutorial assistance is also witnessing the use of AI tools in trying to enhance student participation and retention especially through early identification of struggling learners. Using data such as attendance records, participation,

and performance, AI systems can analyze results and identify learners who may need additional support. Using this approach would enhance retention and academic performance especially when the number of students in a given course is large.

*AI in Collaborative Learning:* AI can also be used to foster collaborative learning through the formation of student groups based on strength, learning ability, and performance. Using data about students, the AI systems can identify the best setting in terms of group diversity and heterogeneity to enhance the formation of teams where all the students will solve the problems together. This also helps to improve the efficiency and productivity of the group assignments through creating a platform for students to learn from one another.

## 8. AI tools used in Higher Education and Teaching Use Cases

AI tools not only save time but also enhance teaching practices by improving student engagement, offering personalized learning experiences, and providing real-time feedback and data-driven insights. By integrating these technologies into higher education, instructors can focus more on creating meaningful learning experiences and addressing students' individual needs. Hence, AI tools in higher education can dramatically enhance the teaching process by automating routine tasks, supporting personalized learning, enriching content, and improving student engagement. By saving time spent on routine tasks, AI has the potential to create resources for more meaningful student interactions. Below are key categories of AI tools and how they can be used effectively during pre-in- and post-class educational settings:

**Figure 6.** Alternative AI Tools for Education




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### 8.1. Chatbots

Chatbots (e.g., ChatGPT, Gemini, Microsoft Copilot) are AI-powered systems designed to simulate human conversation. In education, they assist instructors by automating responses to common student queries, providing real-time information during class, and 24/7 support for course-related questions, and enhancing student engagement. These tools can also be used to create course content (e.g., lesson plans, syllabi, presentations) and visuals (i.e., DALL-E) to prepare class materials. Chatbots can also be used for class management, such as tracking attendance and providing instant feedback during lectures. A chatbot can help students navigate through course materials, answer administrative questions (e.g., deadlines), and even offer tips on study techniques, allowing instructors to focus on more critical tasks.

### 8.2. Plagiarism Detection Systems

Plagiarism detection tools (e.g., Turnitin, Winston AI, Copyscape, ZeroGPT) help educators monitor and maintain academic integrity by automatically scanning student submissions for potential plagiarism. These systems compare student work against a vast database of sources, including academic papers, websites, and other student submissions. Instructors can use these AI tools to evaluate assignments quickly, ensuring originality and providing feedback on proper citation practices.

### 8.3. Automated Grading Systems

Automated grading systems (e.g., Gradescope, Zipgrade, Socrative, Plickers) streamline the assessment process by allowing instructors to grade large volumes of assignments, quizzes, and exams quickly. 41% of teachers are reported to use such systems (AAA, 2024). These tools support various formats, from multiple-choice to open-ended questions, while also providing detailed analytics on student performance. For example, Gradescope can be used to scan, assess, and provide feedback on handwritten or digital exams, freeing up time for instructors to focus on more qualitative aspects of teaching.

### 8.4. AI-Powered Educational Games

AI-powered educational games (e.g., Kahoot!, Minecraft Education Edition, Duolingo, Quizlet) enhance student engagement by making learning fun and interactive and 51% of teachers utilize AI powered games in class (AAA, 2024). These platforms can automatically generate quizzes and learning activities tailored to each student's progress, reinforcing key concepts through gamification. For example, Kahoot!'s AI question generator allows instructors to create dynamic, interactive quizzes in real time, encouraging competition and engagement in the classroom.

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### 8.5. Adaptive learning platforms

Adaptive learning platforms (e.g., Knewton, CogBooks, SmartSparrow, LearnSmart) use AI to personalize learning experiences by adjusting the pace and difficulty of content based on individual student performance. 43% of teachers use such systems to personalize learning experiences (AAA, 2024). These systems offer tailored learning paths, ensuring that each student receives the right content at the right time, maximizing comprehension and retention. For example, an instructor can use Knewton to set up a course where students are guided through lessons based on their mastery of specific concepts, providing personalized exercises to reinforce weaker areas.

### 8.6. Intelligent Tutoring Systems

Intelligent tutoring systems (e.g., My-Moodle, Course Builder, Teachable, ALEKS) provide personalized instruction by guiding students through educational content with tailored feedback and support. These systems analyze student knowledge gaps and offer real-time corrective suggestions. For example, ALEKS can assess a student's knowledge in mathematics and provide adaptive problem sets that are specifically tailored to areas where the student needs improvement.

### 8.7. AI-Powered Learning Analytics

AI-powered learning analytics tools (e.g., Moodle Analytics, Dropout Detective, Learning Locker, Tableau, Power BI) provide insights into student behavior, engagement, and performance by analyzing large datasets. Instructors can track progress, identify students at risk of dropping out, and make data-driven decisions to improve teaching strategies. For example, Dropout Detective uses predictive analytics to identify students who are struggling, allowing educators to intervene early and provide targeted support.

### 8.8. AI-Powered Learning Management Systems (LMS)

AI-enhanced LMS platforms (e.g., *Blackboard Learn -AI design assistant*, *Moodle AI plugins*, *Canvas LMS AI features*, *Docebo*) help instructors manage courses more effectively by automating administrative tasks, suggesting improvements to course design, and providing personalized feedback to students. These systems integrate AI to streamline grading, track student progress, and offer adaptive learning features. For example, Blackboard Learn's AI assistant can help instructors design a more effective course layout by analyzing student data and suggesting modifications to improve engagement and learning outcomes.

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### 8.9. Examination Tools

AI exam tools (e.g., Quizizz, Socrative, Wooclap, ClassPoint) assist educators in creating dynamic assessment tools that adapt to student performance, offering instant feedback. These platforms are great for formative assessments, helping instructors understand comprehension levels in real-time and adjust teaching strategies accordingly. For example, Quizizz allows instructors to create engaging quizzes where AI adjusts the difficulty level based on the students' performance, fostering continuous learning.

### 8.10. AI-Enabled Simulations

AI-enabled simulations (e.g., *Labster*, *iCivics*, *Mursion*) provide immersive learning experiences, allowing students to apply theoretical knowledge in a controlled, virtual environment. These simulations are especially beneficial for subjects like science, social studies, and professional development. For example, Labster offers virtual laboratory experiments, allowing students to conduct scientific experiments in a risk-free, digital setting, enhancing practical understanding.

### 8.11.Speech Recognition and Transcription Software

Speech recognition and transcription tools (e.g., *Whisper*, *VOSK*, *Silero*, *Otter.ai*) convert spoken words into written text, making it easier for instructors to create transcriptions of lectures and students to access notes. These tools are particularly useful for improving accessibility and offering resources for non-native speakers or students with disabilities. For example, Otter.ai can be used to transcribe live lectures, enabling students to review lecture content and making course material more accessible.

Figure 7 displays the degree of familiarity with various artificial intelligence (AI) tools based on empirical data analysis. Participants were most familiar with chatbots (M: 3.71) and plagiarism detection programs (M: 3.57). AI-powered educational games (M: 2.86) and learning management systems (M: 2.63) demonstrate modest familiarity. These findings indicate that participants are more familiar with accessible AI technologies but have less familiarity with specialised and technical tools usually offered by organizations. In addition, tools with the lowest familiarity ratings include AI-enabled simulations (M: 1.85) and adaptive learning platforms (M: 1.97; please see Appendix F).

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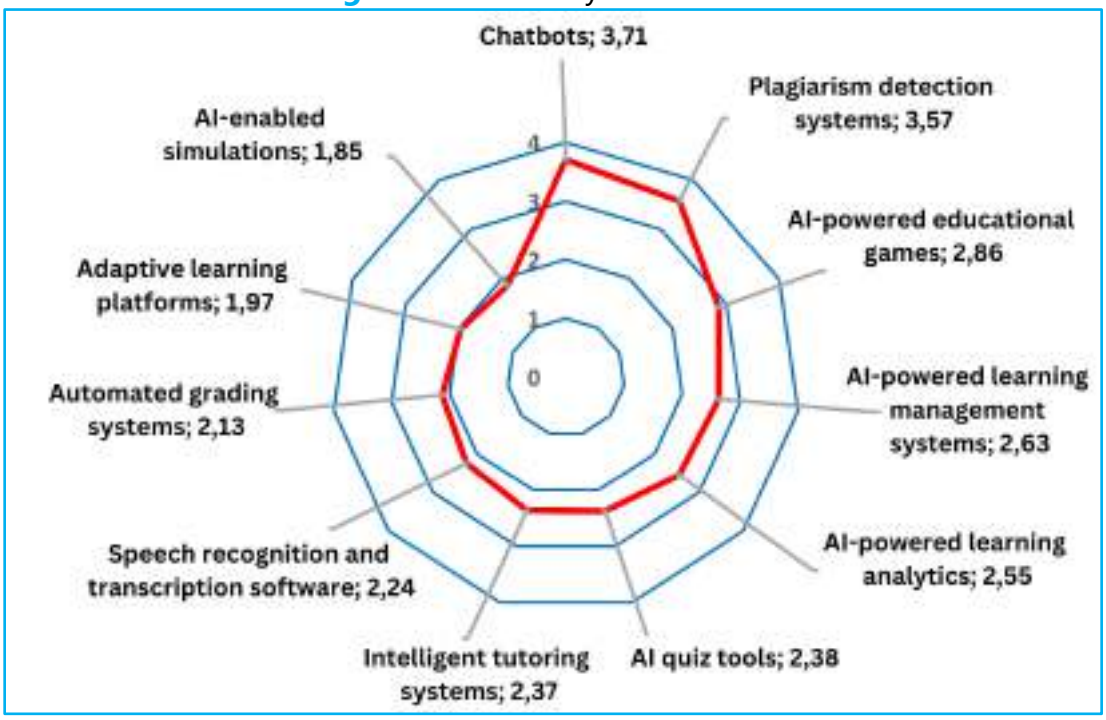
**Figure 7.** Familiarity with AI Tools




## 9. Advantages of AI

The integration of AI in higher education offers numerous advantages, significantly enhancing both teaching and learning experiences. For example, AI-driven adaptive learning systems have been shown to boost exam scores by 62%, demonstrating a substantial improvement in learning outcomes (AAA, 2024). These advantages are observed through qualitative benefits, such as improved student engagement and instructor development, and quantitative benefits, including time savings, increased attendance, and improved evaluation rates. These factors collectively contribute to a more efficient, responsive, and engaging educational environment.

### 9.1. Qualitative

Various qualitative advantages of utilizing AI in teaching include improving student engagement and customization, more inclusive education, enhanced decision-making, and facilitating continuous professional development of instructors through constant exposure to new information and teaching methods via AI.

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*Enhancing Student Engagement:* AI tools like intelligent tutoring systems, adaptive learning platforms, and AI-powered educational games (e.g., Kahoot! AI question generator, Quizlet) allow for interactive, customized learning experiences that actively engage students. Generative models like ChatGPT, also offer unique perspectives and new ways to approach content creation. These tools stimulate creativity by suggesting different angles, offering alternative viewpoints, and generating a variety of educational materials. AI enhances the classroom experience by providing real-time feedback, adaptive quizzes, and personalized pathways, which help students feel more involved and motivated. Educators believe that AI often brings fresh, innovative ideas that enrich teaching strategies and broaden learning experiences. Most educators also agree that AI enhances student engagement, making it easier to keep students interested and attentive during lessons and even after class by providing a wide variety of learning materials and real-time support.

*Facilitating Continuous Professional Development:* Through constant exposure to evolving technologies and new information sources, AI supports instructors' professional growth. Instructors learn new methods for integrating technology into their teaching, staying updated on best practices in digital literacy, data analysis, and AI ethics. Tools like My-Moodle and Teachable provide professional development resources that help educators keep pace with educational innovations. Respondents also mentioned continuous professional learning as a core benefit of AI integration, helping instructors maintain and improve their pedagogical skills.

*Supporting Inclusive and Personalized Education:* AI enhances inclusivity in education by providing accessible resources, such as speech recognition and transcription tools (e.g., Otter.ai, Whisper) and adaptive learning systems such as Knewton and SmartSparrow, which use AI to personalize learning paths for each student, tailoring content and difficulty levels to individual needs. This customization enhances the learning experience, ensuring that students can progress at a pace suitable to their abilities. These tools also make content more accessible to students with disabilities or language barriers, while adaptive learning platforms ensure that each student can progress at their own pace. Many educators highlighted that AI supports personalized learning, helping meet the needs of diverse student groups and fostering an inclusive learning environment.

*Promoting Data-Driven Instructional Decisions:* AI also enables educators to use real-time data for informed decision-making, improving the overall quality and effectiveness of teaching. AI analytics tools, such as Tableau and Moodle Analytics, provide insights into

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student performance and engagement patterns, helping educators make informed instructional decisions. AI-powered learning analytics provide valuable insights into student performance and course engagement, assisting instructors in planning and decision-making. These tools enable instructors to track progress, identify knowledge gaps, and provide targeted support. AI systems like Socrative and Gradescope ensure consistent, accurate grading and feedback. These platforms reduce human error and provide students with clear, constructive assessments, supporting their academic growth. AI's ability to handle vast data sets also aids instructors in making informed decisions, ultimately improving teaching performance. Educators agree that AI supports instructional decision-making by identifying performance patterns, allowing them to adapt and personalize their teaching strategies.

### 9.2. Quantitative

AI can also provide quantitative advantages such as saving instructors' time, increasing student satisfaction and attendance, course completion rates, decreasing response time for student enquiries, and improving student evaluation levels, which in turn also contribute to qualitative benefits.

*Timesaving for Instructors:* AI automates repetitive tasks, such as grading, attendance tracking, and content generation, freeing up valuable time for instructors to focus on pedagogy and student interaction. For instance, tools like Gradescope for grading and ChatGPT for content creation significantly reduce the time spent on routine activities. According to AAA (2024), AI marking tools reduced grading time by 70% compared to manual grading. The majority of instructors noted that AI tools save considerable time, allowing them to allocate more time to greater focus on direct student engagement, individual student needs, and lesson planning.

*Higher Student Satisfaction:* AI can improve student evaluations by enhancing engagement and satisfaction through adaptive learning and personalized feedback. AI systems, such as intelligent tutoring and adaptive platforms, provide instant feedback to students, allowing them to understand errors and improve. This immediate feedback supports continuous learning and helps students retain concepts more effectively. Students are more likely to give positive evaluations when they feel supported and engaged. AI-powered feedback systems, such as those in adaptive platforms, allow instructors to provide detailed, timely feedback, which increases overall student satisfaction. Findings of the empirical study also confirmed AI tools that personalize feedback and foster engagement help increase student satisfaction and evaluation rates.



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*Faster Response Times for Student Inquiries:* AI chatbots, AI clones, and virtual assistants (e.g., Microsoft Copilot, ChatGPT) enable instant responses to student inquiries, providing support outside class hours. This improves the student experience by ensuring they have quick access to the information they need, reducing response times, and relieving instructors of the burden of answering repetitive questions. Educators also agree that AI-powered chatbots greatly reduce response times for student inquiries, fostering a more responsive learning environment.

*Reduction in Administrative Burden:* AI tools handle a range of administrative tasks, from attendance tracking to the organization of student working groups and reporting, which reduces the administrative workload on instructors. This allows educators to focus more on teaching and student engagement, rather than on routine management tasks. Reducing administrative tasks through AI enables instructors to dedicate more time to instruction and student support.

*Tracking and measuring progress:* AI tools streamline data processing and retrieval, helping instructors analyze performance metrics, attendance, and other data effectively. This efficiency supports a data-driven approach to instruction, enabling timely interventions and resource allocation. AI-powered learning analytics and assessment tools streamline the tracking of student progress and performance evaluations. Automated grading systems, such as Socrative and Gradescope, reduce grading time and improve assessment consistency. This efficiency allows instructors to conduct more frequent assessments and provides students with timely feedback, which can improve learning outcomes. Many instructors noted that AI tools make it easier to track and assess student progress, contributing to a more data-driven and efficient evaluation process.

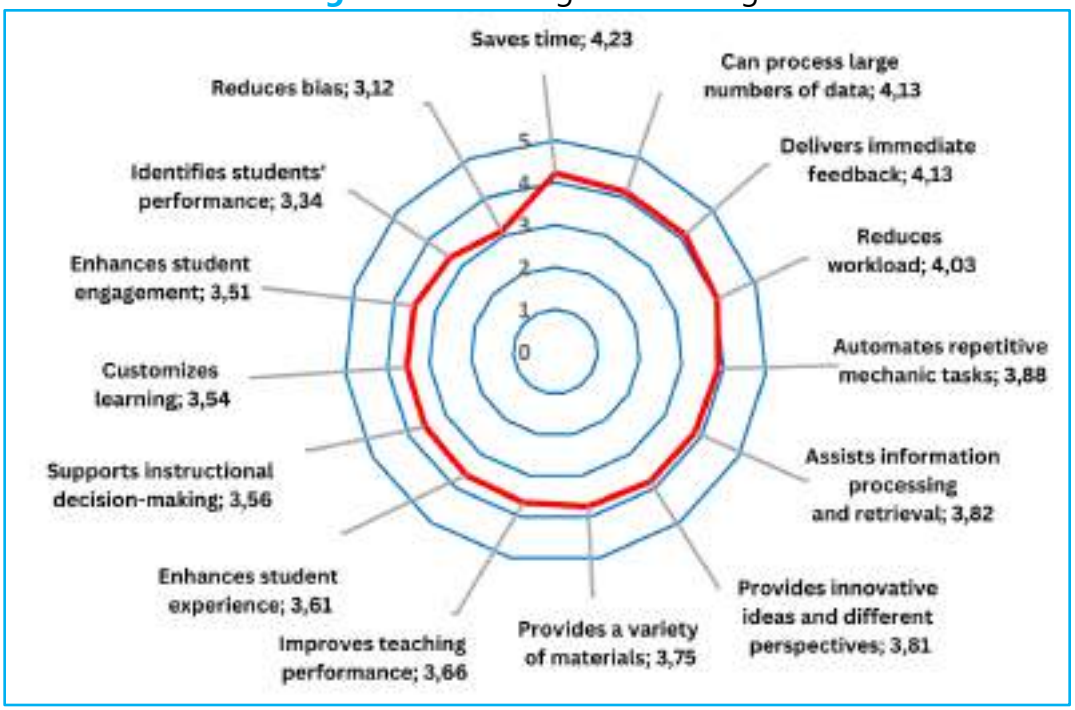
*Increased Attendance and Course Completion Rates:* By providing personalized learning paths, real-time engagement tracking, and timely interventions, AI can improve student attendance and completion rates. Tools like Dropout Detective identify at-risk students early, enabling instructors to offer support and increase retention. Instructors can utilize AI's ability to provide early interventions, contributing to higher attendance and course completion rates. AI tools are able to increase exam scores by 62% and graduation rates by 43% (AAA, 2024).

In sum, AI integration in higher education presents significant qualitative and quantitative benefits. By enhancing engagement, supporting professional development, and providing data-driven insights, AI enriches the educational experience for both instructors and

students. Quantitatively, it allows educators to manage their time more effectively, improves attendance and completion rates, and fosters a more responsive and efficient learning environment.

Figure 8 displays the advantageous effects of AI application in educational settings according to empirical data. The major benefits of AI are time savings (M: 4.23), processing large numbers of data (M: 4.13), and delivering immediate feedback (M: 4.13), demonstrating its efficiency and responsiveness. Similarly, reducing workload (M: 4.03) and automating repetitive mechanic activities (M: 3.88) are reflected as significant advantages. Moderately rated advantages include Enhances student engagement (M: 3.51), Supports instructional decision-making (M: 3.56), and Customizes learning (M: 3.54). Reduces bias (M: 3.12) and Identifies students' performance (M: 3.34) with relatively lower scores. These findings indicate that participants appreciate AI more for its time-saving capabilities, efficiency, and capacity to handle large-scale activities, whereas its functions in bias reduction and personalized learning are perceived as less important (please see Appendix G).

**Figure 8.** Advantages of AI Usage

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## 10.Challenges

Different challenges underscore the need for various interventions, including financial, ethical, technical, and social dimensions of AI use in higher education, as mapped in Figure 9.

**Figure 9.** Map of Challenges


### 10.1.AI Knowledge And Literacy Gaps

*Lack of AI Literacy among Instructors:* Many educators have limited experience with AI, which creates a barrier to effective integration. As mentioned earlier, training programs that enhance AI literacy and support a positive learning environment are important for overcoming this challenge. There are also different levels of knowledge, motivation, and preparation to integrate AI in teaching among faculty. Hence, a targeted intervention (e.g., case studies, training programs) might be needed in some cases.

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*Rapid AI Developments Complicate Adoption:* The fast pace of AI advancements makes it difficult for institutions to stay updated. Educators may also feel overwhelmed by the need to learn constantly evolving tools and may resist adopting new technologies.

### 10.2.Infrastructure and Cost Related Challenges

*Costs of Installation, Training, and Maintenance:* Implementing AI tools requires a substantial initial investment, ongoing maintenance, and regular training for educators. Many institutions face budget constraints that make it difficult to support these costs sustainably.

*Insufficient Technological Infrastructure:* Not all institutions have the necessary infrastructure to support AI tools, which may hinder effective integration. Reliable internet access, strong servers, and compatible hardware are essential but not always available.

### 10.3.Pedagogical and Disciplinary Challenges

*Restricted Applicability:* Different academic disciplines have unique requirements, and not all fields benefit equally from AI. For example, disciplines relying heavily on subjective assessments or creative work may not align well with AI's capabilities. Certain teaching activities, such as hands-on labs or complex social interactions, are also challenging to automate or simulate with AI. Hence, AI may not be suitable for all disciplines, and some activities inherently require human-led, interactive approaches.

*Limited Understanding of Student Thinking:* AI tools are often limited in their ability to understand students' personal thoughts, reasoning, or unique learning styles, making it difficult to replace human insight in complex learning scenarios.

*Lack of Standard Guidelines on AI Use in Education:* The absence of standardized guidelines on how AI should be implemented and managed creates inconsistency, making it challenging for educators to understand best practices and institutional expectations.

*Risk of Overreliance on AI:* There is a risk that educators and students may become over reliant on AI tools, potentially diminishing critical thinking skills, social interactions and undermining traditional teaching practices.

### 10.4.Ethical, Accountability and Equity Issues

*Ethical Issues and Plagiarism:* AI tools raise ethical questions around plagiarism, data privacy, and transparency. Use of AI-generated content may complicate academic integrity. According to AAA (2024) 65% of teachers are concerned about academic integrity of AI use.


*Accountability:* Determining who is accountable for the outputs of AI systems can be challenging. For instance, if AI tools generate biased or incorrect information, it is unclear who holds responsibility—the instructor, the institution, or the AI provider.

*Privacy and Data Security:* AI tools collect and analyze vast amounts of student data, raising concerns about data protection and the secure handling of sensitive information. 42% of teachers were concerned about how personal data is managed within AI systems. Compliance with data protection regulations, such as GDPR, is essential but complex.

*Accessibility and Equity:* AI tools need to be accessible to all students, including those with disabilities and those from underprivileged backgrounds. Ensuring equitable access to AI-enhanced education remains a challenge, particularly in regions with limited resources. Disparities in access to AI tools are also a major concern, and 30% of educators worry about unequal access (AAA, 2024). Most instructors also lack access to reliable and comprehensive AI tools and platforms, which would harm equitable education opportunities.

*Copyright Issues:* Using AI-generated content or training data from copyrighted sources can create legal challenges. Educators must be cautious of copyright restrictions to ensure that AI tools comply with intellectual property laws.

### 10.5.Instructional Limitations and Technical Challenges

*Technical Errors and Limitations:* AI tools can encounter errors or glitches that disrupt the learning process. Unreliable AI systems may lead to incorrect evaluations (i.e., hallucinations), misinterpretation of student data, or misalignment with learning objectives.

*Restricted Contextual Understanding:* AI tools often lack the ability to perceive context, making it difficult for them to understand the reasons behind student responses or behavior. This limitation can lead to misunderstandings and inappropriate feedback.

*Limited Ability to Process Nuanced Responses:* AI systems struggle to interpret subtle language cues, emotions, and other complex student responses, limiting their effectiveness in areas requiring sensitivity, empathy, or deep contextual understanding.

### 10.6.Social Interactions

*Reduced Social Interaction:* 63% of teachers believe AI tools reduce student – teacher interaction. Education is not only about knowledge acquisition; it is also about cultural and social development. Relying on AI may risk eroding these essential components,



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impacting the broader educational experience. AI can limit student-teacher and peer interactions, undermining the social dynamics of learning. Relying too heavily on AI may reduce the opportunity for students to develop communication, collaboration, and interpersonal skills. As it may reduce direct human interaction, AI might also have various psychological and social impacts on students and faculty. Hence, AI tools should be blended with teamwork, and interactive teaching methods to maintain human interaction.

*Reduction of Human Role in Teaching:* Extensive AI integration may devalue the role of educators, as some tasks traditionally performed by instructors are automated. This change can alter the student-teacher relationship and impact the perceived value of human guidance. One study showed 30% of educators feel AI will trigger job displacement. There is also some concern on loss of valuable teaching skills (23%) to automation (AAA, 2024).

The following figure 10 describes the barriers to AI usage in higher education as per empirical data analysis. The most major barriers were cited as ethical issues and plagiarism (M: 3.97), followed by a lack of guidelines and policies (M: 3.92) and AI literacy among instructors (M: 3.88), Accountability (who is responsible for AI-generated information) (M: 3.87), and Copyright issues (M: 3.87). Other notable barriers include the risk of overreliance on AI (M: 3.80) and the fact that different disciplines have different needs (M: 3.63). Moderate concerns include Biassed information (M: 3.61), Accessibility and equity (M: 3.60), and Maintaining the social and cultural aspects of education in AI-integrated teaching (M: 3.57). Reduction of human role in teaching (M: 3.34) is considered as a less important barrier. Overall, the data implies that ethical problems, lack of knowledge and responsibility, and challenges related to infrastructure and standards are the primary challenges faced when integrating AI into education (please see Appendix H).

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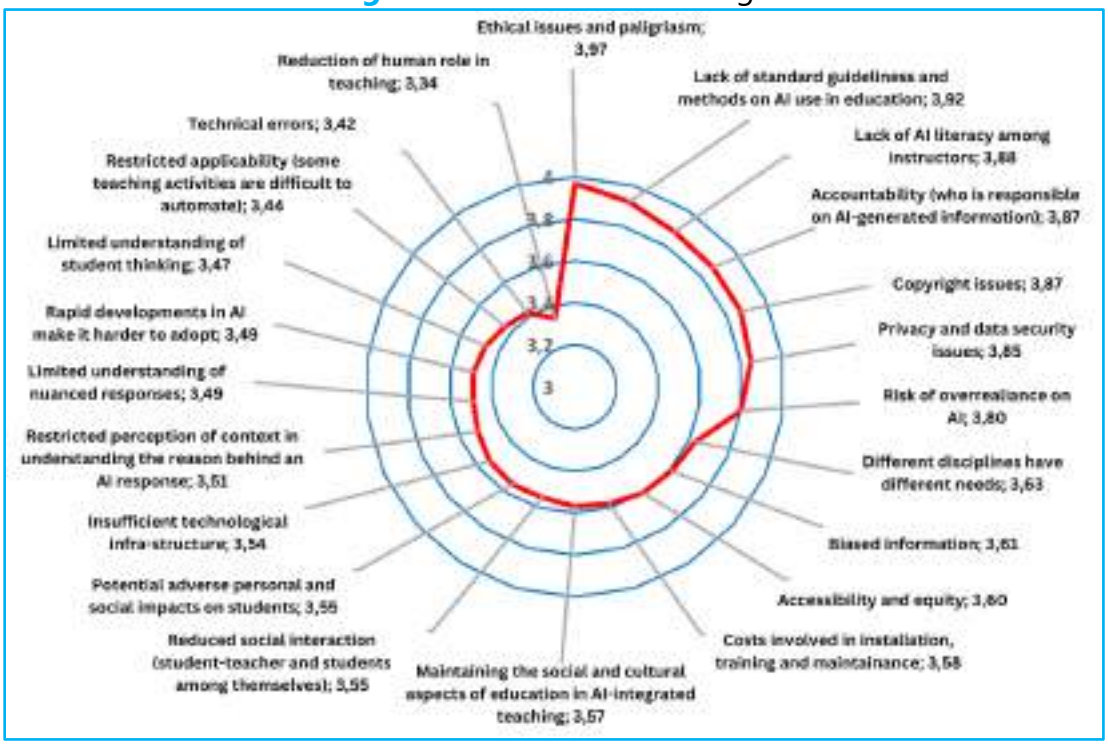
**Figure 10.** Barriers of AI Usage




## 10.7.Personal Resistance

Some instructors might also be less motivated to integrate AI and may resist adopting it in their teaching. The potential of AI for higher education needs to be communicated effectively, emphasizing its possible advantages while also offering various incentives.

Resistance to the adoption of AI in educational institutions often stems from a combination of factors, including skepticism toward new technologies, ethical concerns (Cyrus & Raymond, 2023), and institutional conservatism. The differing opinions among instructors (Mukred et al., 2023), students (Kharroubi et al., 2024), and administrators regarding the role of AI in academia highlight a lack of consensus on the adoption of this technology. Additionally, universities typically have deep-rooted traditions and established norms (Allumi et al., 2024). As a result, changes can be perceived as a threat to the existing order, leading instructors and administrators to be reluctant to adopt AI technologies.

Moreover, many people are concerned about job loss due to AI. Some instructors may fear that AI will alter their roles or diminish their significance within the education system.

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According to the integrated fear acquisition theory (Li and Huang, 2020), AI triggers various emotions, including job replacement anxiety. This anxiety can contribute to resistance against AI systems that streamline processes or automate tasks. Therefore, individual and institutional resistance to change regarding AI adoption in higher education should be addressed. The solutions to these challenges are discussed in the next section.

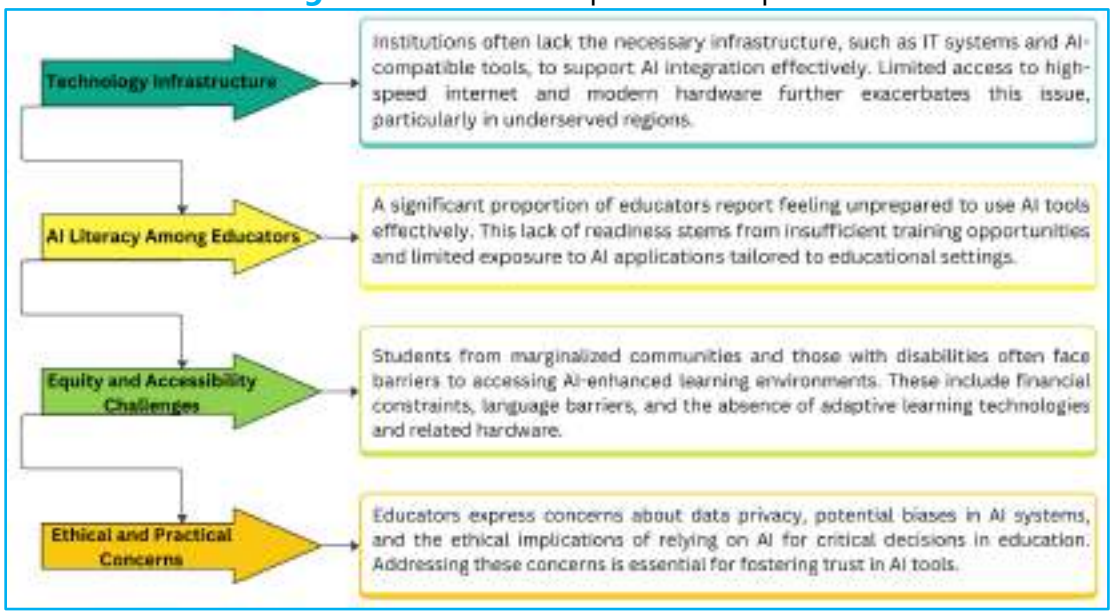
## 11.Needs Assessment

The integration of Artificial Intelligence (AI) into higher education demands a thorough understanding of institutional, faculty, and student needs. A comprehensive analysis not only identifies gaps in current educational practices but also informs the design of strategies and tools that align with the unique challenges and goals of higher education institutions (HEIs). This section outlines key insights derived from qualitative and quantitative research conducted with educators and other stakeholders.

### 11.1.Current Gaps in AI Adoption

The adoption of AI in higher education varies significantly across institutions, disciplines, and roles. Many HEIs have yet to establish a cohesive vision or framework for integrating AI into teaching, learning, and administration. Key gaps include:

**Figure 11.** Current Gaps in AI Adoption

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## 11.2.Stakeholder Insights

Educators emphasize the need for tools that simplify administrative tasks, such as grading and attendance tracking, while enhancing their ability to deliver personalized instruction. They also believe that AI applications should provide real-time feedback, create personalized learning pathways, and support non-traditional learners. Furthermore, AI-driven insights are expected to optimize resource allocation, improve retention rates, and ensure compliance with accreditation standards.

## 11.3.Opportunities for AI Integration

The analysis identifies several opportunities to address these gaps and enhance the adoption of AI in HEIs:

*Training and Professional Development:*

a. Develop comprehensive AI literacy programs for educators and administrators, focusing on practical applications in teaching and learning.
b. Offer certification courses on ethical AI use, data analytics, and adaptive learning technologies.

*Infrastructure Development:*

c. Invest in cloud-based AI platforms and scalable IT solutions that support diverse educational needs.
d. Promote equitable access to technology by offering devices and internet subsidies to underserved stakeholders.

*Ethical Frameworks and Policies:*

e. Establish clear guidelines for ethical AI use, including transparency, accountability, and data privacy standards.
f. Regularly audit AI tools to identify and mitigate biases, ensuring fairness in decision-making processes.

*Collaboration and Innovation:*

g. Foster partnerships with edtech companies and research organizations to co-develop AI solutions tailored to educational contexts.
h. Encourage interdisciplinary collaboration among faculty to explore innovative uses of AI in various fields.

## 11.4.Expected Outcomes of AI Integration

By addressing these gaps and leveraging opportunities, HEIs can achieve transformative outcomes, such as:

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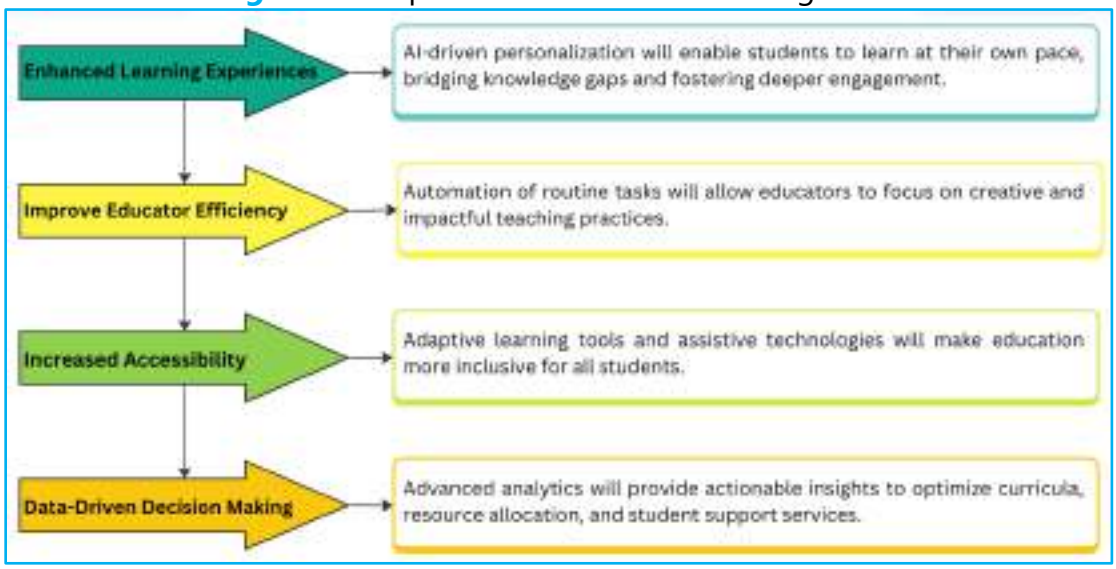
**Figure 12.** Expected Outcomes of AI Integration




Conducting a needs analysis is a critical first step in designing effective AI integration strategies for higher education. By understanding the specific challenges and priorities of their stakeholders, institutions can create tailored solutions that enhance teaching, learning, and administration. This proactive approach ensures that AI serves as a tool for inclusion, innovation, and excellence in education.

Many scholars have also pointed out that universities take a conservative approach to implementing innovative practices, research, and technologies to improve teaching and learning processes (Liu et al., 2020), highlighting the need for a thorough assessment of this trend. This resistance is even more surprising given the profound and widespread advantages of integrated AI in HEIs, such as enhanced efficiency in learning analytics systems, more effective and efficient teaching processes, and a lighter administrative burden through procedures such as algorithmic decision-making support tools.

As discussed above, various reasons can be listed for the reluctance of educators to deploy AI, including a lack of AI literacy, fears regarding job displacement, unwillingness to embrace innovation and take risks, bias and discrimination in learning analytics, and insufficient financing. It is clear that effective models need to be developed to help educators overcome these challenges. Therefore, understanding educators' perspectives on AI systems is a crucial step since they are the main authorities in the educational setting (Kizilcec, 2024).

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A large share of the research on AI in HE has focused on technological improvements (Bond et al., 2024), indicating factors that practically shape the way educators perceive, trust, and implement AI in their academic practices (Buckingham Shum et al., 2019). While these studies offer valuable insights into the role of AI in HE, none have adequately addressed practical solutions for overcoming adoption challenges. Therefore, there is a need to develop a novel and innovative framework for the adoption of AI in higher education, based on both qualitative and quantitative approaches.

Based on empirical data, this report also aims to address this gap. Solutions such as investing in infrastructure, implementing standardized guidelines, and providing continuous AI literacy training are essential for effectively tackling these challenges. Many educators require strong evidence that new approaches will improve learning outcomes, which contributes to fears of being replaced by AI and a cautious stance toward new technology. Some propose hybrid intelligence, emphasizing collaboration between humans and AI rather than replacement (Akata et al., 2019). To address these concerns, extensive communication, training and certification opportunities, as well as standards and guidelines, are needed to support the integration of AI in higher education and guide its future role.

### 11.5.Training for AI

Training, certification, and micro-credentials are tools that can be used to equip educators with the necessary knowledge, technical skills, and ethical understanding required for responsible and effective AI integration, as well as to build AI literacy among instructors in higher education. Considering that 87% of teachers did not receive any sort of AI training (AAA, 2024), the AI literacy gap remains a major barrier.

Based on the empirical analysis, the following themes emerged as the main topics to be covered in an AI training course targeting higher education instructors. The findings suggest that the training program should cover fundamental AI concepts, technical skills, pedagogical strategies, and ethical considerations, enabling educators to leverage AI tools confidently and competently. Below are the core training topics and their suggested contents:

#### *Introduction, History and Development of AI*

This module explores the definition and history of AI, the differences between AI and Generative AI, and the origins and evolution of AI, from early theoretical models to modern applications in various sectors, including education. It covers key milestones,


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technological advancements, and the development of machine learning, natural language processing, and computer vision. This topic provides educators with a foundational understanding of AI's journey and its growing potential in shaping educational technologies.

### *Principles of AI and Its Socio-Economic Implications*

This topic addresses fundamental AI principles, including how AI systems operate, learn, and adapt. It also explores AI's socio-economic impact, discussing issues such as job displacement, data privacy, and the ethical implications of AI in society. This content helps educators understand the broader implications of AI, including both its benefits and potential societal challenges, fostering an informed approach to AI use.

### *Technical Skills for AI Use in Education*

This module covers practical, hands-on training with AI tools commonly used in educational settings, including chatbots, learning analytics, adaptive learning platforms, and automated grading systems. Participants will learn to set up, customize, and apply these tools in their classrooms. The objective is to build technical proficiency, enabling educators to implement AI tools effectively, troubleshoot basic issues, and enhance overall teaching efficiency.

### *Pedagogical Skills for AI Use in Education*

This module explores how AI can be used to enrich pedagogy. Topics include personalized learning design, adaptive teaching strategies, and methods for blending AI with traditional teaching approaches. Case studies will demonstrate successful AI-pedagogy integration. This module equips educators with pedagogical strategies for using AI to enhance teaching practices, ensuring that AI supports rather than replaces human-led education.

### *Prompting Skills in AI*

Educators will learn the art of prompting AI models like ChatGPT to generate specific, relevant content under this topic. This module covers prompt engineering, effective questioning, and strategies for obtaining accurate, high-quality responses from AI tools. This module will develop educators' prompting skills to maximize the utility of generative AI tools, allowing for efficient content creation, research assistance, and student support.


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### *Addressing Trustable AI and Ethical Considerations*

This module focuses on the ethical considerations of using AI in education, specifically addressing transparency, responsibility, bias, equality, and the responsible use of AI. Instructors will be equipped to recognize and mitigate biases in AI-generated content or assessments and to establish guidelines for ethical AI use, ensuring that AI tools are accessible to all students, particularly those with disabilities or from financially disadvantaged communities. The aim of this module is to ensure educators are prepared to address potential ethical and diversity issues related to AI use, fostering a culture of integrity within AI-enhanced educational settings.

### *Strategies for Evaluating and Detecting AI-Generated Content*

This module trains educators to recognize and evaluate AI-generated content, helping them assess the originality of student work. Traditional anti-plagiarism software often fails to detect AI-generated content, with instances where AI-generated exam submissions went virtually undetected among real student submissions (AAA, 2024). Tools and techniques for detecting AI use, such as plagiarism detection software and content analysis, are covered. The objective is to prepare educators to address the increasing presence of AI-generated work, ensuring academic standards are maintained, fairness is upheld, and originality is protected.

### *Enhancing Student Engagement with AI Tools*

This module explores AI tools designed to improve student engagement, such as AI-powered games, interactive assessments, and personalized learning paths. Educators will learn to incorporate these tools into lesson plans to create engaging, immersive learning experiences. This module provides educators with the skills to use AI tools that actively involve students, enhancing motivation and participation through interactive and adaptive content.

### *Developing AI-Based Lesson Plans and Syllabus*

In this training, educators will learn to create lesson plans and syllabi that integrate AI tools for personalized learning. This includes setting learning objectives, planning assessments, and designing instructional materials that incorporate AI-driven resources during pre-class preparation. The module will enable educators to design AI-enhanced curricula that address diverse learning needs, providing a structured approach to blending AI with traditional course materials.

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### *AI-Driven In-Class Presentation and Teaching*

This module covers the use of AI-driven tools for live in-class teaching, including AI-assisted presentation tools, interactive quizzes, and real-time feedback systems. Educators would practice using tools that enhance student participation during lessons. This module will equip educators to use AI tools in real-time classroom settings, enhancing engagement and interaction during lectures and discussions.

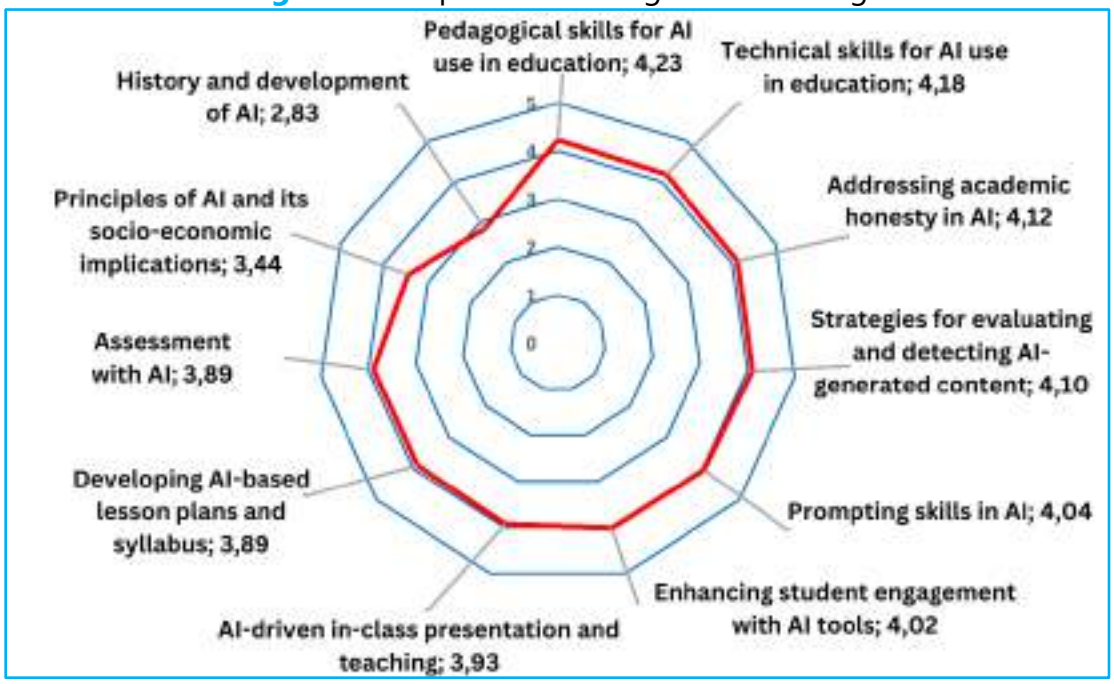
### *Assessment with AI*

Considering that AI is expected to score half of the college essays by 2030 (AAA, 2024), this module focuses on post-class and AI-supported assessment methods, such as automated grading systems, formative assessments, and personalized feedback tools. Educators will learn to streamline the grading process and use AI analytics to monitor student performance. The objective is to simplify the assessment process and improve feedback quality, enabling educators to provide timely, personalized evaluations that support student growth.

Based on empirical data in the context of higher education, Figure 11 displays the importance of subjects for AI integration training as perceived by instructors. A significant focus on the practical, ethical, and instructional elements of integrating AI is evident, including pedagogical skills for AI use in education (M: 4.23), technical skills for AI use in education (M: 4.18), and addressing academic honesty in AI (M: 4.12).

The requirement for advanced abilities to maximize AI in educational contexts is highlighted by several noteworthy areas, such as strategies for evaluating and detecting AI-generated content (M: 4.10), prompting skills in AI (M: 4.04), and enhancing student engagement with AI tools (M: 4.02). Conversely, principles of AI and its socio-economic implications (M: 3.44) and the history and development of AI (M: 2.83), which are the least prioritized topics, indicate that theoretical and fundamental knowledge is perceived as less important than educational approaches and real-world applications (see Appendix I).

**Figure 13.** Topics for AI Integration Training




## 11.6.Equality in AI Integrated Teaching:

Students from vulnerable groups, including those with learning disabilities, language barriers, and social or financial challenges, could benefit from AI assistance, which can improve educational equity (Buckingham Shum et al., 2019). Literature also emphasizes the equity-based reasons for universities to engage with relevant AI tools (Lee et al., 2024).

This framework highlights AI's potential to transform personalized learning. It suggests that AI, through its capacity for data analysis, translation, audio-visual representation, and pattern recognition, can design learning experiences tailored to the distinct needs and preferences of both instructors and learners. This perspective underscores the practical application of AI in enhancing learning outcomes by offering adaptive content and personalized feedback.

The framework also reinforces theoretical propositions that relate AI to improved access and diverse representation in education (Muhammad, 2024). AI provides key opportunities, including translation, transcription, and other accessibility tools. These tools enhance the availability of tutorial content for students with disabilities. Hence, AI contributes not only to making the education process more inclusive but also helps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mitigate the problem of educational inequality, aligning with the overarching goal of using AI to provide fair educational opportunities for everyone.

There are several ways in which AI can be effectively utilized to enhance access and improve the inclusiveness of education. For instance, AI-powered language translation and transcription applications can make teaching documents accessible to diverse students who speak different languages. Additionally, audio content can be transcribed for hearing-impaired learners, and AI can enhance access for visually impaired students by describing visuals or making content compatible with screen readers.

AI can also personalize course delivery to meet special needs, monitor each student's progress, and provide real-time feedback for learners with varying abilities. Furthermore, AI can help remove physical, geographic, or economic barriers by delivering content and guiding learners to suitable online resources more efficiently than simply presenting materials. Such an approach can expand the application of AI in education, reduce bias in learning activities, and create equal opportunities for all learners.

Furthermore, AI can provide solutions to overcome geographical and economic obstacles in achieving educational equity. Specifically, for students in remote areas or low-income regions, AI can help reduce the barriers associated with attending physical classrooms. Computer-based methods, digital platforms, and various web-based tools enable education to be delivered to a large number of students without relying on local infrastructure or physical spaces.

Through free or low-cost resources, all students can gain access to quality study materials and education. Consequently, AI can help address economic and geographical limitations, reducing inequalities and disparities in education.

### 11.7.Plagiarism and Responsibility in AI Use:

The ownership and responsibility of generated content, along with the ethical issues surrounding the use of AI tools in academia, remain major topics of discussion (Dwivedi et al., 2023). Nevertheless, the potential benefits of AI have led to a more favorable view of its utilization (Ali & OpenAI, 2023). However, little empirical research has been conducted on how the use of AI, combined with the lack of guidelines, continues to affect its adoption.

Although representatives of the European Parliament (2023) and other global policymakers, including those in the United States (U.S. Department of Education, 2023)


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and Australia (NSW Government, 2023), have attempted to design rules for AI use in learning environments, there are no specific, distinct, and transferable norms for applying AI tools in educational contexts (Ganjavi et al., 2024). However, as the recent Horizon Report 2022 identifies, AI is one of the technologies with the highest potential to trigger transformations in academia (Pelletier et al., 2022).

For example, AI chatbots do not qualify for authorship in research because systems such as ChatGPT cannot be held responsible for content quality or integrity (Dwivedi et al., 2023). On the other hand, some publishers claim that it is acceptable to declare AI's participation in writing an article, provided this information is acknowledged in the publication (Stokel-Walker, 2023). Similar to citing statistical software, Ivanov and Soliman (2023) noted that AI use should be mentioned in the methods section of papers. They also recommend that, similar to funding and conflict of interest statements, some publications may require a statement on the use of AI. Educators might also adopt one of these methods for student work.

However, plagiarism and responsibility in AI usage make these discussions more challenging. The distinction between copyrightable authorship and AI-generated content becomes increasingly blurred because texts produced by chatbots are very similar to those written by humans (Rudolph et al., 2023). Moreover, as Skavronskaya et al. (2023) found, current plagiarism detection systems are unable to identify AI-generated texts, even when the same tools and programs are used. Existing plagiarism detection tools are unable to accurately identify AI-generated content, raising concerns about the extent to which AI-generated material can be considered original or properly attributed to a specific researcher. Furthermore, some current AI detection tools may mistakenly flag non-AI work as AI-generated.

In addition, several emerging tools are designed to "humanize" AI-generated text, making it increasingly difficult for detection systems to distinguish between human-authored and AI-generated content. This further complicates the issue of determining authorship and ensuring the originality of scholarly work. In cases where AI participates in the process of producing texts, particularly when a significant portion of the paper is created by AI, the issue of the paper's academic credibility arises, even if the authors acknowledge the use of AI.


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Additionally, there is an increasing concern about AI's potential role in cheating. Students can easily communicate with AI using multiple mediums (e.g., text, microphone, camera) and generate extensive content instantly. As a result, students can misuse AI by presenting work generated by the system as their own. Therefore, instructors will need to develop skills and become familiar with tools to prevent (in the case of exams) or detect the level of AI utilization by students for various assignments.

Hence, there is an urgent need to create awareness among instructors, institutions, and students and set concrete ethical guidelines concerning the use of AI in HEIs. While institutions should establish general guidelines on AI use, instructors should also provide class-specific guidelines in their syllabi, and students should be encouraged to explicitly state how they used AI for assignments. Indeed, some authors (e.g., Bouschery et al., 2023) have acknowledged AI's involvement in drafting parts of academic papers without any human intervention, which raises serious ethical questions about responsibility and contribution. This framework suggests drawing a clear distinction between AI as mere tools for support and AI as co-authors (Ivanov & Soliman, 2023). The absence of such a distinction raises concerns about the integrity of academic work and the true value of teaching and learning.

Instructors at HEIs are also increasingly using artificial intelligence (AI) to improve their scholarly work and research; nonetheless, many academics voice concerns about the use of AI tools, highlighting the importance of protecting academic integrity and ethical awareness, as well as maintaining academic standards (Gendron et al., 2022). The growing number of academic studies employing AI raises the need to formulate clear and universally recognized principles to address these issues. The higher education community must confront these challenges by developing a code of ethics to ensure the responsible use of AI in the academic process and to protect academic integrity and credibility.

### 11.8.Investment on AI

Instructors need to have access to AI-related tools and platforms; hence, institutions should invest in AI infrastructure and provide training on available tools. Some of this training might also be considered obligatory, particularly regarding transparency and bias detection. Institutions should also allocate funds toward AI tools, besides the free LLM tools, that enhance teaching efficiency, such as automated assessment platforms and


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adaptive learning systems. HEIs should also ensure that all students have access to these tools, considering equity and diversity. Regular feedback from instructors should guide AI investments and training programs, ensuring alignment with teaching needs.

### 11.9.AI Integration Guidelines

The successful integration of Artificial Intelligence (AI) into higher education requires thoughtful planning, clear strategies, and collaborative efforts from educators, administrators, and policymakers. These guidelines are designed to provide a structured approach for institutions and instructors aiming to harness the potential of AI while addressing challenges such as ethical concerns, accessibility, and institutional resistance.

**Table 1.** AI Integration Guidelines for Institutions and Instructors

| Guidelines for Institutions | Guidelines for Instructors |
|---|---|
| Institutions play a pivotal role in creating an environment that fosters the seamless integration of AI into higher education. These institutions not only include individual HEIs but also professional and public organizations, higher education councils, and those related to higher education. Establishing a clear vision and providing the necessary support infrastructure is crucial. Institutions must align AI initiatives with strategic goals, ensuring that the integration is meaningful and impactful. | Instructors directly influence how AI tools are applied in teaching and learning. Building a certain level of AI literacy is the initial step. Participating in institutional and professional development programs, as well as hands-on workshops, can help educators understand how to effectively incorporate AI into their pedagogy. Familiarity with specific AI platforms also enables instructors to explore their potential and adapt them to their unique teaching contexts. |
| A shared vision for AI integration should involve collaboration among stakeholders, including faculty, students, and administrative staff. This participatory approach ensures that diverse perspectives are considered and that the AI implementation addresses the actual needs of the academic community. Institutions should also anticipate emerging trends in AI to develop future- | Ethical use of AI in the classroom requires transparency and rigor. Instructors should clearly communicate how AI tools are being used in course delivery and assessments, ensuring that students understand their purpose and limitations. Addressing biases in AI-generated content is essential to maintain fairness and uphold academic integrity. |

| | |
|---|---|
| oriented strategies that align with long-term educational and societal demands. | |
| Building AI literacy across the institution is essential for both educators and students. Comprehensive training programs, workshops, and certification courses can equip stakeholders with the technical and ethical understanding necessary to use AI effectively. Integrating AI literacy modules into curricula ensures that students are prepared for AI-enhanced workplaces and societal applications. | AI can significantly enhance teaching and learning by enabling personalized learning experiences. Adaptive AI tools can tailor learning paths to individual student needs, supporting diverse abilities and learning styles. Interactive tools, such as AI-driven simulations and quizzes, can further engage students, making the learning process more dynamic and impactful. These tools should also be explored, in addition to the generic LLM models. |
| Ethical and responsible AI use must be a foundational principle. Institutions should develop clear policies that promote transparency, fairness, reliability, and accountability. Regular audits can identify and mitigate biases in AI systems, while robust data protection measures ensure compliance with regulations like GDPR and safeguard student privacy. | Assessment and feedback processes can also be streamlined using AI. Automated grading systems save time and provide consistent, timely feedback to students. Performance analytics available through AI tools can help instructors track student progress, identify learning gaps, and refine their teaching methods accordingly. |
| Accessibility and equity are also significant institutional responsibilities in AI integration. Institutions should prioritize inclusive design in AI tools to support diverse learners, including those with disabilities and underserved populations. Investing in digital infrastructure is critical to bridging the digital divide, ensuring equitable access for all. AI tools adopted should be either free or available to students at minimal cost | Addressing resistance to AI and fostering trust are critical for the successful and equitable adoption of AI among students. Instructors should educate students about the benefits and limitations of AI, creating a collaborative learning environment. Continuous feedback, where students can share their experiences with AI tools, helps refine their use and build confidence in their effectiveness. |

| | |
|---|---|
| Pilot programs are a practical way to introduce AI tools on a small scale, gather insights, and refine strategies before scaling up. Insights from these pilots can inform broader adoption across departments, ensuring that AI tools are effective and aligned with institutional goals. Hence, AI testing in controlled environments is suggested before full implementation. | Collaboration and innovation should be central to instructors' approach to AI as well. Working with colleagues to share best practices and co-develop AI-enhanced lesson plans can promote a culture of experimentation and improvement. Staying updated on AI advancements allows educators to continuously innovate, ensuring their teaching remains relevant and effective. |
| AI also offers significant potential for enhancing administrative efficiency. Automating routine processes such as admissions, scheduling, and advising can free up resources for strategic initiatives. AI-driven data analytics can also provide actionable insights for curriculum development, resource allocation, and policymaking. | AI integration in higher education requires a dual focus: empowering institutions to provide robust support and infrastructure while equipping instructors to effectively leverage AI tools in their pedagogy. |
| Collaboration and partnerships are key to successful AI integration as well. Partnering with other HEIs, public bodies, EdTech suppliers, and AI developers can provide access to state-of-the-art tools, while inter-institutional and interdisciplinary cooperation enables the sharing of best practices. Engaging with community stakeholders also ensures that institutional AI initiatives align with broader societal needs. | Some AI tools require institutional commitment considering their infrastructural needs and costs. Hence, educators should also identify, communicate, and encourage their institutions to adopt organizational-scale AI tools. By adhering to these basic guidelines, institutions and educators can harness AI's transformative potential, creating dynamic, inclusive, and innovative learning environments. |
| Figures 14, 15, and 16 present a sample guideline for AI adoption for HE instructors and institutions. | |

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**Figure 14.** Guidelines for Higher Education Institutions I

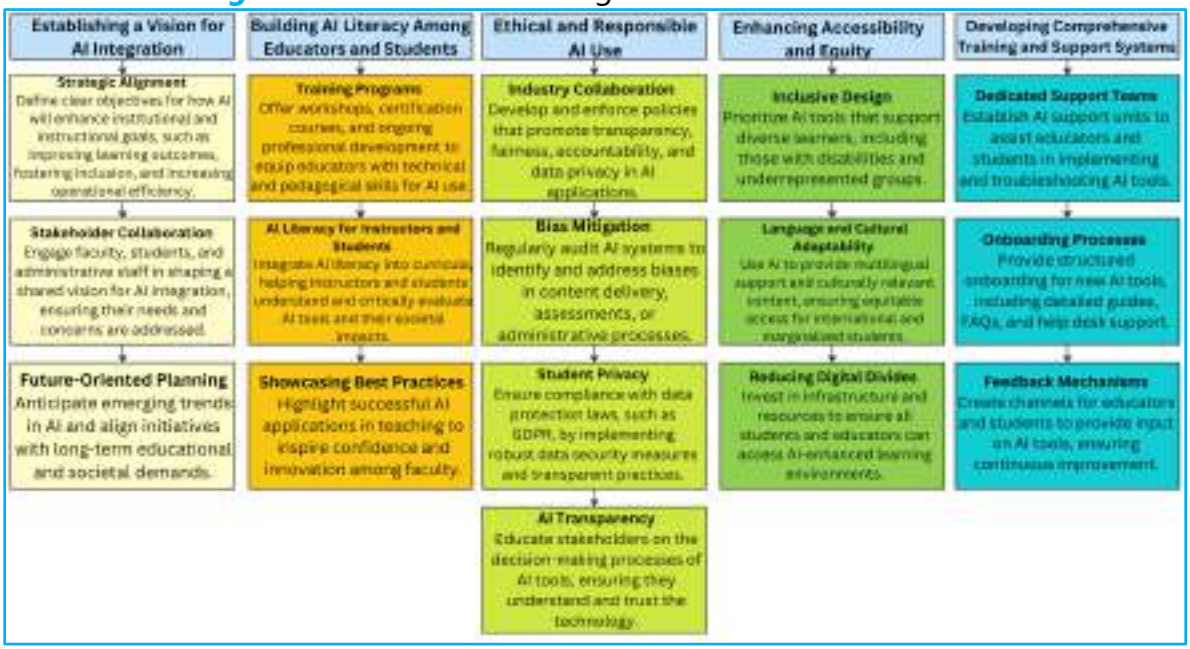


**Figure 15.** Guidelines for Higher Education Institutions II

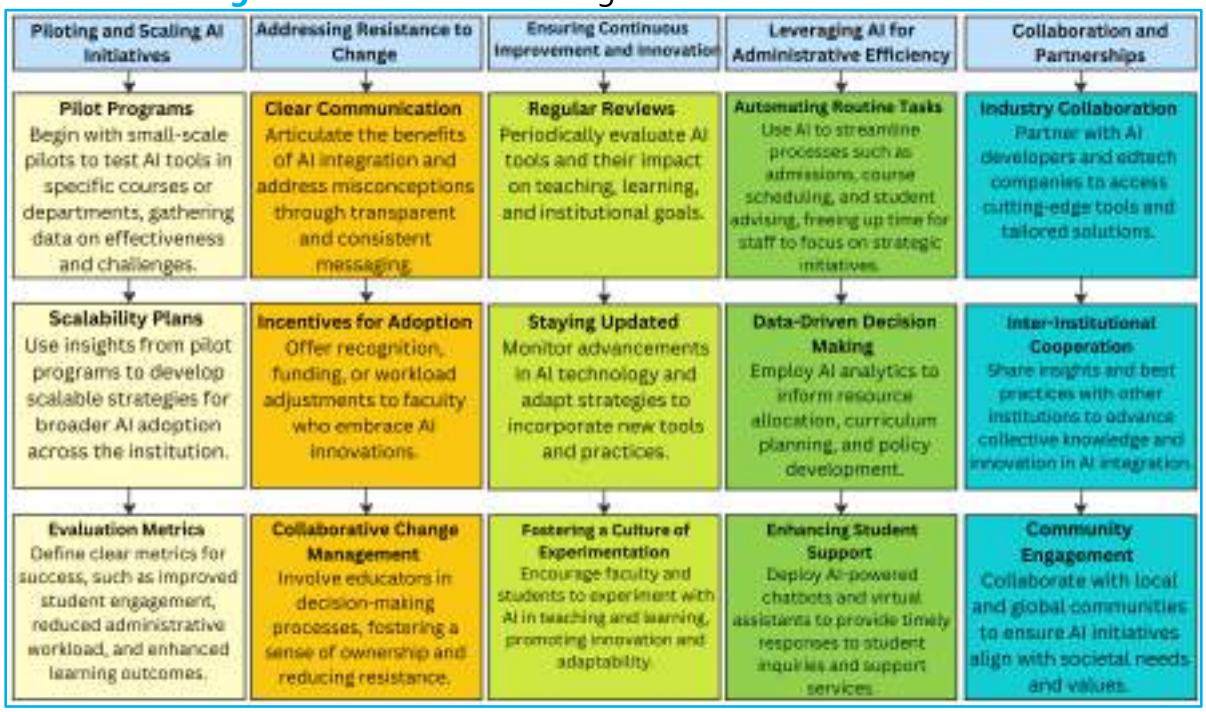


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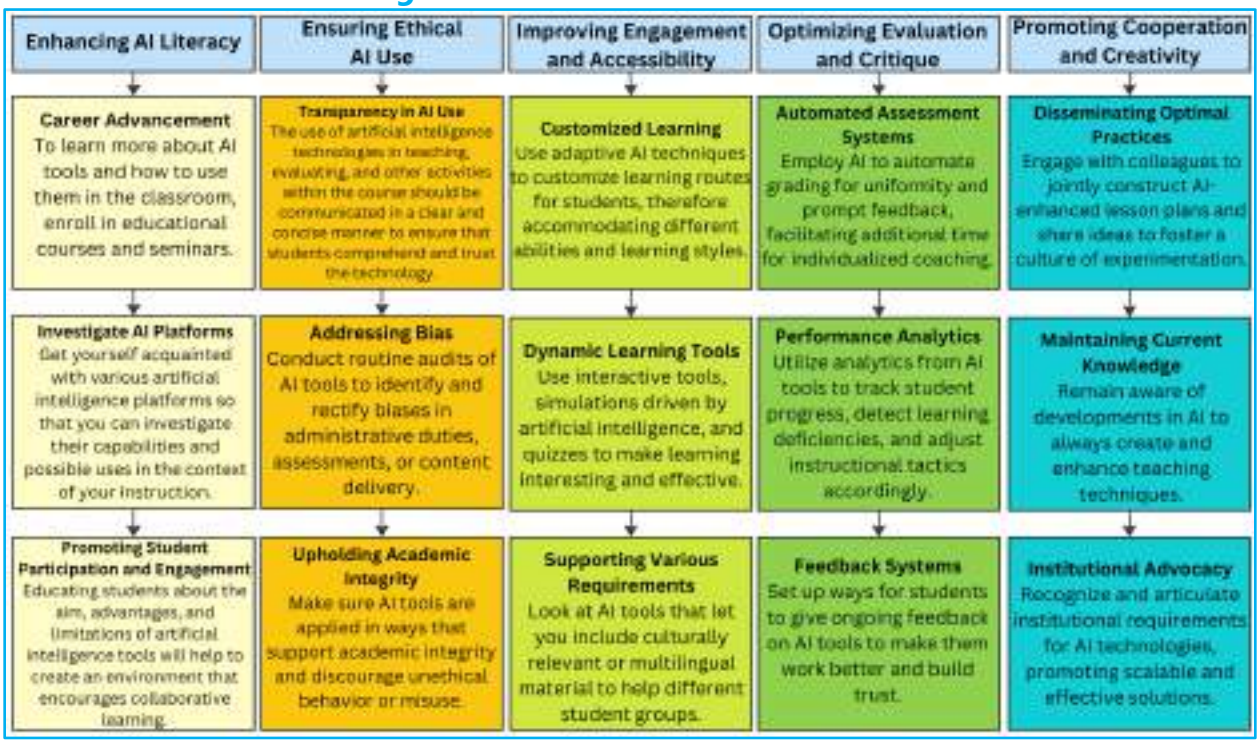
**Figure 16.** Guidelines for Instructors




## 12.Future transformations in HE brought about by AI

Artificial Intelligence (AI) is not just a technological innovation; it is a transformative force reshaping the very fabric of higher education. As institutions try to deal with these evolving demands, such as the need for providing relevant education, personalized learning, equitable access, and operational efficiency, AI presents a unique opportunity to address these challenges. By seamlessly integrating into various facets of education, AI empowers both educators and learners, creating dynamic ecosystems where technology complements human capabilities.

Educators interviewed also emphasized how AI is bridging the gap between traditional and future-focused pedagogies in higher education. They highlighted its potential to revolutionize not only how knowledge is delivered but also how it is absorbed and applied in real-world contexts. From enhancing decision-making with data-driven insights to fostering global collaboration, AI is redefining the boundaries of what is possible in education. This section explores ten key transformations that AI is driving in higher education. These changes promise to make education more accessible, inclusive, and aligned with the needs of an increasingly interconnected and digital world.

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### *Personalization and Adaptive Learning*

Adaptive learning platforms will spread, and AI will continue to enable highly personalized educational experiences through these platforms. These systems will analyze individual student data, such as learning pace, strengths, and weaknesses, to create customized learning content and curricula. This shift will, in turn, support diverse learning styles and abilities, provide real-time feedback and adjustments to instructional content, and reduce learning gaps by targeting specific areas where students need improvement. Educators have also highlighted the value of AI-generated quizzes and personalized study materials in improving student outcomes. For example, participants noted average test score increases of up to 15% when using such tools.

### *Lifelong Learning and Micro-Credentials*

The current level of knowledge creation might also result in prolonged education (e.g., lifelong learning). AI will foster the culture of lifelong learning by offering flexible, modular learning options such as micro-credentials and short courses. These programs will be tailored to evolving workforce needs, allowing students and professionals to continuously update their skills, access personalized recommendations for new learning opportunities based on career goals, and earn credentials that align with industry demands. Hence, the profile of students might also change toward older and more experienced individuals. This process might also shift the focus from knowledge acquisition to skill-building in higher education.

### *Enhanced Data-Driven Decision Making*

AI-powered analytics will provide institutions with actionable insights into student performance, faculty effectiveness, and institutional operations. These tools would help educators and administrators identify at-risk students and intervene early to improve retention rates, optimize resource allocation, such as classroom usage and staffing needs, and inform curriculum development based on data trends and future workforce requirements.

### *Redefining Educator Roles*

As AI takes over repetitive administrative and grading tasks, educators will have to transform into mentors rather than information sources. They will have more time to focus on providing personalized guidance to students, engaging in research and professional development, and designing creative and interdisciplinary learning experiences. This shift

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will emphasize the human aspects of teaching, such as fostering critical thinking and emotional intelligence.

### *Globalization and Collaboration*

AI will facilitate global access to quality education by breaking down geographical barriers. Institutions will leverage AI tools to offer multilingual support through real-time translation and transcription services, create virtual classrooms where students and faculty collaborate across borders, and develop globally relevant curricula that prepare students for interconnected economies. This, in turn, might result in the spread of TNEs (Transnational Education) and even the standardization of higher education.

### *Immersive and Experiential Learning*

Virtual Reality (VR) and Augmented Reality (AR), powered by AI, will create immersive learning environments. These technologies would simulate real-world scenarios for practical learning, enable students to experience environments and contexts that would otherwise be inaccessible, and enhance engagement and retention through interactive and experiential learning models. Instructors have also reported improved student engagement through interactive simulations, which make abstract concepts more tangible and easier to understand.

### *Ethical and Responsible AI Education*

As AI becomes integral to education, institutions will need to address ethical considerations and equip students with AI literacy. This will involve embedding AI ethics and data privacy education into curricula, training instructors and students to critically evaluate AI tools and their societal impacts, data protection, potential bias, and developing guidelines and policies to ensure fair and responsible AI use.

### *Automation of Administrative Processes*

AI will streamline administrative tasks, improving operational efficiency, such as automating admissions, course registration, and scheduling. Student support services will also be transformed through AI-driven chatbots and virtual assistants. AI will also enhance and simplify student and instructor recruitment, accreditation, and compliance processes in higher education.

### *Inclusion and Accessibility*

AI tools will make higher education more inclusive by providing assistive technologies for students with disabilities, such as text-to-speech and speech-to-text applications, offering

personalized learning resources for underserved populations, and bridging language barriers through AI-enabled translation and multilingual content.

### *Continuous Evolution and Innovation*

AI will drive continuous innovation in pedagogy, assessment, and institutional strategies. As technology evolves, higher education will experiment with and develop new hybrid and AI-driven learning models, redefine curriculum content and assessment methods to focus on creativity, problem-solving, and collaboration, and foster a culture of innovation that prepares students for AI-integrated workplaces.

AI is set to transform higher education into a dynamic, adaptive, and inclusive ecosystem. By embracing AI's potential while addressing its challenges, institutions can create educational environments that are more effective, equitable, and aligned with the needs of a rapidly changing world. Through thoughtful implementation and collaboration, higher education can harness AI to empower learners and educators, shaping a future that values both technological innovation and human connection.

## Conclusions

AI has brought about significant transformations in higher education. The Digital Education Council's Global AI Student Survey shows that 86% of students are already using AI applications (DEC, 2024), despite only 60% of educators utilizing AI in teaching (Forbes, 2024). This framework offers a comprehensive guide for integrating Artificial Intelligence (AI) into higher education, addressing the opportunities, alternative uses of AI, its advantages and challenges, and strategic pathways to successful implementation. By analyzing AI's transformative role, this document serves as a critical resource for HE educators and institutions aiming to leverage AI for improved teaching and learning outcomes.

Briefly, based on the analysis of empirical data collected through 26 interviews and 295 surveys, the framework underscores the multifaceted capabilities of AI. It showcases alternative uses of AI in teaching, such as tools like adaptive learning platforms, plagiarism detection systems, and automated grading solutions that enable educators to streamline administrative tasks while personalizing education. These AI tools foster enhanced student engagement and improved academic performance and provide a more inclusive educational environment. For instance, AI-powered simulations and intelligent tutoring systems create dynamic learning experiences, catering to diverse learner needs.

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While the advantages are evident, the framework also highlights significant challenges such as the AI literacy gap, data privacy concerns, ethical dilemmas, and accessibility issues. The impact of various constructs and individual perceptions, such as TAM, AI-TPACK, anthropomorphism, academic resistance to change, perceived trust, and perceived autonomy, and their impact on AI adoption were also explored. To navigate these complexities, the document provides actionable guidelines tailored for institutions and instructors. HEIs are encouraged to invest in infrastructure, foster AI literacy, and establish ethical policies, while educators are guided on effectively integrating AI into their pedagogical practices.

Despite its contributions to various stages of teaching and learning, human oversight remains a vital component of AI integration in higher education. The world of higher education is too complex for AI to completely take over. While AI enhances efficiency and innovation, the critical role of educators in fostering creativity, ethical judgment, and interpersonal connections cannot be replaced by current AI systems and tools. Hence, the analysis offers various alternative content on AI training for educators.

The framework also explores future transformations in higher education driven by AI, such as lifelong learning, personalized education, global collaboration, and immersive technologies like augmented reality. As AI systems get smarter and provide more user-friendly interfaces, these advancements promise to redefine the educational landscape, making learning more accessible, engaging, and adaptive to the needs of instructors and learners of all technical skill levels.

In conclusion, this framework explores the adoption of AI in various HE teaching processes and offers a roadmap for utilizing AI to create inclusive, innovative, and effective educational ecosystems. By embracing its recommendations, institutions and educators will not only address current challenges but also prepare for a future where AI serves as a powerful ally in advancing the objectives of higher education. The needs analysis offered in the framework is expected to inform other project results, such as the learning and training platform, co-creator labs, documentaries, and podcasts, which together will not only contribute to empowering educators in AI implementation but also the theory of AI and its integration into education systems.

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# Appendices

## Appendix A. Interviewers' Profile

| Participant No | Country | Gender | Age | Marital | Year of Experience | Position | Lectures Though at different levels | Teaching time per week |
|---|---|---|---|---|---|---|---|---|
| **P1** | Poland | F | 28 | S | 11+ | Lecturer | Postgraduate | 1 |
| **P2** | Poland | M | 38 | M | 14+ | Lecturer | Postgraduate | 10 |
| **P3** | Poland | F | 37 | S | 9+ | Assistant professor | Bachelor and Master | 10 |
| **P4** | Greece | M | 27 | S | 2+ | Lecturer | Graduate | 10 |
| **P5** | Greece | F | 25 | S | 3+ | Lecturer | Graduate | 20 |
| **P6** | Greece | F | 34 | M | 4+ | Lecturer | Postgraduate | 10 |
| **P7** | Germany | F | 27 | S | 1+ | Lecturer | Undergrad | 5 |
| **P8** | Germany | M | 45 | M | N/A | Assistant professor | Bachelor | |
| **P9** | Germany | F | 42 | M | 5+ | Lecturer | Bachelor | 2 |
| **P10** | Portugal | M | 41 | M | 14 | Associate professor | Teaching at three levels | 10 |
| **P11** | Portugal | F | 47 | M | 13 | Assistant professor | Postgraduate | 0 |
| **P12** | Portugal | M | 37 | S | 11 | Associate professor | Undergrad | 9 |
| **P13** | Türkiye | F | 32 | S | 13 | Lecturer | Graduate | 6 |
| **P14** | Türkiye | M | 38 | S | 13 | Assistant professor | Postgraduate | 10 |
| **P15** | Türkiye | F | 26 | S | 1+ | Lecturer | Bachelor | 5 |
| **P16** | Türkiye | M | 46 | S | 24 | Full Professor | Bachelor | 10 |
| **P17** | Türkiye | M | 43 | M | 10+ | Assistant professor | Postgraduate | 18 |
| **P18** | Türkiye | M | 44 | M | 16+ | Associate professor | Postgraduate | 20 |
| **P19** | Türkiye | M | 58 | M | 30+ | Senior lecturer. | Bachelor | 12 |
| **P20** | Türkiye | F | 40 | S | 14+ | Associate professor | Bachelor | 10 |
| **P21** | Türkiye | F | 33 | M | 7+ | Assistant professor | Graduate | 12 |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **P22** | Türkiye | M | 44 | M | 15+ | Full Professor | Teaching at theree levels | 15 |
| **P23** | Türkiye | M | 57 | M | 37+ | Full Professor | Teaching at theree levels | 12 |
| **P24** | Portugal | M | 43 | S | 15+ | Associate professor | Teaching at theree levels | N/A |
| **P25** | Portugal | M | 61 | S | 35 | Full Professor | Undergrad and graduate level | 4 |
| **P26** | Portugal | M | 46 | S | 10+ | Full Professor | Bachelor | N/A |

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## Appendix B. Demographics of quantitative data

| Demographic Characteristics | | Frequency | Percent | Cumulative Percent |
|---|---|---|---|---|
| **Sex** | Female | 139 | 47.1 | 47.1 |
| | Male | 154 | 52.2 | 99.3 |
| | Prefer not to answer | 1 | .3 | 99.7 |
| | Other | 1 | .3 | 100 |
| **Age** | 24 or under | 4 | 1.4 | 1.4 |
| | 25 to 34 | 48 | 16.3 | 17.6 |
| | 35 to 44 | 95 | 32.2 | 49.8 |
| | 45 to 54 | 90 | 30.5 | 80.3 |
| | 55 to 64 | 47 | 15.9 | 96.3 |
| | 65 or over | 11 | 3.7 | 100 |
| **Country of Residence** | Türkiye | 72 | 24.4 | 24.4 |
| | Germany and Belgium | 23 | 7.8 | 32.2 |
| | Portugal | 54 | 18.3 | 50.5 |
| | Greece | 52 | 17.6 | 68.1 |
| | Poland | 25 | 8.5 | 76.6 |
| | Others | 69 | 23.4 | 100 |
| **Institution of work** | Private (including NGOs) | 94 | 31.9 | 31.9 |
| | Public | 201 | 68.1 | 100 |
| **Years of teaching experience** | 0–5 years | 75 | 25.4 | 25,4 |
| | 6–10 years | 49 | 16.6 | 42.0 |
| | 11–15 years | 57 | 19.3 | 61.4 |
| | 16–20 years | 33 | 11.2 | 72.5 |
| | 20+ years | 81 | 27.5 | 100 |
| **Current positions** | Non-teaching position | 25 | 8.5 | 8.5 |
| | Lecturer | 59 | 20.0 | 28.5 |
| | Assistant professor | 63 | 21.4 | 49.8 |
| | Associate professor | 68 | 23.1 | 72.9 |
| | Full Professor | 57 | 19.3 | 92.2 |
| | Other | 23 | 7.8 | 100 |

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| | | | | | |
|---|---|---|---|---|---|
| **Prior AI experience** | | No experience | 17 | 5.8 | 5.8 |
| | | Basic understanding (familiar with terms and concepts) | 79 | 26.8 | 32.5 |
| | | Intermediate experience (hands-on with basic tools) | 147 | 49.8 | 82.4 |
| | | Advanced experience (developed models or worked on complex projects) | 31 | 10.5 | 92.9 |
| | | Expert (published research, deep involvement in AI) | 21 | 7.1 | 100 |



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## Appendix C. Key Constructs Affecting Educators' Intentions towards AI Adaptation

| Constructs | Items' Mean | Factors' Mean | Cronbach's Alpha |
|---|---|---|---|
| *Perceived Usefulness* | | 3.9517 | .911 |
| The use of AI technologies improves teaching practice. | 3.94 | | |
| The use of AI technologies makes teaching practice more effective. | 3.91 | | |
| The use of AI technologies makes it easier to carry out teaching tasks. | 3.89 | | |
| In general, AI technologies are useful in higher education teaching. | 4.07 | | |
| *Perceived Ease of Use* | | 3.6212 | .866 |
| Learning how to use AI technologies would be easy. | 3.51 | | |
| I find it easy to interact with AI technologies. | 3.66 | | |
| I find it flexible to interact with AI technologies. | 3.74 | | |
| In general, AI technologies are easy to use. | 3.58 | | |
| *The Technological Pedagogical Content Knowledge* | | 3.8011 | .896 |
| I can combine technologies and teaching approaches using AI. | 3.86 | | |
| I can select AI technologies to use in teaching. | 3.81 | | |
| I can teach using AI technologies. | 3.73 | | |
| *Perceived Trust* | | 3.1424 | .933 |
| I would have faith in the information provided by the AI technologies. | 3.12 | | |
| The AI technologies would provide accurate information. | 3.09 | | |
| The AI technologies would be trustworthy. | 3.08 | | |
| AI technologies would provide a reliable service. | 3.27 | | |
| *Anthropomorphism* | | 3.8486 | .784 |
| I want the AI technologies to be pleasant to interact with. | 3.94 | | |
| I want the AI technologies to understand me easily. | 4.00 | | |
| I want the AI technologies interaction to be human-like (similar to communicating with a real person). | 3.61 | | |
| *Perceived Autonomy* | | 3.5831 | .773 |
| I think using AI technologies would allow me to control how I teach. | 3.54 | | |
| I could express my true self when utilizing AI technology-based information. | 3.28 | | |
| I think using AI technologies would allow me to access information. | 3.93 | | |



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| | | | |
|---|---|---|---|
| *Academic Resistance to Change* | | 3.3259 | .788 |
| I have a good feeling about the changes AI technologies offer. | 2.19 | | |
| I see the change in AI technologies provide as a positive process. | 2.15 | | |
| The change AI technologies offer is refreshing. | 2.17 | | |
| The AI technologies change will improve work. | 2.05 | | |
| The AI technologies change will simplify work. | 2.05 | | |
| I want to devote myself to the process of AI change. | 2.62 | | |
| I am willing to make a significant investment to the change in AI technologies | 2.58 | | |
| I am willing to put energy into the process of AI change. | 2.43 | | |
| I am resistant towards AI technology change. | 2.27 | | |
| I am reluctant to incorporate AI technology changes into my work. | 2.37 | | |
| Most AI technology changes will have a negative effect on education. | 2.41 | | |
| Future improvements will come with AI technology changes. | 3.79 | | |
| Most AI technology changes will only do a little good. | 2.67 | | |
| *Behavioral Intention* | | 3.8480 | .848 |
| AI technologies are very easy for a beginner to learn. | 3.21 | | |
| AI technologies can be used for pre-class activities (e.g., developing course content). | 3.92 | | |
| AI technologies can be used for in-class activities (e.g., answering students' queries). | 3.86 | | |
| AI technologies can be used for post-class activities (e.g., evaluation). | 3.98 | | |
| I recommend that all the stakeholders in higher education explore AI technologies for their teaching activities. | 3.98 | | |
| I intend to use AI technologies for teaching purposes in the future. | 4.14 | | |



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**Appendix D.** Regression Analysis of Factors Influencing Behavioral Intention to Use AI Tools

| *Model* | Standardized Coefficients Beta | T Value | Level of Significance |
|---|---|---|---|
| *(Constant)* | | 6.343 | .000 |
| *PU* | .242 | 3.961 | .000 |
| *PEU* | .204 | 4.144 | .000 |
| *TPACK* | .145 | 2.907 | .004 |
| *PT* | -.041 | -.815 | .416 |
| *ANT* | .137 | 2.678 | .008 |
| *PA* | .051 | .860 | .391 |
| *ARC* | -.241 | -4.568 | .000 |

***Dependent Variable: BI***

***$R^2$: 0,632, F: 70,384 Sig. (At 0.05 significance level): 0.00***

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## **Appendix E.** Teaching/Research Practices

| **Teaching/Research Practices** | **Mean** |
|---|---|
| Design adaptive learning | 2,46 |
| Generate learning analytics | 2,41 |
| Prepare the curriculum and syllabus | 2,9 |
| Generate course content and material | 2,94 |
| Evaluate the quality of the course | 2,46 |
| Predict student performance | 2,06 |
| Assess the students' emotional state | 1,93 |
| Provide personalised feedback | 2,31 |
| Obtain the student's opinions about teaching/learning | 2,27 |
| Form student working groups | 2,37 |
| Assessment | 2,51 |
| Enhance student experience in class | 2,77 |
| Professional learning and development | 2,92 |
| Create in-class activities | 2,86 |
| Detect plagiarism | 3,27 |
| Identify learning gaps and student needs | 2,39 |
| Speech recognition and transcription | 2,42 |
| Data analysis | 2,84 |

## Appendix F. Familiarity with AI Tools

| Familiarity with AI Tools | Mean |
|---|---|
| Chatbots (e.g., ChatGPT, Gemini, Microsoft Copilot) | 3,71 |
| Plagiarism detection systems (e.g., Turnitin, Winston AI, Copyscape, ZeroGPT) | 3,57 |
| Automated grading systems (e.g. Gradescope, Zipgrade, Socrative, Plickers) | 2,13 |
| AI-powered educational games (e.g., Kahoot! AI question generator, Minecraft Education Edition, Duolingo, Quizlet) | 2,86 |
| Adaptive learning platforms (e.g. Knewton, CogBooks, SmartSparrow, LearnSmart) | 1,97 |
| Intelligent tutoring systems (e.g., My-Moodle, Course Builder, Teachable, ALEKS) | 2,37 |
| AI-powered learning analytics (e.g., Moodle Analytics, Dropout Detective, Learning Locker, Tableau, Power BI) | 2,55 |
| AI-powered learning management systems (e.g., Blackboard Learn - AI design assistant, Moodle AI plugins, Canvas LMS AI features, Docebo) | 2,63 |
| AI quiz tools (e.g., Quizizz, Socrative, Wooclap, ClassPoint) | 2,38 |
| AI enabled simulations (e.g. Labster, iCivics, Mursion) | 1,85 |
| Speech recognition and transcription software (e.g., Whisper, VOSK, Silero, Otter.ai) | 2,24 |

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## Appendix G. Advantages of AI Use

| Advantages of AI Usage | Mean |
|---|---|
| Can process large numbers of data | 4,13 |
| Delivers immediate feedback | 4,13 |
| Saves time | 4,23 |
| Reduces workload | 4,03 |
| Provides innovative ideas and different perspectives | 3,81 |
| Enhances student engagement | 3,51 |
| Improves teaching performance | 3,66 |
| Automates repetitive mechanic tasks | 3,88 |
| Assists information processing and retrieval | 3,82 |
| Reduces bias | 3,12 |
| Customizes learning | 3,54 |
| Provides a variety of materials | 3,75 |
| Enhances student experience | 3,61 |
| Supports instructional decision-making | 3,56 |
| Identifies students' performance | 3,34 |

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## Appendix H. Barriers to AI Use

| Barriers of AI Usage | Mean |
|---|---|
| Costs involved in installation, training and maintenance | 3,58 |
| Restricted applicability (some teaching activities are difficult to automate) | 3,44 |
| Limited understanding of student thinking | 3,47 |
| Technical errors | 3,42 |
| Restricted perception of context in understanding the reason behind a AI response | 3,51 |
| Reduced social interaction (student-teacher and students among themselves) | 3,55 |
| Limited understanding of nuanced responses | 3,49 |
| Ethical issues and plagiarism | 3,97 |
| Accountability (who is responsible on AI generated information) | 3,87 |
| Potential adverse personal and social impacts on students | 3,55 |
| Insufficient technological infra-structure | 3,54 |
| Lack of AI literacy among instructors | 3,88 |
| Lack of standard guidelines and methods on AI use in education | 3,92 |
| Biased information | 3,61 |
| Different disciplines have different needs | 3,63 |
| Rapid developments in AI make it harder to adopt | 3,49 |
| Risk of overreliance on AI | 3,8 |
| Maintaining the social and cultural aspects of education in AI integrated teaching | 3,57 |
| Reduction of human role in teaching | 3,34 |
| Privacy and data security issues | 3,85 |
| Accessibility and equity | 3,6 |
| Copyright issues | 3,87 |

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## Appendix I. Topics for AI Integration Training

| Topics for AI Integration Training | Mean |
|---|---|
| History and development of AI | 2,83 |
| Principles of AI and its socio-economic implications | 3,44 |
| Technical skills for AI use in education | 4,18 |
| Pedagogical skills for AI use in education | 4,23 |
| Prompting skills in AI | 4,04 |
| Addressing academic honesty in AI | 4,12 |
| Enhancing student engagement with AI tools | 4,02 |
| Strategies for evaluating and detecting AI generated content | 4,1 |
| Developing AI based lesson plans and syllabus | 3,89 |
| AI driven in class presentation and teaching | 3,93 |
| Assessment with AI | 3,89 |

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