From Classroom to AI-Driven Workforce: Higher Education Practices for Graduate Employability

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ABSTRACT

Advances in artificial intelligence (AI) are fundamentally reshaping higher education which prompts academic institutions to reconsider the competencies necessary for graduate employability in an evolving technology-driven workforce. This systematic literature review investigated higher education practices that prepare graduates for employability in an AI-enabled workforce, and identified the critical competencies necessary for success in AI-enabled workplaces. The review was performed in accordance with the PRISMA 2020 framework and integrated evidence from 30 empirical studies published in the period of 2023-2025 and located through systematic search, screening, eligibility assessment and thematic synthesis. Higher education institutions are responding to the labor market demands through conventional approach of redesigning curriculum, university-industry collaboration with work integrated learning however, implementing AI governance and ethical AI education, integrating learning analytics or AI predictive analytics, and establishing AI research centers or innovation hubs are considered least evident or still in the emerging stage. The review further identified AI literacy, digital competence, critical thinking, and problem-solving as the most frequently reported employability competencies required for graduates including other soft skills like communication, collaboration, adaptability, creativity, ethical reasoning, leadership, and lifelong learning to thrive in AI-enabled workplaces. This review contributes to design future-ready curricula and integrate AI-driven institutional policies in support to the human capital development and resource generation strategies for comprehensive delivery of quality instruction for achieving the AI-related employability competencies.

Keywords: AI literacy, AI-supported learning, digital competence, educational management, ethical AI education, employability

INTRODUCTION

Artificial Intelligence (AI) is fundamentally reshaping the nature of work by transforming occupational roles and redefining employer expectations towards shifting the skills that determine graduate employability. Rather than simply automating jobs, AI increasingly augments human work which replaces routine and repetitive tasks while amplifying the value of uniquely human capabilities such as critical thinking, creativity, communication, collaboration, ethical judgment, and adaptability. This shift has increased the demand for graduates who can work efficiently with AI systems and interpret AI outputs, while also being able to keep their skills up to date in a fast-changing technology landscape (Adepoju & Adepoju, 2025; O'Dea et al., 2025; Cheng et al., 2025). Employers are no longer satisfied across industries with graduates who possess disciplinary knowledge alone; instead, they seek professionals who integrate AI literacy and digital fluency with transferable employability skills that support innovation and interdisciplinary problem-solving (Coetzee & Goede, 2024; Kaushal & Vaghela, 2023; Laguador et al., 2020). AI is changing but not replacing many professional roles and increasing the importance of human-centered competencies alongside technical expertise while prompting educational institutions to rethink how they prepare students for emerging labor market demands.

Graduate employability has become a strategic concern for higher education, as universities are expected to prepare learners not only for their first job, but for sustained career success where technological adaptability and responsible human–AI collaboration have become indispensable for long-term professional relevance (Deckha

et al., 2025; Grama & Todericiu, 2025; Soproni, 2023). Universities are moving beyond the traditional content-based instruction toward competency-based education that integrates digital fluency with authentic workplace experiences throughout the curriculum (Ha, 2025; Cheng et al., 2025; O'Dea et al., 2025; Aguila et al., 2016; Chavez et al., 2016).

Preparing graduates for AI-enabled workplaces requires higher education institutions to embed interdisciplinary AI literacy, practical hands-on experience with relevant tools, ethical reasoning, data fluency, and adaptable problem-solving into curricula and co-curricular opportunities. This will enable the graduates to apply AI and digital competencies with intelligent technologies in addressing complex workplace challenges (Deckha et al., 2025; Coetzee & Goede, 2024; Grama & Todericiu, 2025). Universities create transferable competencies that are complementary and not competitive to Artificial Intelligence (Soproni, 2023; Bedoya-Guerrero et al., 2024). The preparation of graduates who possess technical competence in AI technologies and the capacity to contribute to innovation and sustainable workforce development in an increasingly intelligent economy should be recognized as a fundamental role of higher education. In addition, the literature emphasizes that AI should be introduced as a pedagogical partner supported by institutional policies and ongoing curriculum renewal to meet the rapidly changing expectations of the labor market (Aditya et al., 2024; Shumeiko & Osadcha, 2024; Ha, 2025).

Despite the growing body of research on Artificial Intelligence and graduate employability, the existing literature remains fragmented in its treatment of how higher education can effectively prepare graduates for AI-driven employment. Many studies have examined specific aspects of AI adoption in education, digital transformation, employability skills, employer expectations, or discipline-specific curriculum innovations, while others have focused on particular competencies in terms of AI literacy, digital skills, communication, emotional intelligence, or lifelong learning (Cheng et al., 2025; Adepoju & Adepoju, 2025; Hidayat & Amran, 2025). Similarly, numerous investigations have proposed educational interventions but these practices have rarely been synthesized within the context of AI-driven teaching and learning processes to determine which approaches are consistently reported across diverse educational contexts (Deckha et al., 2025; Ha, 2025; Coetzee & Goede, 2024) that contribute to the development of employability skills. Furthermore, although the literature identifies a wide range of employability competencies, there is limited consolidated evidence regarding the competencies that consistently emerge as essential for graduates to thrive in AI-enabled workplaces.

The need for a more comprehensive synthesis to support evidence-informed decision-making in the development of AI-oriented curricula is underscored by the fragmented state of the existing evidence. Therefore, this review addresses this gap by systematically synthesizing the literature to answer two questions on what higher education practices have been reported to prepare graduates for employability in an AI-driven workforce and what employability competencies are identified in the literature as essential for graduates to succeed in the AI workforce. By integrating evidence across diverse studies, this review seeks to provide a comprehensive framework that can guide universities, educators, curriculum developers, and policymakers in designing future-oriented educational practices that enhance graduate employability in the age of Artificial Intelligence.

METHODOLOGY

Review design

A systematic literature review (SLR) was employed because it provides a rigorous and replicable approach for identifying, evaluating, and synthesizing evidence from existing studies to address a clearly defined research question. A systematic review is a reviewing research method that uses explicit, accountable, and reproducible procedures to identify, appraise, and synthesize available evidence to minimize bias (Gough et al., 2012). This review design provides compelling evidence for identifying the emerging institutional practices and essential employability competencies, as well as research gaps that will serve as a strategic foundation for advancing AI-responsive higher education institutions.

Search strategy

The literature search was conducted across multidisciplinary and education-focused databases to maximize the comprehensiveness of the review that index high-quality peer-reviewed publications. Using multiple databases

minimized database selection bias and increased the likelihood of identifying all relevant studies on Generative AI in teacher education. A systematic search was conducted using Scopus, Web of Science, Google Scholar, ScienceDirect, and DOAJ because these databases provide broad coverage of peer-reviewed literature on employability, artificial intelligence, educational practices, and higher education. The search terms were derived from the research questions and major concepts of the review, including the technology (Generative AI), population (college students), context (teaching strategies), and outcome (employability skills). Boolean operators (AND, OR) and truncation symbols were used to broaden or narrow the search while maintaining precision. The search strategy combined Boolean operators and keywords such as ("higher education" OR university OR college* OR "tertiary education") AND ("artificial intelligence" OR AI OR "generative AI" OR GenAI) AND (curriculum AND pedagogy AND "teaching strategies" OR "instructional practices" AND "curriculum innovation" OR "work-integrated learning" AND internship* AND practicum OR "industry collaboration" OR "experiential learning") AND (employability OR "graduate employability" OR "workforce readiness" OR "career readiness")

Eligibility criteria

Explicit inclusion and exclusion criteria were utilized in the review as presented in Table 1 to ensure that only relevant and up-to-date empirical evidence was included in the synthesis. Meanwhile only quantitative, qualitative, and mixed-method studies were considered since these research designs provide empirical evidence that enhances understanding of how higher education prepares graduates for employability in an AI-driven workforce. However, the materials that might not provide primary empirical evidence and might cause interpretive bias which include opinion papers, editorials, literature reviews, and unpublished theses were excluded in the selection of articles.

Table 1. Inclusion and Exclusion Criteria

Category	**Inclusion Criteria**	**Exclusion Criteria**
Types of Research	Quantitative, qualitative, or mixed-method	Opinion papers, editorials, literature reviews, unpublished theses
Focus	Studies examining employability skills of graduates, integration of AI in classroom instruction and institutional practices.	Studies focusing purely on the delivery of instruction without component of AI and skills development
Language	Published in English	Published in languages other than English
Article Type	Research Article with full text available	Books, conference proceedings, dissertation and theses
Year of Publication	2023–2025	Published 2022 and older

These 30 studies came from 19 different countries as respondents of the reviewed empirical studies including Australia (1), Bangladesh (1), Bosnia and Herzegovina (1), China (2), Ghana (2), India (5), Malaysia (2), Myanmar (1), Nigeria (3), Palestine (1), Poland (1), Portugal (1), Saudi Arabia (1), South Africa (1), Spain (1), Taiwan (1), United Kingdom (4), Uzbekistan (1) and Vietnam (1). This signifies the diversity of contexts from different countries were considered in the study.

Regarding the focus of the review, the researcher considered the article eligible for review if the studies examined graduates' employability skills, with integration of artificial intelligence in classroom instruction, and the institutional practices support graduate employability. Studies that concentrated solely on instructional delivery without addressing AI integration or employability skills development were excluded because they did not align

with the objectives of the review. The technological and pedagogical dimensions of graduate preparation for the evolving labor market were directly addressed through the application of this criterion.

To ensure consistency and enhance the reliability of the review, only full-text, peer-reviewed research articles published in English were included. Studies published in languages other than English were excluded to minimize potential translation bias and maintain consistency throughout the data extraction and synthesis processes. However, those materials which are generally subject to different publication, evaluation and peer-review standards like books, dissertations and theses and others that may not provide the same level of methodological rigor like conference proceedings were excluded in the review.

Finally, the review was limited to studies published specifically between January 2023 and December 2025 to capture the most recent developments in artificial intelligence, higher education practices, and graduate employability. The review covered studies published within a three-year period, with an increasing trend in publications comprising four (4) studies with 13.3% in 2023, seven (7) studies or 23.3%in 2024, and 19 studies or 63.3% in 2025 which indicate a growing research interest in higher education practices and graduate employability in the context of an AI-driven workforce. Studies published in 2022 and earlier were excluded to ensure that the review reflected the most recent developments in generative AI and contemporary workforce expectations.

Screening process

The PRISMA 2020 flow diagram is shown in Figure 1 which summarizes the systematic study selection process undertaken in this review (Page et al., 2021). The initial search of the selected databases: Scopus (97 records), Web of Science (34 records), Google Scholar (107 records), ScienceDirect (43 records), and DOAJ (71 records) with a total of 352 records. Out of these records, 136 duplicates were removed which leaves 216 unique records to be screened by title and abstract. After the application of the predetermined inclusion and exclusion criteria, 139 records were excluded and 77 full-text articles were retained for a comprehensive eligibility assessment.

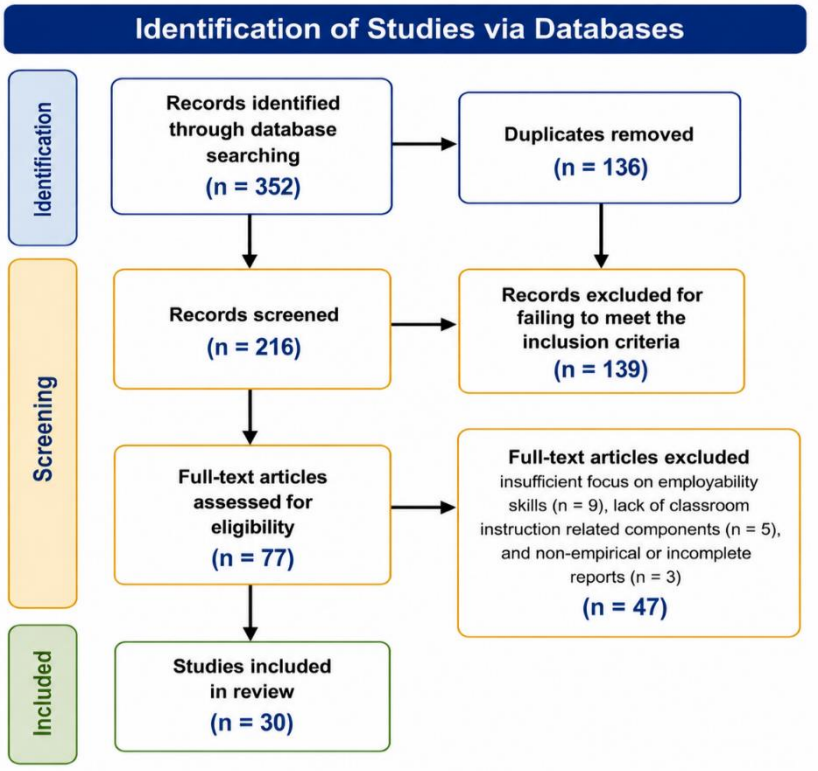

Figure 1. PRISMA 2020 Flow Diagram of the Literature Selection Process

During the eligibility stage, there were 47 full-text articles excluded for specific reasons like studies with insufficient focus on employability skills (n = 9), studies that lacked classroom instruction-related components (n = 5), and non-empirical or incomplete reports (n = 3), while the remaining excluded articles did not meet

other eligibility requirements established in the review protocol. The 30 empirical studies have met all inclusion criteria and were retained for the final synthesis after considering the rigorous screening and eligibility assessment.

The PRISMA flow diagram demonstrates the transparency and methodological rigor of the systematic literature review by documenting each step of the study selection process and it enhances reproducibility of the review by providing a transparent audit trail of the flow of records from initial identification to final inclusion.

Quality appraisal

The researcher conducted the quality appraisal to evaluate the methodological quality and credibility of the included studies, ensuring that the synthesis was grounded in reliable empirical evidence. The methodological quality of the included studies was evaluated using the Mixed Methods Appraisal Tool (MMAT) that permits the assessment of qualitative, quantitative and mixed-methods studies in one instrument. The study utilized various research designs to capture the different aspects of previous research findings that will provide more insightful empirical evidence for the synthesis. This warranted the use of the MMAT which provides standardized criteria for appraising methodological rigor across multiple methodologies to evaluate the clarity of the research objectives, the appropriateness of the research design, the adequacy of the sampling procedures, the robustness of the data collection methods, the analytical rigor, and the validity of the reported findings. Each criterion was rated as "Yes," "No," or "Can't Tell" according to MMAT guidelines (Hong et al., 2018). Studies with major methodological limitations were excluded from the final synthesis to strengthen the credibility of the findings. This quality appraisal process strengthened the trustworthiness of the review by minimizing the influence of methodologically weak studies and ensuring that the synthesized evidence was based on high-quality empirical research.

Data extraction

Table 2 presented the example of detailed information of data extraction which was conducted by the researcher using a standardized matrix to ensure the consistent and systematic collection of relevant information from each included study. The extracted data included the author, title, country of origin, and research design to describe the characteristics of the studies, as well as the significant findings related to Artificial Intelligence, higher education practices for preparing graduates for employability in an AI-driven workforce, and the employability competencies essential for graduates to succeed in the AI workforce. This structured extraction process facilitated the synthesis and thematic analysis of evidence across the selected studies.

Table 2. Example of Detailed Information

Authors	Hrnjić, Pilav-Velić, Hadžiahmetović-Milišić, & Dedović
Title	2025
Country	Bosnia and Herzegovina
Research Design	Explanatory sequential mixed-methods research design, 218 University of Sarajevo students who had experience using Generative AI (GenAI) tools.
Significant Findings Related to Artificial Intelligence	The study found that Generative AI (GenAI) significantly enhances student employability when integrated with soft skills and digital competencies while perceived usefulness, user satisfaction, and continued AI use are positively influenced by high-quality AI-generated content. However, autonomy has emerged as the critical mediator that transforms AI usage into improved academic performance…
Higher Education Practices	The study identifies numerous higher education practices that strengthen graduate employability that include integration of AI tools across curricula;

	AI literacy education; digital competency development; soft-skills integration; communication training; teamwork activities…
Essential Employability Competencies	The study identifies a broad set of employability competencies required in AI-enabled workplaces which include AI literacy; digital literacy; communication; teamwork; collaboration; critical thinking; analytical reasoning; creativity; innovation; problem-solving; autonomy; self-directed learning…

Data synthesis

The thematic analysis followed the six-phase approach of Braun and Clarke (2006) which comprises familiarization with the extracted data, generation of initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the final synthesis. The researcher inductively coded recurring competency-related concepts from the salient findings and pedagogical practices of each study. Similar codes were then grouped into broader themes representing AI-ready teaching competencies. Repeated comparison across studies helped ensure conceptual consistency and reduce overlap among themes. Finally, the frequency of each theme was measured across the included studies and cross-study synthesis was conducted to identify common processes of competency development, similarities, differences, and emerging trends in the application of Generative AI for pre-service teacher education.

No new datasets were generated or analyzed during this study; all data supporting the findings were obtained from publicly available published articles cited in the reference list.

RESULTS

Table 3. Quantitative Synthesis of Higher Education Practices Reported in the Literature (n ≈ 30 studies)

Higher Education Practice	**f**	**%**
Curriculum redesign/alignment with industry and AI workforce needs	25	83.3
Industry partnerships / University-industry collaboration	23	76.7
Experiential learning	21	70.0
Work-integrated learning (internships, apprenticeships, workplace learning)	20	66.7
Project-based learning	19	63.3
AI literacy integration	18	60.0
Digital literacy / Digital competency development	17	56.7
Lifelong learning / Continuous professional development	17	56.7
Competency-based education	15	50.0
Communication skills development	14	46.7
Interdisciplinary learning	13	43.3
Technology-enhanced learning	12	40.0
Critical thinking instruction	11	36.7
Ethical AI education / Responsible AI use	10	33.3

Adaptive Personalized Learson	8	26.7
AI-supported teaching and assessment	8	26.7
Simulation-based learning	7	23.3
AI governance / Institutional AI policies	7	23.3
Learning analytics / AI predictive analytics	6	20.0
AI research centers / Innovation hubs	6	20.0

The quantitative synthesis of higher education practices reported in the literature is presented in Table 3. The frequency analysis demonstrates that curriculum redesign aligned with industry and AI workforce needs have emerged as the most consistently reported higher education practice which appear in 25 studies (83.3%) where universities are continuously updating their curricula to reflect technological advances and emerging occupations including the changing employer expectations associated with Artificial Intelligence and digital transformation. Establishing university-industry partnerships (76.7%) has emerged as strong practice of higher education institutions where the school leaders signed agreements with companies to send students for internship or training while gaining experiential learning (70.0%), work-integrated learning (66.7%), and project-based learning (63.3%) which indicate that authentic workplace experiences remain central strategies for bridging classroom learning with AI-enabled professional practice. Meanwhile, a strong emphasis on AI literacy (60.0%), digital literacy (56.7%) and lifelong learning (56.7%) has reflected that graduates need to keep adapting to the changing technologies and not rely solely on disciplinary knowledge.

More than half of the reviewed studies further highlighted competency-based education (50.0%), communication skills development (46.7%), interdisciplinary learning (43.3%), technology-enhanced learning (40.0%), and critical thinking instruction (36.7%) which further imply that universities should integrate AI-related technical competencies with transferable human skills. A recurring emphasis on ethical AI education was identified in 33.3% of the reviewed studies, reflecting the growing concern for the responsible use of AI in professional settings.

However, it is surprisingly to note the following approaches were less frequently reported regarding the emerging educational practices that demonstrate the evolving role of AI in higher education. These include adaptive and personalized learning (26.7%), AI-supported teaching and assessment (26.7%), simulation-based learning (23.3%), institutional AI governance (23.3%), and learning analytics using AI (22.5%). A small number of studies also proposed establishing AI research centers and innovation hubs (20.0%) to support institutional capacity building and workforce innovation.

Table 4. Category-Level Quantitative Synthesis of Employability Competencies Essential for Graduates to Succeed in the AI Workforce

Competency Dimension (%)	Representative Competencies	Reviewed Studies
Personal Adaptability Competencies (75.0%)	Adaptability, lifelong learning, self-directed learning, resilience	Verma et al. (2025); AlAfnan et al. (2024); Utkirov (2024); Nayan & Nayan (2024); Ratnayake & Amarasinghe (2025); Mahmood et al. (2023); Kana & Letaba (2024); Anowor et al. (2025); Imarhiagbe et al. (2025); Kamaruzaman et al. (2024)
Higher-Order Cognitive Competencies (72.0%)	Critical thinking, analytical thinking, creativity, innovation, problem-solving, decision-making	Yuriev et al. (2024); Verma et al. (2025); AlAfnan et al. (2024); Lee et al. (2024); Chen et al. (2025); Kamaruzaman et al. (2024); Nayan & Nayan (2024); Mahmood et al. (2023); Ratnayake & Amarasinghe (2025); Kana & Letaba (2024)

Interpersonal Competencies (71.8%)	Communication, teamwork, collaboration, leadership, emotional intelligence	AlAfnan et al. (2024); Lee et al. (2024); Verma et al. (2025); Mahmood et al. (2023); Nayan & Nayan (2024); Ratnayake & Amarasinghe (2025); Osunde (2025); Kana & Letaba (2024); Utkirov (2024)
Digital and AI Competencies (46.7%)	AI literacy, digital literacy, data literacy, programming, prompt engineering	Chen et al. (2025); Yuriev et al. (2024); Imarhiagbe et al. (2025); Utkirov (2024); AlAfnan et al. (2024); Lee et al. (2024); Anowor et al. (2025); Kana & Letaba (2024); Ngatiman et al. (2023); Ratnayake & Amarasinghe (2025); Kamaruzaman et al. (2024)
Professional Competencies (40.8%)	Workplace readiness, ethics, project management, entrepreneurship	Osunde (2025); Lee et al. (2024); Ratnayake & Amarasinghe (2025); Utkirov (2024); Verma et al. (2025); Mahmood et al. (2023); Chen et al. (2025); Kana & Letaba (2024); Ngatiman et al. (2023)
Emerging Competencies (16.6%)	Sustainability, intercultural competence, human–AI collaboration	Yuriev et al. (2024); Imarhiagbe et al. (2025); Chen et al. (2025); Lee et al. (2024); Anowor et al. (2025); Kana & Letaba (2024); Kamaruzaman et al. (2024); AlAfnan et al. (2024); Verma et al. (2025)

The category-level of quantitative synthesis on essential employability competencies for graduates to succeed in the AI workforce is presented in Table 4. The quantitative synthesis demonstrates a strong consensus across the reviewed literature that human-centered competencies remain the cornerstone of employability in AI-driven workplaces. The competencies reported most consistently were personal adaptability competencies (75.0%) where most studies emphasized this soft skill as evidence for being future-ready graduate, followed by higher-order cognitive competencies (72.0%) and interpersonal; competencies (71.8%) which indicate that graduates are expected to continuously acquire new knowledge, respond effectively to technological change, solve complex problems, and communicate across multidisciplinary environments. Similarly, digital and AI competencies (46.7%), professional competencies (40.8%) and emerging competencies (16.6%) that include sustainability, intercultural competence and huma-AI collaboration were frequently identified which reflect the increasing expectation for graduates to possess both technological competence and the interpersonal capabilities necessary to work productively alongside intelligent systems.

DISCUSSION

The quantitative synthesis reveals that the most common higher education practices to prepare graduates for employability in an AI-driven workforce are curriculum redesign aligned with AI workforce needs and university-industry collaboration with experiential learning, work-integrated learning and project-based learning. The results show a clear transition from the traditional methods of knowledge transfer towards competency-based and workplace-integrated learning models, where students can apply their disciplinary knowledge in real professional contexts. Micro-credentialing is increasingly being introduced to complement degree programs with workforce-relevant competencies. This approach is further supported by engaging industry practitioners as mentors, guest lecturers, and co-supervisors to strengthen the connection between academic learning and professional practice. The systematic integration of AI literacy and digital competencies with employability skills across higher education curricula is widely supported, while the development of human-centered competencies is likewise emphasized rather than limiting AI education to standalone courses. This pattern aligns with previous reviews which have similarly concluded that AI should complement rather than replace human capabilities and the integrated approach of technological proficiency and transferable skills is required for successful graduate preparation (Deckha et al., 2025; Grama & Todericiu, 2025; O'Dea et al., 2025). Similar to this, the studies by Perez-Encinas and Berbegal-Mirabent (2023) and Cheng et al. (2025) recognizes competency-based, experiential, and work-integrated learning as key approaches to improve employability in rapidly changing labor markets. Collectively, these findings underscore the evolving role of higher education

institutions as interconnected learning ecosystems that embed AI-enabled pedagogies and industry collaboration to link academic learning with workplace innovation which broaden their traditional role as providers of disciplinary knowledge.

Continuous mechanisms for curriculum review were established through collaboration with employers and professional bodies to ensure that academic programs remained aligned with evolving workforce demands (Lee et al., 2024; Ngatiman et al., 2023). This initiative is expected to strengthen partnerships between higher education institutions and industry which reinforce as best practice that aligns graduates' employability competencies with the evolving needs of the labor market. Furthermore, the importance of experiential learning has been emphasized in the study which enables the students to apply theoretical knowledge in real-world contexts while developing competencies aligned with evolving workforce demands (Lee et al., 2024; Ratnayake & Amarasinghe, 2025; Ngatiman et al., 2023; Verma et al., 2025). This finding is consistent with Kolb's Experiential Learning Theory where meaningful learning occurs through the transformation of experience into knowledge, thereby enhancing learners' professional competence and employability (Kolb, 2014).

The strong emphasis on ethical AI education indicates the need to embed in the academic curriculum rather than restricting them to computing and technology-related fields (AlAfnan et al., 2024; Imarhiagbe et al., 2025; Vuc et al., 2026) which provides students with skills and judgment to design, deploy and critique AI systems that are aligned with societal values. This requires higher education institutions to build faculty capacity to integrate AI enhanced pedagogies and invest in digital infrastructure and learning analytics by developing robust ethical AI governance frameworks to promote responsible and equitable use of AI in teaching and learning (Yuriev et al., 2024; Utkirov, 2024; Chen et al., 2025). This institutionalization of such practices fosters the development of AI and digital competencies and lifelong learning mindset among graduates to navigate technological advancements and thrive in an AI-driven workforce (Vuc et al., 2026; Imarhiagbe et al., 2025; Yuriev et al., 2024).

The findings contribute theoretically in extending current employability frameworks beyond traditional graduate attributes to an AI integrated employability ecosystem. Traditional theories such as human capital theory, competency-based education and graduate employability models focus on the acquisition of knowledge, skills and workplace experience. However, the current synthesis demonstrates that employability in AI-driven contexts is the result of the interplay of four interrelated dimensions: AI and digital competencies, authentic learning experiences, industry engagement, and human-centered capabilities (Lee et al., 2024; Chen et al., 2025; Utkirov, 2024; Verma et al., 2025; Ngatiman et al., 2023; Coetzee & Goede, 2024). This finding aligns with the recent conceptual framework of Industry 5.0, which considers AI literacy as a complement to creativity, ethical reasoning, collaboration, resilience, and lifelong learning and not as a competitor (O'Dea et al., 2025; Hrnjić et al., 2025; AlAfnan et al., 2024; Yuriev et al., 2024; Imarhiagbe et al., 2025; Anowor et al., 2025). The findings thus support the view that graduate employability is no longer based on academic achievement or technical expertise alone but on the ability of universities to create adaptive learners who can continuously merge technological innovation with critical human judgment (Segbenya et al., 2023; Kana & Letaba, 2024; Nayan & Nayan, 2024; Ratnayake & Amarasinghe, 2025; Verma et al., 2025). This review thus contributes to the literature by proposing that higher education be viewed as an adaptive learning ecosystem where curriculum innovation, AI-enabled pedagogy, competency-based learning, and industry collaboration jointly shape graduates' preparedness for sustainable employment in ever-intelligent and technology-intensive workplaces (Lee et al., 2024; Khan et al., 2025; Deckha et al., 2024; Chen et al., 2025; Ngatiman et al., 2023; Utkirov, 2024).

The category-level quantitative synthesis demonstrates that personal adaptability competencies, higher-order cognitive competencies, and interpersonal competencies constitute the three most dominant competency domains identified across the reviewed literature, whereas digital and AI competencies, professional competencies, and emerging future competencies were reported less frequently (Verma et al., 2025; AlAfnan et al., 2024; Nayan & Nayan, 2024; Hrnjić et al., 2025; O'Dea et al., 2025). Despite the rapid transformation of the workplace by Artificial Intelligence, graduates' long-term employability is consistently recognized in the literature as being primarily dependent on uniquely human capabilities that complement rather than compete with intelligent technologies (Yuriev et al., 2024; Imarhiagbe et al., 2025; O'Dea et al., 2025; Hrnjić et al., 2025; Segbenya et al., 2023). Moreover, the Future of Jobs Report 2025 has identified AI and big data, technological literacy, curiosity and lifelong learning, analytical thinking, creative thinking, resilience, flexibility and agility, and talent management as the most critical and rapidly growing skills needed to build a future-ready workforce

by 2030 while human-centric and adaptive skills are at the heart of future workforce strategies (World Economic Forum, 2025). Therefore, competencies such as adaptability, lifelong learning, critical thinking, communication, teamwork, and creativity remain the foundation for success because they enable graduates to respond effectively to technological disruption and unstructured problems to collaborate across multidisciplinary environments, and continuously acquire new knowledge throughout their careers (Verma et al., 2025; AlAfnan et al., 2024; Kana & Letaba, 2024; Nayan & Nayan, 2024; Deckha et al., 2024; Grama & Todericiu, 2025).

These findings are in strong agreement with previous review studies that also found that future employability requires balancing AI-related technical competencies with transferable human skills. For example, Deckha et al. (2025) reported that collaboration, communication, critical thinking, creativity, and lifelong learning were the most frequently identified competencies among international future-of-work frameworks while O'Dea et al. (2025) suggested that graduate attributes for Industry 5.0 should include a blend of conceptual, technological, and human skills. Similarly, Grama and Todericiu (2025) and Perez-Encinas and Berbegal-Mirabent (2023) found that adaptable graduates who can combine digital skills with critical thinking and teamwork are increasingly valued by employers as a means to remain competitive in technology-driven labor markets.

Higher education institutions should take a holistic approach when training the students to integrate technological competencies into wider competency-based educational structures rather than teaching AI as a standalone technical specialization (Chen et al., 2025; Lee et al., 2024; Kana & Letaba, 2024; Verma et al., 2025; Ngatiman et al., 2023). One way to include ethical AI education in the curriculum is to embed in subject areas such as algorithmic bias, privacy, transparency, intellectual property and responsible use of AI (Yuriev et al., 2024; Imarhiagbe et al., 2025; AlAfnan et al., 2024; Ha, 2025). The lower frequency of digital and AI competencies should not be viewed as less important but rather as a signal of the need to build foundational AI literacy as a cross-disciplinary graduate attribute with advanced technical competencies (e.g., programming, prompt engineering, and machine learning) specific to the needs of the discipline (Segbenya et al., 2023; Hrnjić et al., 2025; Palariya & Shah, 2025; Utkirov, 2024; Chen et al., 2025). Faculty development should be part of workforce development with the deployment of training on responsible AI integration with ongoing curriculum review and continuous institutional investment in digital infrastructure to ensure graduates are not only technologically proficient but also possess the human-centered skills needed for sustainable employability in AI-enabled workplaces (Ngatiman et al., 2023; Lee et al., 2024; Kana & Letaba, 2024; Imarhiagbe et al., 2025; Utkirov, 2024).

The findings also contribute theoretically by extending traditional employability theories to the context of Artificial Intelligence (AI) and Industry 5.0. Traditionally, scholars have viewed graduate employability through classical employability frameworks and Human Capital Theory as the accumulation of knowledge, technical skills, and work experience that improves labour market outcomes. However, the present synthesis indicates that employability in AI-based environments is conceptualized as a holistic and dynamic capability that encompasses personal adaptability, higher order cognitive skills, interpersonal effectiveness, AI literacy, digital competence, professional capability, and future-oriented competencies (Vuc et al., 2026; AlAfnan et al., 2024; Imarhiagbe et al., 2025; Lee et al., 2024; Ratnayake & Amarasinghe, 2025). This multi-dimensional structure aligns with emerging Industry 5.0 perspectives that view human-centric capabilities as complementary to AI which also reinforces the concept of human–AI collaboration rather than technological substitution (Yuriev et al., 2024; Kamaruzaman et al., 2024; Nayan & Nayan, 2024; Verma et al., 2025).

The continuing evolution of emerging competencies such as prompt engineering, sustainability, and human–AI collaboration is indicated by their comparatively lower representation in the reviewed studies which suggest that these domains have not yet been universally embedded in graduate employability frameworks (O'Dea et al., 2025; Hrnjić et al., 2025; Yuriev et al., 2024; Palariya & Shah, 2025; Imarhiagbe et al., 2025). These emerging competencies have to be explored systematically in providing more insightful strategies for higher education and training institutions to enhance student competencies leading towards the achievement of required qualifications and demands of the industry. This review therefore adds to the employability literature by suggesting that AI-ready graduates should be seen not only as digitally competent individuals, but also as adaptive lifelong learners who can integrate technological expertise with critical judgment and ethical reasoning while maintaining interpersonal effectiveness with ongoing professional development (AlAfnan et al., 2024; Verma et al., 2025; Kana & Letaba, 2024; Nayan & Nayan, 2024; Utkirov, 2024; Anowor et al., 2025). Such a

perspective offers a wider theoretical foundation for future curriculum development, employability research and higher education policy in the age of Artificial Intelligence (Lee et al., 2024; Chen et al., 2025; Khan et al., 2025; Segbenya et al., 2023; Grama & Todericiu, 2025).

Research Gaps

Despite the growing body of literature on graduate employability in the age of Artificial Intelligence, some important gaps are still evident in the methodologies employed and the findings reported across the reviewed studies. Cross-sectional survey and descriptive quantitative research designs were primarily employed by the reviewed studies, whereas longitudinal, mixed-methods, experimental, and intervention-based approaches were adopted by only a limited number of studies to assess the long-term effectiveness of higher education practices on graduate employability. Moreover, most of the evidence available is located in specific national contexts, limiting the translatability of findings across disciplines of academia and higher education systems. While substantial agreement exists on the importance of industry collaboration, curriculum redesign, experiential learning, AI literacy, digital literacy, and lifelong learning in preparing graduates for an AI-driven workforce, limited empirical evidence identifies the optimal combination of these higher education practices for maximizing graduate employability outcomes. Similarly, although adaptability and critical thinking including communication, collaboration and lifelong learning were consistently reported as the core employability competencies, there are no standardized competency frameworks or validated measurement models in the literature that integrate AI-specific competencies such as human–AI collaboration, prompt engineering, responsible AI use and AI governance with traditional employability skills across different professions. These gaps underscore the need for future research employing longitudinal and multi-institutional designs, cross-country comparisons, intervention-based evaluations, and comprehensive competency validation studies to determine the higher education practices that most effectively prepare graduates for sustainable employability in increasingly AI-driven labor markets.

CONCLUSION

This review synthesized the existing literature to identify the practices of higher education reported in preparing graduates for employability in an AI-driven workforce and the employability competencies considered to be essential for success in increasingly technology enabled workplaces. The synthesis demonstrates a broad consensus across the reviewed studies that graduate employability requires more than disciplinary knowledge and depends on the holistic integration of competency-based education, curriculum redesign, work-integrated learning, experiential learning, project-based learning, university–industry collaboration, AI literacy, and digital literacy. Concurrently, adaptability, lifelong learning, critical thinking, problem-solving, communication, teamwork, creativity, and digital competence are the competencies that are most often associated with AI workforce readiness. There is a strong consensus on the importance of these human-centered and transferable competencies, but there are inconsistencies on the distinction of discipline-specific AI competencies such as programming, machine learning, prompt engineering, and human-AI collaboration that appear to be emerging rather than universally expected across academic disciplines.

The adoption of transformative higher education practices that combine AI-oriented learning environment with authentic workplace experiences enables the development of graduates for AI-enabled workplaces. Overall, the review contributes to employability studies by synthesizing fragmented evidence into an integrated framework linking educational practices to graduate competencies. It theoretically links current employability and Industry 5.0 discourse and methodologically provides a comprehensive synthesis of evidence across different disciplinary and international contexts.

RECOMMENDATION

Future researchers should develop and empirically validate AI-ready employability frameworks that integrate AI literacy and digital competence with human-centered skills that will provide insights for the higher education practices to support graduate employability in AI-driven labor markets. Educators are encouraged to redesign curricula that integrate AI literacy and ethical AI education with experiential learning and interdisciplinary collaboration while continuously cultivating adaptability and lifelong learning along with higher-order thinking

skills. Likewise, policymakers and school leaders may strengthen university–industry partnerships by establishing AI research and innovation centers that facilitate work-integrated learning and industry-driven innovation to prepare graduates for AI-enabled workplaces.

The review is limited by its reliance on published studies, the predominance of cross-sectional studies and the heterogeneity of educational settings and competency frameworks that may limit comparability of findings. Future research should focus on multi-country comparative studies and longitudinal evaluations of graduate outcomes with experimental studies to evaluate AI-enhanced pedagogies for AI-related employability competencies. Such efforts will enhance the understanding of how HE can prepare graduates to be successful in fast-changing AI workplaces in a sustainable way while keeping the supporting role of technology by human capabilities unique to sustainable employability.

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