**Understanding the impact of artificial intelligence on curriculum, instruction, and assessment in higher education: A systematic review**

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The emergence of artificial intelligence (AI) presents many opportunities and challenges to teaching and learning in higher education. However, compared to student-facing AI or administration-facing AI, little attention has been given to the impact of AI on faculty’s perspective or their curriculum, instruction, and assessment (CIA) practices. To address this gap, we conducted a systematic review of articles published within the first nine months following the release of ChatGPT. After screening following PRISMA guidelines, our review yielded 33 studies. The majority of these studies (*n* = 17) were conducted in Asia, and simulation and modelling were the most frequently used methods (*n* = 14). Thematic analysis of the studies resulted in four themes about the impact of AI on CIA triad: (a) generation of new material, (b) reduction of staff workload, (c) automation/optimisation of evaluation, and (d) challenges for CIA. Implications for future research and practices are proposed.

Implications for practice or policy:

* AI is being used to create new materials, revise existing courses, and develop interdisciplinary courses. This seems to reduce academics’ logistical workload .,
* However, the quality of these outputs are rarely subject to formal evaluation. Given the fallibility of AI tools, more stringent review processes are recommended.
* Knowledge about AI in higher education is restricted to a small sample of regions where and research methods limiting relevance and validity.
* AI use is likely to be highly contingent on the intersection of disciplinary structure and AI affordances and constraints.
* A collaborative teaching system between human teachers and AI virtual teachers is needed. The quality of AI-generated assessments is especially unknown.

**Keywords**: Artificial intelligence, large language models, curriculum, instruction, assessment, systematic review

# Introduction

The introduction of large language models (LLM), such as ChatGPT, have created interesting possibilities and challenges for all educational systems. The ubiquity and power of LLM tools means that there are opportunities for instructors to change their curriculum, instruction, or assessment. However, much of the current research on LLM and AI technologies has focused on how students are using AI (e.g., Chan & Hu, 2023; Crompton & Burke, 2023) or on how administrators use AI (e.g., Nagy & Molontay, 2023; Teng et al., 2023). In this paper, we offer a systematic review of studies focused on how emergence of these technologies have affected the teaching, curriculum design, or assessment practices of academics in higher education. Using thematic analysis, we provide an overview of how the field is handling these new technologies to change or adapt their work in terms of curriculum, instruction, and assessment.

# The Higher Education Curriculum-Instruction-Assessment (CIA) Triad

All educational systems have to make decisions concerning what they teach (i.e., curriculum), how they teach it (i.e., instruction), and how they evaluate student learning (i.e., assessment). Normally, curriculum decisions (e.g., what to teach and the order in which to teach it) lead to instructional decisions (e.g., how material be introduced and which methods might best help students learn it), and culminate in assessment and evaluation decisions (e.g., how many assessments of what type and when those assessments will take place). Thus, curriculum, instruction, and assessment comprise the essential triad of all educational practices (Pellegrino, 2006). Higher education systems give academics considerable autonomy over these decisions based on their higher research degrees and contribution to research outputs within their disciplines. While professional certifying bodies have some control over what must be covered, universities give academics responsibility for deciding how to organise, teach, and assess learning in their courses

This systematic review aimed to explore what the first wave of research following the release of ChatGPT in November 2023 had focused on and found with respect to the impact of Gen-AI tools in HE. In particular, we wanted to understand how AI technologies were affecting curriculum, instruction, and assessment processes to identify pros and cons that might inform promising pathways as well as potential challenges and problems. To complement those insights, we also wanted to identify where this early research was being conducted, what methods were used by researchers, and which aspects of LLM technologies were of concern. We hope this contextual information helps readers better understand the applicability of results to their own jurisdictions or situations.

# Method

A systematic review of the literature was carried out in the three major databases in education: Scopus, Web of Science (WoS), and EBSCOhost. To answer the research question, search terms were trialled iteratively to retrieve relevant literature on how AI has influenced curriculum, instruction, and assessment in higher education (HE). Search terms were then finalised and used identically in each database: (“artificial intelligence” OR “generative artificial intelligence” OR “generative AI” OR “Gen-AI” OR “ChatGPT” OR “GPT\*”) AND ((“higher education”) AND (“teaching” OR “assessment” OR “evaluation” OR “feedback” OR “curriculum” OR “instruction\*” OR “lesson” OR “planning” OR “delivery” OR “implementation”)).

As Figure 1 indicates, a total of 2810 articles were identified. Filters were set only to include peer-reviewed journal articles published in English from December 2022 to the present (August 2023). Filtering only to include peer-reviewed journal articles helped ensure the quality of literature in the search phases. The time frame was chosen to return the most recent literature exploring the impact of AI, after the release of a demo of ChatGPT on 30 Nov 2022.

Figure 1. PRISMA Flowchart of the Literature Search Process

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## Search process

After removing duplications, 279 records were obtained for screening following the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Moher et al., 2009). First, the titles and abstracts of these records were assessed using the agreed inclusion and exclusion criteria (see Table 1), resulting in the exclusion of 206 records. These records were excluded because they did not investigate how AI affected HE curriculum, instruction, and assessment (*n* =135), they lacked empirical evidence (*n* = 63), or they did not focus on university contexts but other contexts (*n* = 8).

Table 1

*Inclusion and Exclusion Criteria*

|  |  |
| --- | --- |
| Inclusion criteria | Exclusion criteria |
| 1. Articles present an analysis of empirical data, written in English and published in peer-reviewed journal articles. 2. Articles about how AI influences HE curriculum, instruction, and assessment (e.g., curriculum design, instructional planning, delivery, assessment, evaluation). | 1. Articles about HE curriculum, instruction, and assessment but not related to AI. 2. Articles about broad perspectives on AI (e.g., benefits, weaknesses, preparation) rather than the impact on curriculum, instruction, and assessment. 3. Articles about the impact of AI on non-HE levels (e.g., school). |

The remaining 73 records were downloaded for a full-text screening using the same inclusion and exclusion criteria. Studies that introduced AI or HE curriculum, instruction, and assessment but did not actually explore the relationship between them were excluded (*n* = 32). Finally, eight additional records were excluded due to non-empirical evidence (*n* = 4), non-HE context (*n* = 1), non-available full text (*n* = 2), and non-English language (*n* = 1). Consequently, a total of 33 articles were included for review.

## Data extraction and analysis

Due to the exploratory nature of this research, an inductive thematic analysis (Braun & Clarke, 2006) was conducted to identify key patterns of the impact of AI on HE curriculum, instruction, and assessment. First, the first author read 33 articles thoroughly again and extracted key information from each literature, including citations, context, sample size, data collection method, measurement, impact on HE curriculum, impact on HE teaching, and impact on HE assessment. With an eye to finding answers to the research question, meaningful segments, such as “AI tools allow educators to/provide students with…” and “the challenge is”, were used to identify descriptive codes regarding how AI influences HE curriculum, instruction, and assessment.

Twenty-five initial descriptive codes (e.g., improve teaching effectiveness, challenge the role of educators, assess teaching effect) were captured. Then, the similarities and differences between each code were iteratively compared to identify high-level categories. For instance, codes such as “challenge instructors’ AI literacy”, “ethical consideration”, and “lack of support in AI teaching” were integrated into a category named “challenge exiting teaching”. Based on the raw data, research questions, and conceptual framework, similar categories were further reviewed and merged into four key themes: generation of new material, reduction of staff workload, automation/optimisation of evaluation, and challenge for CIA. Articles could be arranged into more than one theme because of the presence of multiple themes. Please see Appendix A for complete details of themes, categories, and codes.

To establish trustworthiness, the research team made agreements on search terms and initial inclusion and exclusion criteria before the first author identified the literature. During the screening stage, either author was unsure if a specific article should be included, and then the content of this article was discussed against the research question and focus of this review. These discussions resulted in refining the inclusion and exclusion criteria and a consensus on included articles. Afterwards, the first author coded the key information from each study to address the research questions. The authors of this study critically read the coding results and final synthesis. Any uncertainty on internal homogeneity and external heterogeneity (Patton, 2003) among codes, categories, and potential themes was discussed at regular meetings.

# Results

## Nature of studies

Table 2 shows the characteristics of the regions where the 33 studies were conducted, as well as the methods utilised to explore the impact of AI on HE curriculum, instruction, and assessment. Details of which papers are in each category are provided in Appendix B. There are 16 countries around the world contributing to this field. Asia, predominantly China, accounted for 17 of the 33 studies. As Table 2 shows the balance were distributed widely across the world.

Regarding research methods, 14 of the studies used modelling or simulation methods to design, implement, and test the accuracy and effect of AI tools. For instance, Shi (2023) designed a teaching mode based on the neural network model to provide students with personalised resources and assignments in moral education. This intelligent mode was then tested by simulating different teaching scenarios, and its accuracy and practical effect were confirmed. Each of the following methods were used in six studies each, experimental design to compare AI with an intervention group and a control group, administered surveys or conducted interviews. For instance, Farazouli et al. (2023) conducted Turing test experiments by inviting instructors to examine AI-generated texts and student-written texts blindly, and interviewed their perceptions on the quality of assessed texts and whether they worry that AI makes it. A small number of studies used one of a set of diverse methods (e.g., case study, workshop, observation, discussions, etc.).

Three distinct foci of AI were examined. The most common focus in 16 studies was the technological dimensions of AI, such as designing and modelling an AI tool for HE curriculum, instruction, and assessment and testing the accuracy of this tool itself. Computer science and engineering researchers tended to focus on the technological aspects. The human dimension of AI experience was the focus of ten studies and seen mostly in social science research. This examined how university teachers perceived the impact of AI on their curriculum, instruction, and assessment. Just seven studies highlighted how AI supported curriculum, instruction, and assessment.

Table 2

*Study Characteristics: Number of Publications by Region, Methods, and Foci*

|  |  |
| --- | --- |
| Characteristic | *n* |
| *The region where the study was conducted* |  |
| Asia (i.e., Mainland China, Hong Kong, India) | 17 |
| Europe | 8 |
| North America | 5 |
| Latin America (i.e., Brazil, not specified) | 3 |
| Middle East (i.e., Oman, Turkey) | 2 |
| Australia | 2 |
| *Methods* |  |
| Modelling/Simulation | 14 |
| Experiment | 6 |
| Survey | 6 |
| Interview | 6 |
| Others (e.g., discussion, workshop, open-ended questions, observation) | 5 |
| Mixed methods | 2 |
| Case study | 2 |
| *Foci* |  |
| Technology | 16 |
| The human experience | 10 |
| Use of AI in class | 7 |
| *Education Dimension* |  |
| Curriculum | 9 |
| Instruction | 21 |
| Assessment | 18 |

*Note.* The number of included studies is more than 33 because some were conducted in cross-national contexts and/or used multiple research methods.

The focus of AI in higher education was classified according to the CIA triad. As shown in Figure 2, while there was an overlap of topics among the studies, two-thirds of all studies focused on just one of the three topics, with instruction and assessment topics having more studies than curriculum by a large margin. Of the 33 studies, taking into account all overlapping categories, 21 (63.6%) papers had something to do with instruction, a similar proportion related to assessment (18, 55%), and a quarter focused on curriculum (9, 27%).

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Figure 2.AI’s Impact on the CIA Triad in HE: A Venn Diagram of the Number of Published Articles

## Thematic Analysis

Based on thematic analysis of the articles (their purposes and findings), four key themes were identified: (a) generation of new material, (b) reduction of staff workload, (c) automation/optimisation of evaluation, and (d) challenges for CIA.

### Generation of new material

Ten studies describe the ample new material AI provides for curriculum preparation and instruction implementation. Attributes mentioned include providing various resources and generating new teaching content, building an immersive learning environment, and improving or replacing existing teaching modes with a new teaching approach (Al-Shanfari et al., 2023; Chen et al., 2023; Guo, 2023; Pisica et al., 2023; Pretorius, 2023; Shi, 2023; Y. Wang, 2023; Yang, 2023; Zhang et al., 2023; K. Zhu, 2023).

*Generate new curriculum content*

Two studies examined how academics perceive the influences of AI on specific subject-related curricula and teaching, one in data science and one in English translation (Chen et al., 2023; Y. Wang, 2023). Both studies conducted focus group interviews, and revealed that AI, at curriculum levels, can provide instructors and students with new, rich, and personalised materials, contributing to curriculum design, and development and facilitation of course preparation. According to Pisica et al. (2023), 18 academics from Romanian universities reported the benefits of AI in curriculum, which included generating new content for existing courses and developing new curricula or disciplines.

*Provide an immersive learning environment*

AI technology, such as smart classroom, enables the simulation of the atmosphere of a “real” classroom, practicum, or internship, where students can better understand and practice what they learned (Y. Wang, 2023; Zhang et al., 2023). For instance, Y. Wang (2023) stated that AI could make teaching content visualisable; that is, students could practice key communication competencies in a virtual community of practice, which improves teaching efficiency. Additionally, Zhang et al. (2023) designed and experimented with an intelligent classroom for the English language and literature in China, and found that this AI tool provided the experimental group with a good learning environment and enhanced students’ language proficiency.

*Offer a new teaching mode*

A large body of research has designed and implemented an AI tool (e.g., speech recognition, ChatGPT) in HE teaching, providing a new teaching mode with good accuracy and effectiveness (Al-Shanfari et al., 2023; Chen et al., 2023; Guo, 2023; Pisica et al., 2023; Pretorius, 2023; Shi, 2023; Yang, 2023; K. Zhu, 2023). Guo’s (2023) study, conducted in the Chinese context, showed that a newly designed speech recognition method, based on a recurrent neural network algorithm, had a better accuracy rate and faster convergence, and could replace the previous method and effectively address issues of the low speech recognition rate caused by noisy environments. In addition, two studies in multimedia teaching or moral education (Shi, 2023; Yang, 2023) conducted simulation experiments, suggesting that the new AI-powered teaching mode was effective and had the potential to be implemented in real classrooms.

### Reduction of staff workload

Ten studies have demonstrated that AI could support staff in curriculum, instruction, and assessment, by reducing their logistical workloads by reflecting on curriculum design, improving their interaction with students, delivering personalised instruction, and preparing adaptive assignments (e.g., Holmes et al., 2023; Pereira et al., 2023; Sajja et al., 2023)

*Work as a curriculum assistant*

AI could work as a virtual curriculum assistant that helps address time-consuming and repetitive questions about curriculum (e.g., content, time, deadline), reduce instructors’ logistical workloads and give them more time to improve teaching quality and support students’ development (Sajja et al., 2023). For example, Sajja and his colleagues (2023) used the syllabus and other teaching materials to design a curriculum-oriented intelligent assistant and found that this vituralTA effectively provided accurate course information and improved students’ course engagement.

*Reflect on curriculum and content difficulty*

AI has been demonstrated to help instructors reflect on curriculum and content difficulty. One study investigated using an AI toolkit to collect students’ assessment data and further support teachers’ reflections on curriculum design (Phillips et al., 2023). More specifically, researchers assumed that assessment texts were closely associated with lecture texts, therefore, they used skip-gram word embedding to test the linguistic divide and connection between these two texts, and finally predicted the difficulty of course materials by predicting assessment difficulty (e.g., exams and homework). Researchers also compared the results produced by the AI toolkit with lecturers’ self-reported material difficulty and found consistent results. Properly using this toolkit, teachers could learn from students’ assessment outcomes to reflect on the quality of teaching preparation and adjust curriculum design.

*Personalised instruction*

Applying AI technologies can facilitate analysing students’ learning procedures, performance, and needs, providing instructors with timely feedback, and assisting them in delivering adaptive instruction. Consequently, teaching and learning effects were somewhat improved (Al-Shanfari et al., 2023; Firat, 2023; Kohnke et al., 2023; L. Li et al., 2023; Q. Li et al., 2023; Pisica et al., 2023; Y. Wang, 2023). By implementing embedded glasses in real classrooms, L. Li et al. (2023) showed that this device helped instructors recognise and process students’ real-time images and emotions and keep abreast of their learning status, and this information further provided timely feedback to instructors to change their teaching strategies. Therefore, compared to the control group, the teaching effect of the experiment group increased by 9.44%, and students reported more satisfaction with teaching. Similarly, a new piano teaching mode powered by a vocal music singing learning system has been demonstrated to be relatively successful: it not only made piano teaching more personalised and intelligent, increased teaching efficacy by 7.31% compared to the traditional teaching mode, but also motivated students to engage more in piano practice time and classroom participation (Q. Li et al., 2023).

*Prepare personalised assignments*

A new assessment method driven by AI tools can help instructors prepare personalised assignments. Pereira et al. (2023) described how an emerging recommender system generated equivalent questions for assignments and exams, to enhance the variations of assignments and support instructors in preparing individualised assignments and avoiding plagiarism. They also indicated that this recommender system was confirmed accurate after instructors evaluated the equivalence of AI-created questions to the questions instructors provided (e.g., interchangeability, topic, and coding effort).

### Automation/optimisation of evaluation

Many scholars have investigated the potential of using AI in HE assessment and evaluation. For instance, a new assessment method driven by AI tools can automatically evaluate teaching, learning, and grading (Kumar et al., 2023).

*Assess students’ learning process and outcomes*

AI is found to accurately assess students’ learning process and outcomes, and further determine teaching effect (Novais et al., 2023; Saad & Tounkara, 2023; D. Wang et al., 2023; L. Zhu et al., 2023). For instance, Archibald et al. (2023) showed that an AI-enabled discussion platform accurately calculated students’ curiosity scores to present their engagement in discussion, further reducing teachers’ assessment workload and facilitating their intervention based on post quality. Using small-sample experiments, L. Zhu et al. (2023) developed an AI tool to predict students’ performance based on their classroom behaviour and previous performance in China. They suggested that this tool could be used to adjust instructors’ teaching strategies and improve teaching quality. Similarly, Tang et al. (2023) discussed how a designed intelligent evaluation system could better recognise voices, face, postures, and teaching skills in microteaching skill training, accurately assess preservice teachers’ teaching performance, and provide accurate guidance. Moreover, Saad and Tounkara (2023) used students’ information, including class participation frequency and quality, absent rate, contribution to group work, and utilisation of learning resources, in distance learning, to establish a preference model for instructors to recognise “atrisk students” and “leader students” quickly. The former refers to students who are more likely to drop out, and the latter refers to those who could help their peers. They found that this model helped 85% of students be allocated to the correct clusters, and assisted instructors in making correct decisions. Besides evaluating students’ cognitive-related outcomes, researchers also use AI to assess students’ non-cognition outcomes (e.g., emotions, attitudes, and values). For instance, Novais et al. (2023) designed an evaluation fuzzy expert system, employed it to build students’ soft skills profile, such as communication and innovation skills, management skills, and social skills, then compared AI-generated scores with real scores, and finally argued that this system could provide consistent feedback to instructors and students.

*Assess teaching effect*

To replace the unreasonable evaluation method for innovation and entrepreneurship teaching, Wang et al. (2023) combined human-computer interaction and deep learning algorithm to design an intelligent evaluation system, which can detect students’ attitudes and behaviours and assess teachers’ teaching preparation, language expression, content mastery, and teaching design. The operability of this system was further supported by assessing the teaching quality and effect of two classes, and the results showed that both classes’ teaching quality scored nearly 7 out of 10 and needed to improve.

### Challenge for CIA

Besides the above advantages, some challenges brought by AI in HE curricula, instruction, and assessment are described in six studies.

*Challenge existing curricula*

AI is found to bring many challenges to curriculum developers and existing curricula, such as what content is more valuable, how to integrate AI into the current curriculum, and how to prepare students with digital literacy via curriculum. In order to address these questions, Lopezosa et al. (2023) interviewed 32 journalism faculties from Spain and Latin America about how they perceive this new technology; however, no consensus on whether to integrate AI into curricula was identified. Although most faculties embraced AI technology and suggested establishing AI as a standalone subject, some stated that challenges, limitations, and uncertainty about AI in education should be thoroughly researched before incorporating it into curricula. Others also suggested a compromise idea to integrate AI into current communication subjects in a complementary way.

*Challenge existing instruction*

There are some concerns about using AI in HE instruction, including challenging teacher’s AI teaching competencies, ethical considerations, and lack of teaching support. First, Chan (2023) indicated that AI may cause overdependence on technology, and weaken social connections between teachers and students. In this light, Firat (2023) indicated that implementing AI requires educators to change roles from instructors to guides or facilitators. Furthermore, based on interviews with 12 university teachers in Hong Kong, Kohnke et al. (2023) found that AI challenged participants’ teaching competencies to teach students how to judge AI-generated text critically, use AI tools ethically, and foster digital citizenship.

Ethical concerns in instruction include incorrect or fabricated information, accessibility, and algorithm biases (Firat, 2023). According to a teaching reflection of an educator from Monash University, she taught postgraduate students how to use generative AI effectively. She showed them examples of communicating with generative AI to brainstorm and design research questions and achieved good teaching feedback. However, she realised that incorrect or biased information produced by ChatGPT, as well as unequal access to AI caused by distinct socioeconomic status, required educators to shift their ability to prepare students with AI literacy to use AI professionally and ethically (Pretorius, 2023). Firat (2023) also mentioned over-reliance on AI, data privacy, and unequal accessibility to AI tools.

Another concern centres on inadequate technical support and training in integrating AI into teaching. For instance, Al-Shanfari et al. (2023) utilised a mixed-method method to understand how instructors perceive the awareness, preparation, and challenges of integrating intelligent tutoring systems (ITS) in Omani universities. They found that most participants considered ITS effective in providing customised instruction; however, lack of support and guidance in using ITS brought instructors challenges. As one participant said, “Teaching approaches at my university are not supporting the use of ITS” (p. 956). Similarly, Chen et al. (2023) interviewed 16 faculty members in data science and revealed that inconsistent definitions of data science, inadequate team support and lack of collaboration platforms were major challenges.

*Challenge existing assessment methods and strategies*

While there are various opportunities for HE assessment, several challenges exist and need to be addressed. The most frequently mentioned challenge is that AI has been proven to pass many examinations and assignments, which some students may use to cheat or plagiarise. For instance, Chan (2023) stated that new concerns in HE assessment emerged, as most students and teachers worried that some students use AI tools to cheat and plagiarise, and teachers could not identify it correctly. Similarly, Kohnke et al. (2023) found that AI challenged the current assessment system, as participants worried that AI tools are too convenient for students to cheat and not work independently.

Moreover, it is hard for humans or AI detectors to identify AI-generated texts or assignments, which in turn challenges existing assessment practices and strategies. A case study conducted in an Australian Master’s program for Geographic Systems and Science found that ChatGPT, acting as a fictional student, effectively addressed most assignments (e.g., coding) (Stutz et al., 2023). Although AI detectors identified it, lecturers did not recognise AI made them and gave a grade of “satisfactory”. They also discussed that ChatGPT challenged traditional evaluation methods, calling researchers and practitioners to rethink learning objectives, content, and assessment approaches (e.g., oral exam, video conference). In a similar study, both AI-generated and student-written texts were assessed by AI detectors and six English as a Second Language (ESL) lecturers from Cyprus (Alexander et al., 2023). It was found that AI detectors worked more effectively in identifying AI-generated texts than humans, and AI, to some extent, challenged lecturers’ previous evaluation criteria and strategies. Lecturers seemed to conduct deficit assessment strategies and considered that AI-generated texts were characterised as having fewer grammar errors and more accurate expressions. Therefore, the authors recommended improving instructors’ digital literacy and rethinking assessment policies and practices in the AI era. Similar findings were shown in Sweden, Farazouli et al. (2023) conducted a Turing test among 24 university teachers in humanities and social sciences, and found that teachers tended to be critical about students’ texts and underestimated students’ performance, and doubted some student texts finished by GPT, which negatively influenced the trust relationship between teachers and students. They also discussed how ChatGPT impacted teachers’ perceptions of AI and human performance in assessment practices.

# Discussion

This study examined how LLM and AI technologies influence HE curriculum, instruction, and assessment by reviewing 33 recent articles.

## Summary of Results

The analysis of 33 recent studies showed that most were conducted in Asia, Europe, or North America. Consistent with findings indicating a rapid trend in Chinese research on AI in higher education (Crompton & Burke, 2023), China accounted for the majority of studies in this review. One possible reason is that AI has been considered a priority in the Chinese government’s agenda (State Council, 2017) and is thus highly emphasised in education. This review also indicated that simulation and modelling were the most frequently used methods to assess the potential impact of AI in the HE context (e.g., Phillips et al., 2023; Saad & Tounkara, 2023; Sajja et al., 2023; Shi, 2023). Moreover, AI has been found to bring benefits and threats to HE curriculum, instruction, and assessment, which will be presented elaborately in the following sections.

## Weaknesses in the Research

This early research, however, is potentially problematic because of its narrowness. Specifically, research conducted in many regions, especially developing countries, is poorly represented. The currently available research has been conducted largely in Western, Educated, Industrialized, Rich, and Democratic (WEIRD; Heinrich, Heine, & Norenzayan, 2010) societies. This means that there is a bias in what we can know since participants from other regions of the world are excluded. To the degree that cultural, historical, and developmental factors impinge upon the practice of higher education, more work with such populations is needed. Such research would enhance our understanding of how academics perceive the threats and opportunities of AI.

Another gap in the literature is the absence of research into the real world of higher education classroom pedagogical activities, course development, and assessment design. Comparatively, few studies focused on the human experience of AI or its use in classrooms (e.g., Al-Shanfari et al., 2023; Archibald et al., 2023; Farazouli et al., 2023). Related to this, is the lack of cross-discipline collaborative research between computer scientists and social scientists. If AI tools are meant to make a difference to classroom teaching, learning, and evaluation, researchers from different backgrounds will need to collaboratively explore how AI technology could be used in educational practice.

## Benefits of AI in Higher Education

Several benefits were identified in this review, such as generating new material, reducing staff workload, and evaluating automatically or optimally (e.g., Kumar et al., 2023; Pretorius, 2023; Shi, 2023). This review first reveals that AI can create new courses and resources, promote curriculum development, address time-consuming workloads concerning curriculum (e.g., questions about syllabi, time, and deadline), and evaluate the material difficulty and quality (Chen et al., 2023; Lopezosa et al., 2023; Pisica et al., 2023; Y. Wang, 2023). These findings reinforce earlier findings that the implementation of AI (e.g., ChatGPT) could contribute to generating a lesson plan and course objectives (Kiryakova & Angelova, 2023; Rahman & Watanobe, 2023) and to assessing general resources and textbooks (Koć-Januchta et al., 2022). Given the above benefits, academics could utilise AI to revise existing courses and free up their time to focus on improving existing curriculum quality.They can also consider developing interdisciplinary courses with the help of AI. One way is to integrate AI itself as learning content into existing curricula, such as introducing ethical considerations of AI into Philosophy or research methods courses. Another way is to use AI to bridge the intersections of different disciplines (e.g., Arts-Arts disciplines, Science-Science disciplines, and Arts-Sciences disciplines). An example in the Science-Science disciplinary intersection could be using AI to predict how air pollution (environmental science) affects health outcomes (healthcare).

AI has also been found to provide an immersive learning environment and a new teaching mode, where instructors facilitate students to conduct “trial-error” strategies and practice specific competencies in simulated scenes (e.g., Y. Wang, 2023; Zhang et al., 2023). Meanwhile, AI, as virtual teachers, could take up logistical workloads (e.g., reinforce students’ mastery of key concepts) and provide instructors time and energy to conduct personalised instruction and satisfy students’ distinct needs (Al-Shanfari et al., 2023; Firat, 2023; Kohnke et al., 2023). In line with this, previous studies have demonstrated that AI, in most cases, worked well in sharing instructors’ tutoring tasks, providing students with immediate and unique feedback, and reducing instructors’ workload (Chou et al., 2011; Zawacki-Richter et al., 2019). Therefore, it may be feasible to establish a collaborative teaching system, where virtual teachers (i.e., AI) share intensive and repetitious teaching workloads (e.g., immediate feedback, knowledge reinforcement), and where human teachers pay attention to student’s personal, emotional, and development needs and conduct one-to-one adaptive instruction. For instance, AI teachers could automatically grade and constantly offer targeted practice for students, which would provide adaptive support to teachers.

Additionally, AI seems to benefit assessments by generating personalised assignments (Pereira et al., 2023), effectively assessing and predicting students’ academic achievement (D. Wang et al., 2023) and non-cognitive outcomes (e.g., soft skills, Novais et al., 2023), identifying disadvantaged students (Saad & Tounkara, 2023), and assessing teaching effectiveness (Wang et al., 2023). This review finds evidence that AI-empowered assessment can effectively assess students’ learning and teachers’ teaching (Hooda et al., 2022; Zawacki-Richter et al., 2019). Consequently, developing AI-empowered student and teacher assessment models could be important research and practice directions.

We suppose that student-facing AI assessment models can be implemented in three steps. Before the classroom, AI can be used to diagnose students’ knowledge bases and help instructors better understand students’ learning preferences, motivations, and needs. During the classroom, AI techniques (e.g., speech recognition, facial recognition) can be combined to collect students’ facial expressions, emotions, gestures, classroom dialogue, and so on, and promptly analyse their learning engagement, behaviours, strategies, and difficulties. This information can inform instructors as to students in need, possible changes in teaching strategies, and early advice on where to intervene. After the classroom, AI, working as a teaching assistant, could provide students with targeted assignments, facilitate individualised learning, and predict future performance based on current performance. Similarly, instructors’ information (e.g., preparing lessons and teaching) could be collected into a digital profile for each instructor, informing assessments of their teaching performance, abilities, and professional development needs. It could inform faculty professional development programmes.

Nevertheless, caution is still needed when embracing AI-generated assessment results, as some indicators (e.g., instructors’ professional ethics) cannot be assessed effectively or, depending on programming, might be overlooked. Therefore, combining AI-generated and human-based assessments is necessary, respecting human beings’ values and educational principles.

## Challenges AI Brings to Higher Education

The literature makes clear substantial challenges to curriculum, instruction, and assessment. Despite the importance of curriculum, this review found less research into AI’s integration into HE curriculum than on the two other aspects of the CIA triad. In terms of existing curricula, there is considerable debate as to what students need to be taught about or with AI and how it could be integrated (Lopezosa et al., 2023). AI creates the possibility that skill with large language models (e.g., to analyse data, to compose communication) is what students might need in the future. Considerable enthusiasm exists for the integration of AI skills with other graduate attributes such as the 4C skills (i.e., communication, collaboration, critical thinking, and creativity). This is an extension of the long-standing arguments advanced by technologists that the best way to prepare future citizens and workers is to ensure they develop generic competencies rather than disciplinary specific knowledge and ability (Chickering & Ehrmann, 1996; Cuban, 2003). Consequently, faculty members need to consider the intersection of disciplinary structure and AI affordances and constraints in terms of integrating contemporary capabilities with long-standing traditions of knowledge.

The impact of AI applies also to instructors’ role and their teaching abilities. Most academics have little understanding of how AI tools are designed and what large language models can do. Thus, few have thought constructively as to how to integrate AI into their teaching. The question is how AI tools, with their capacity to translate text, analyse it, and compose fluent, but potentially meaningless, text can be integrated into diverse fields such as engineering, medicine, studio art, laboratory science, and so on. Application within humanities may be much more feasible, but still academics have to learn how AI can be an adjunct to teaching rather than potentially a substitute for the instructor’s knowledge and skill. An important skill that currently AI cannot do is identify fabrication or error in the text that it assembles.

The most important challenge centres around assessment and evaluation of learning. With the free access students have to powerful AI language models, it is difficult to ensure that the work submitted by students is a genuine intellectual contribution. The fear and possibility of indetectable academic dishonesty will require substantial efforts to ensure the integrity of course grades and academic qualifications. A possible response to generative AI capabilities is to impose invigilated in-person examinations without access to digital resources. Another way to ensure the integrity of evaluation is to require students to participate in an oral examination of their learning; a solution that will have large impact on workloads, efficiency, validity of sampling, and accuracy of scoring. It is clear generative AIs will force academics to rethink the purpose of assessment (e.g., student-centred or knowledge-based learning), the content and format of what is assessed, the design of assessments (e.g., process evaluation, outcome evaluation, or value-added evaluation), and the formative use of assessed performances.

Given the interactive and integrated nature of curriculum, instruction, and assessment processes, there simply is little research on AI’s impact on their intersection. Indeed, only four papers attempted to address the CIA triad. Future research will need to examine the integration of AI impact, rather than studying each aspect of the triad in isolation.

## Limitations

Although this review explored three major education databases to minimise selection bias, the recent articles were published in English rather than in other languages, such as Chinese and Spanish. Therefore, the generalisability of these findings needs to be taken with caution for use in non-English contexts. Considering that Asia accounted for a large number of studies and that an emerging number of studies were conducted in South America and the Middle East, multi-lingual or culture-responsive studies should be conducted in the future. More importantly, this review was limited to first nine months following the release of ChatGPT on 30 Nov 2022; hence, it is a preliminary exploration of how AI impacted higher education. In light of how fast the AI systems are being developed and changed, new research is being published constantly. Hence, the findings presented in this review have probably been superseded already.

## Conclusion

This review contributes to a better understanding of the benefits and threats of AI that recent research has identified in the higher education context. It also identifies challenging opportunities for higher education institutions and faculty members. This paper offers a first step toward understanding the impact AI on the CIA triad in higher education. While the future remains uncertain, several of the trends found in the study are likely to continue for some time to come. In particular, it seems very likely that China will continue to lead the way in research outputs and that studies using stimulations/modeling are likely to remain the most common method, perhaps because they are relatively easy to conduct. It is also likely that the challenges associated with meaningful integration of AI into curriculum, instruction, and assessment will remain difficult for years to come. The challenge of students’ unsanctioned use of AI within assessment processes will require higher education to find valid ways of implementing or managing AI.

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**Appendices**

**Appendix A**

*Research Themes, Categories, and Codes*

|  |  |  |
| --- | --- | --- |
| Themes (4) | Categories (12) | Codes (25) |
| Generation of new material | Generate new curriculum content | Generate new curriculum content |
| Provide an immersive learning environment | Provide an immersive learning environment |
| Offer a new teaching mode | Provide a new teaching mode |
| Replace existing teaching mode |
| Test new model accuracy or application effect |
| Reduction of staff workload | Work as a curriculum assistant | Help answer course-specific questions about curricula |
| Reflect on curriculum and content difficulty | Predict the difficulty and quality of course materials |
| Personalised instruction | Keep abreast of students learning |
| Provide personalised/individualised feedback/instruction |
| Improve teaching effectiveness |
| Prepare personalised assignments | Help prepare one-fits-all or personalised assignments/exams |
| Automation/optimisation of evaluation | Assess students’ learning process and outcomes | Assess students’ learning process |
| Assess students’ performance, achievement, outcome |
| Assess teaching effect | Assess teaching effect |
| Challenge for CIA | Challenge existing curricula | Integrate AI into curricula |
| Prepare students’ AI literacy and digital citizenship |
| Challenge existing teaching | Challenge instructors’ AI teaching competencies |
| Challenge the role of educators |
| Ethical consideration: bias |
| Ethical consideration: equity of access |
| Lack of support in AI teaching |
| Challenge existing assessment methods and strategies | Students use AI to cheat or plagiarism |
| AI passed exams or assignments |
| Challenge instructors’ ability to detect AI-generated texts |
| Challenge teacher perceptions and strategies of assessment |

**Appendix B**

*Study Characteristics with References*

| Characteristic | Papers |
| --- | --- |
| *Region* |  |
| Asia (i.e., Mainland China, Hong Kong, India) | Chan, 2023; Devi & Rroy, 2023; Guo, 2023; Kohnke et al., 2023; Kumar et al., 2023; F. Li & Zhang, 2023; L. Li et al., 2023; Q. Li et al., 2023; Y. Li & Wu, 2023; Shi, 2023; Tang et al., 2023; D. Wang et al., 2023; Y. Wang, 2023; Yang, 2023; Zhang et al., 2023; K. Zhu, 2023; L. Zhu et al., 2023 |
| Europe | Alexander et al., 2023; Farazouli et al., 2023; Firat, 2023; Holmes et al., 2023; Lopezosa et al., 2023; Pisica et al., 2023; Saad & Tounkara, 2023; Stutz et al., 2023 |
| North America | Archibald et al., 2023; Chen et al., 2023; Firat, 2023; Phillips et al., 2023; Sajja et al., 2023 |
| Latin America (i.e., Brazil, not specified) | Lopezosa et al., 2023; Novais et al., 2023; Pereira et al., 2023 |
| Middle East (i.e., Oman, Turkey) | Al-Shanfari et al., 2023 |
| Australia | Firat, 2023; Pretorius, 2023 |
| *Methods* |  |
| Modelling/Simulation | Archibald et al., 2023; Guo, 2023; Kumar et al., 2023; F. Li & Zhang, 2023; Novais et al., 2023; Phillips et al., 2023; Saad & Tounkara, 2023; Sajja et al., 2023; Shi, 2023; D. Wang et al., 2023; Yang, 2023; Zhang et al., 2023; K. Zhu, 2023; L. Zhu et al., 2023 |
| Experiment | Farazouli et al., 2023; L. Li et al., 2023; Pereira et al., 2023; Tang et al., 2023; Zhang et al., 2023; L. Zhu et al., 2023 |
| Survey | Al-Shanfari et al., 2023; Devi & Rroy, 2023; Holmes et al., 2023; L. Li et al., 2023; Q. Li et al., 2023; Y. Wang, 2023 |
| Interview | Al-Shanfari et al., 2023; Chen et al., 2023; Farazouli et al., 2023; Kohnke et al., 2023; Lopezosa et al., 2023; Pisica et al., 2023 |
| Others (e.g., discussion, workshop, open-ended questions, observation) | Alexander et al., 2023; Firat, 2023; Holmes et al., 2023; Novais et al., 2023; Stutz et al., 2023 |
| Mixed methods | Chan, 2023; Y. Li & Wu, 2023 |
| Case study | Sajja et al., 2023; Pretorius, 2023 |
| *Foci* |  |
| Technology | Guo, 2023; Kumar et al., 2023; F. Li & Zhang, 2023; Y. Li & Wu, 2023; Novais et al., 2023; Pereira et al., 2023; Phillips et al., 2023; Saad & Tounkara, 2023; Sajja et al., 2023; Shi, 2023; Tang et al., 2023; D. Wang et al., 2023; Yang, 2023; Zhang et al., 2023; K. Zhu, 2023; L. Zhu et al., 2023 |
| The human experience | (Al-Shanfari et al., 2023; Chan, 2023; Chen et al., 2023; Devi & Rroy, 2023; Firat, 2023; Holmes et al., 2023; Kohnke et al., 2023; Lopezosa et al., 2023; Pisica et al., 2023; Y. Wang, 2023 |
| Use of AI in class | Alexander et al., 2023; Archibald et al., 2023; Farazouli et al., 2023; L. Li et al., 2023; Q. Li et al., 2023; Pretorius, 2023; Stutz et al., 2023 |
| *Education Dimension* |  |
| Curriculum | Al-Shanfari et al., 2023; Chen et al., 2023; Firat, 2023; F. Li & Zhang, 2023; Lopezosa et al., 2023; Phillips et al., 2023; Pisica et al., 2023; Sajja et al., 2023; Y. Wang, 2023 |
| Instruction | Al-Shanfari et al., 2023; Archibald et al., 2023; Chan, 2023; Chen et al., 2023; Devi & Rroy, 2023; Firat, 2023; Guo, 2023; Holmes et al., 2023; Kohnke et al., 2023; F. Li & Zhang, 2023; L. Li et al., 2023; Q. Li et al., 2023; Y. Li & Wu, 2023; Pisica et al., 2023; Pretorius, 2023; Shi, 2023; Tang et al., 2023; Y. Wang, 2023; Yang, 2023; Zhang et al., 2023; K. Zhu, 2023 |
| Assessment | Alexander et al., 2023; Archibald et al., 2023; Chan, 2023; Farazouli et al., 2023; Firat, 2023; Kohnke et al., 2023; Kumar et al., 2023; F. Li & Zhang, 2023; Novais et al., 2023; Pereira et al., 2023; Phillips et al., 2023; Pisica et al., 2023; Saad & Tounkara, 2023; Stutz et al., 2023; Tang et al., 2023; D. Wang et al., 2023; L. Zhu et al., 2023 |