

A Literature Review on AI for Lifelong Learning: Tools, Benefits, and Opportunities

Jussara Reis-Andersson

Mid Sweden University, Department of Education, Sundsvall, Sweden

Jussara.reis-andersson@miun.se

Abstract: Lifelong learning plays a crucial role in both personal development and societal advancement. By continually enhancing their skills, individuals can better adapt to change and contribute to progress. In this regard, artificial intelligence (AI) supports lifelong learning by enabling personalised learning experiences, increasing accessibility, and fostering continuous education. This study examines existing research on AI's role in supporting lifelong learning, with a focus on personalised education, skill development, and the reduction of learning gaps across educational stages. A systematic literature review was carried out following the guidelines established to examine the evolving contributions of AI to the development and support of lifelong learning practices. This study follows the standards outlined in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). Articles relevant to the study's objectives were identified through a systematic search of the Scopus database, limited to English-language publications in the field of social sciences over the past ten years. The search strategy employed the following string: ("Artificial Intelligence" OR "AI") AND ("Lifelong learning" OR "continu* education") AND ("personali* learning" OR "skill* development"). This process yielded a total of 14 selected studies, from which three themes were identified through thematic analysis: 1) perspectives shaping AI in lifelong learning, 2) benefits of AI tools in education, and 3) AI's potential for optimising and transforming learning. Findings show that diverse perspectives, along with social and cultural factors, shape the design and effectiveness of AI in lifelong learning. Various AI tools, such as adaptive learning platforms, provide personalised content and immediate feedback, enabling learners to progress at their own pace and promote skill acquisition. These tools offer clear benefits: they foster personalised learning experiences that go beyond mere productivity gains to truly enhance learners' capabilities. Personalised education models also optimise resource allocation by tailoring content to individual needs, improving outcomes in higher education settings. Looking forward, AI presents significant opportunities to transform education through tailored learning and teacher support. AI must balance technology with human interaction to foster critical thinking, creativity, and problem-solving essential to lifelong learning.

Keywords: Artificial intelligence (AI), Lifelong learning, Personalised learning, Skill development

1. Introduction

The rapid advancement of digital technologies is transforming both education and the labour market, with breakthroughs in artificial intelligence (AI), accelerated digital transitions, and shifting skill demands reshaping how individuals learn, work, and adapt. These developments have intensified the need to understand how digitalisation influences lifelong learning and the continuous development of competencies. In a world marked by constant societal change, the acquisition of new knowledge has become essential. Learning is an ongoing process that takes place not only through formal schooling or university education but also through a variety of other experiences and forms of instruction. Learning, whether formal or informal, should be seen in a long perspective. Even the globalisation we are living in now requires a long-term perspective on learning. Today, a lifelong learning perspective is a necessity, not only a choice (Laal & Salamati, 2012).

Lifelong learning is essential to meeting these challenges through enhanced competitiveness, increased innovation, and reinforcing social inclusion (Rial-Gonzalez et al., 2024). The scholars explain that the fourth industrial revolution, driven in part by advances in artificial intelligence, presents profound challenges for employment. The widespread integration of AI into the modern workplace carries systemic implications, with estimates indicating that up to 30 percent of work activities could be automated by 2030, which could influence the livelihoods of up to 375 million workers across the globe (Frey & Osborne, 2017).

Artificial intelligence creates many opportunities and challenges in society (Cummins et al., 2022; Seo et al., 2025), and its integration into education has gained increasing attention in recent years, as digital technologies continue to reshape both learning processes and labour market demands. AI is no longer limited to technical applications but is now influencing how individuals acquire knowledge, develop competencies, and participate in lifelong learning. Understanding these dynamics is essential, as AI not only personalises learning pathways but also has the potential to strengthen digital competence and empower key educational actors, including learners, educators, and institutions.

In light of this, the present study systematically reviews existing research on AI in the context of lifelong learning. Specifically, it seeks to address two central questions:

- In what ways does AI contribute to personalised and lifelong learning?
- How does the literature address empowerment of learners, educators and institutions in AI-supported education?

2. Background

The connection between work and education has long been characterised by complexity and continual change. In this context, lifelong learning emerges as a critical framework for navigating the shifting demands of the labour market and ensuring the continued relevance of education throughout an individual's career in today's rapidly changing world. According to Laal and Salamati (2012), the ability to learn throughout life is essential for everyone. Frey and Osborne (2017) note that in the United States, for example, approximately 50 % of all jobs could be automated within the next 10 to 20 years.

Lifelong learning encompasses the wide range of opportunities provided by social institutions as well as the diverse processes through which individuals acquire knowledge, skills, attitudes, values, emotions, beliefs, and a sense of identity (Jarvis, 2007). It is a continuous process that extends across the entire lifespan and takes place in many different contexts, both formal and informal (Jaldemark, 2021). In this way, lifelong learning is not only a personal activity but also a collective responsibility, linking individuals to broader cultural, social, and institutional systems (Jaldemark et al., 2021). More specifically, lifelong learning includes organised and unorganised learning throughout life, such as formal education, informal learning through work and other activities, and structured higher education opportunities for working professionals throughout their careers (Kristiansen et al., 2025). Continuing professional development, as scholars emphasise, represents a commitment to ongoing lifelong learning. This ongoing development of knowledge and competencies not only supports individual growth but also contributes to societal progress. By equipping people to adapt to changing circumstances and to participate meaningfully in collective advancement, lifelong learning has become a vital element of modern life (Reis-Andersson, 2024).

Within this context, artificial intelligence (AI) plays an increasingly important role by enhancing lifelong learning processes. AI technologies contribute by delivering customised educational experiences, broadening access to learning opportunities, and fostering sustained engagement in continuous education (Escotet, 2024; Fahimirad & Kotamjani, 2018). In doing so, AI strengthens the potential of lifelong learning to empower both individuals and societies in an era of rapid change.

2.1 The Role of AI in Lifelong Learning

AI has become an increasingly important driver of change in education, with significant implications for lifelong learning. By offering new possibilities for personalisation, accessibility, and flexibility, AI enables learning processes that align with the evolving demands of individuals and societies in the digital age (Bankins et al., 2024). One of the central benefits of AI is its capacity to provide personalised learning experiences. By adapting content to learners' individual progress, preferences, and learning styles, AI enables students to advance at their own pace (Hwang, 2014; Hwang et al., 2020). These adaptive and personalised approaches represent a significant shift from traditional, standardised education and align closely with the principles of lifelong learning. Beyond personalisation, AI also improves accessibility by helping to overcome barriers related to geography, time, and resources. Through intelligent tutoring systems, adaptive platforms, and predictive analytics, educational tools can be extended to a much wider audience, ensuring that high-quality learning opportunities are available regardless of learners' circumstances (Espinoza, 2025). In this way, AI contributes to more inclusive and equitable lifelong learning settings.

Another key contribution of AI is its support for continuous learning. By enabling flexible access to resources at any time and place, AI empowers individuals to pursue skill development alongside personal and professional responsibilities (Hamal et al., 2022). This flexibility is particularly important in a rapidly changing world, where upskilling and reskilling are essential to remain competitive and adaptable in evolving labour markets. Taken together, these affordances highlight AI's potential to strengthen lifelong learning through enhanced personalisation, accessibility, and flexibility (Block, 2024; Mariyono & Nur Alif Hd, 2025). By integrating these dimensions, AI contributes not only to individual growth but also to broader societal development, reinforcing the role of lifelong learning as a cornerstone of adaptation and progress in the digital age. Against this background, the following section outlines the methodological approach used in this study.

3. Method

Following the guidelines of Page et al. (2021), a systematic literature review was conducted to explore the evolving role of AI in fostering and supporting lifelong learning practices. The review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses standards (PRISMA, February 21, 2024). Relevant articles were identified through a systematic search in the Scopus database.

3.1 Search and Selection Process

About 117 studies used the query string: (“Artificial Intelligence” OR “AI”) AND (“Lifelong learning” OR “continu* education”) AND (“personali* learning” OR “skill* development”) have been identified in Scopus database. No duplicates have been found. Of these, 46 studies were excluded at the initial stage because they were not in English (English-only studies were included), were published outside 2016-2025, or did not fall within the subject area of social sciences (e.g., studies focusing solely on technical aspects of AI without application to education were excluded). This resulted in 71 studies eligible for screening.

During the title and abstract screening, a further 21 studies were excluded for not meeting the inclusion criteria, most commonly due to a lack of focus on AI in lifelong or continuing education, absence of explicit links to personalised learning or skill development, or being primarily conceptual or theoretical discussions without addressing practical applications in lifelong learning contexts. These exclusions helped ensure that only studies directly relevant to the intersection of AI, lifelong learning, and personalisation were retained for the review. From the 50 studies that remained after initial screening, 19 were accessible in full text. During full-text review, five publications were excluded because they did not meet the inclusion criteria, specifically lacking relevance to the study’s aim and research questions. This left 14 publications for the final analysis.

To ensure a transparent and systematic selection process, predefined inclusion and exclusion criteria were applied at each stage of the review. These criteria were guided by the study’s aim and research questions, and they also reflected practical considerations such as language, publication year, and subject area. Table 1 presents the criteria, while Figure 1 (PRISMA flow diagram) visually illustrates the number of studies identified, screened, excluded, and included.

Table 1: Inclusion and exclusion criteria

Criterion	Inclusion	Exclusion
Topic relevance	Focus on AI in the context of lifelong learning, continuing education, personalised learning, or skills development	Publications that do not address AI in relation to lifelong learning, personalisation, or skills development
Type of study	Peer-reviewed journal articles and conference papers	Non-peer-reviewed sources
Research scope	Studies that contribute to the aim and research questions	Studies outside the scope of the research aim and questions
Publication year	2016-2025	Published before 2016 or after 2025
Subject area	Social sciences	Studies outside the social sciences domain
Language	Published in English	Published in other languages, not accessible for analysis
Accessibility	Full text available	Full text not accessible

By combining these predefined criteria with a staged screening and review process, the study ensured both transparency and rigor in selecting the most relevant publications for analysis.

The overall selection process is illustrated in the PRISMA flow diagram (Figure 1), which shows the number of studies identified, screened, and excluded at each stage, as well as the final number of studies included in the review.

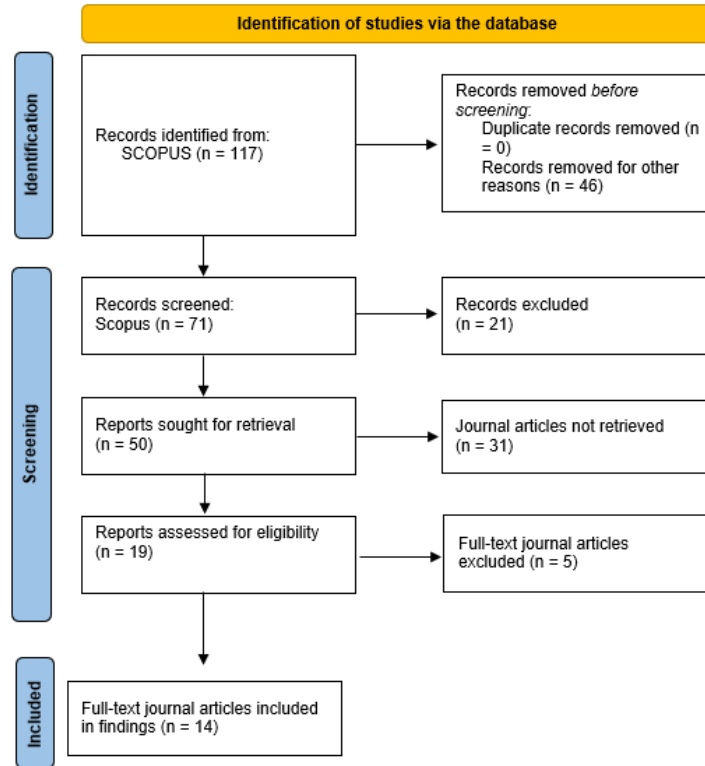


Figure 1: PRISMA flow diagram of the study selection process

3.2 Thematic Analysis

The thematic analysis followed Braun and Clarke’s (2021) six-phase framework, which consists of familiarisation with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report. The analysis was conducted solely by the author, who carefully reviewed coding decisions to ensure consistency. In the first phase, I familiarised myself with the 14 studies by repeated reading and note-taking. In the second and third phases, the studies were coded and grouped into potential themes, with the understanding that, as Braun and Clarke (2006) highlight, themes must capture something significant in relation to the research questions rather than follow fixed rules. In phases four and five, these themes were refined and combined, resulting in three overarching themes related to lifelong learning, AI, education, and personalised learning. In the final phase, the report was produced, with each theme linked to the corresponding studies (A1-A14).

4. Findings

This section presents the findings of this study. To provide an overview of the material forming the basis for the analysis, the 14 included studies are presented in Table 2. The table summarises author(s), year, title, aim, and key findings.

Table 2: Studies included in the review

	Author(s), Year	Article’s title	Aim of Study	Key Findings
A1	Adankon, G., & Hounque, P., 2024	How Can Intelligent Educational Technologies Address the Challenges of Professional Retraining in Africa: From Current State to Future Perspectives?	To explore the evolution and potential of intelligent educational technologies for professional retraining in web development.	IETs support personalisation, engagement, accessibility, and flexibility in retraining. Challenges remain in meeting learner needs and developing transversal skills.
A2	Al-Zahrani et al., 2024	Exploring the impact of artificial intelligence on higher education: The dynamics of ethical, social, and educational implications	To investigate the impact of AI on higher education, focusing on attitudes, ethics, and future expectations.	Positive attitudes toward AI; enhances teaching/ learning and administration; ethical concerns (privacy, bias, security) must be addressed.

	Author(s), Year	Article's title	Aim of Study	Key Findings
A3	Anghel, G. A. et al., 2025	The Integration of Artificial Intelligence in Academic Learning Practices: A Comprehensive Approach	To examine how students perceive and use AI tools in academic learning and identify factors influencing AI's integration into education.	AI use was linked to better academic performance, motivation, and personalised learning, supporting the development of lifelong learning skills.
A4	Boesl, D. B. et al., 2023	Foundations of an AI-based, cross-platform companion app for lifelong learning optimisation	To present the Apollo project framework for AI-based lifelong learning optimisation	AI-based app aims to support lifelong learning and continuing education by offering personalised, cross-platform learning pathways.
A5	El Bachari, E. et al., 2022	Personalised Learning Paths for Smart Education: Case Studies from Cadi Ayyad University	To explore AI and learning style models for improving digital and distance learning through personalised frameworks.	AI can effectively adapt learning paths, personalise online learning, and improve performance and outcomes.
A6	Ghnemat, R. et al., 2022	Higher Education Transformation for Artificial Intelligence Revolution: Transformation Framework.	To present an AI-based learning framework for transforming higher education and aligning outcomes with industry needs.	AI competency-based learning enhances engagement, accelerates outcomes, bridges the academia-industry gap, and fosters lifelong learning.
A7	Gulyamov, S. S. et al., 2024	Creating Self-Updating Digital Platforms Using Artificial Intelligence Technologies for Continuous Education and Professional Development	To propose AI-driven self-updating education platforms for adaptive and lifelong learning.	AI-enabled platforms can refresh content automatically, provide personalised learning, and support workforce resilience.
A8	Kallonas, C. et al., 2024	Empowering professionals: a generative AI approach to personalized cybersecurity learning.	To explore how generative AI can support personalised study plans in cybersecurity education to close the skills gap.	Generic training hinders effective upskilling; generative AI can enable tailored learning, motivation, and lifelong learning in cybersecurity.
A9	Puttajanyawong, N. et al., 2025	Utilizing Generative AI to Develop Programming Skill Through Self-Directed and Interactive Learning	Explore how generative AI can support programming skill development through self-directed and interactive lifelong learning.	Students without prior programming or AI experience gained motivation, skills, and positive attitudes toward self-directed learning; process supports lifelong learning across ages and genders.
A10	Ray, P. P. (2024)	A deep introspection into the role of ChatGPT for transforming hospitality, leisure, sport, and tourism education	Explore the role of ChatGPT and AI in transforming HLST education, including opportunities and challenges	AI personalises learning and streamlines tasks but raises privacy, quality, and equity concerns. Future directions include adaptive learning, intelligent assessment, collaboration, and lifelong learning.
A11	Sun, W. et al., 2024	Exploring educational transformation and innovation pathways in the era of artificial intelligence.	To examine AI's impact on education through reform, innovation, and equity theories.	AI promotes personalisation, equity, and lifelong learning, but raises privacy and ethical concerns.
A12	Xiao, Y., & Zhi, Y., 2023	An exploratory study of EFL learners' use of ChatGPT for language learning tasks: Experience and perceptions	To explore students' experiences and perceptions of ChatGPT in language learning.	ChatGPT supports language tasks and personalised learning; students used critical judgment to evaluate and adapt outputs, balancing integrity concerns.
A13	Yang, C. et al., 2025	Intersections between cognitive-emotion regulation, critical thinking and academic resilience with academic motivation and autonomy in EFL learners: Contributions of	To examine how cognitive-emotion regulation, critical thinking, and resilience influence motivation and autonomy in AI-mediated learning.	Emotion regulation, critical thinking, and resilience significantly enhance motivation and autonomy in AI learning, supporting lifelong learning skills.

	Author(s), Year	Article's title	Aim of Study	Key Findings
		AI-mediated learning environments.		
A14	Nedungadi, P. et al., 2024	The transformative power of generative artificial intelligence for achieving the sustainable development goal of quality education	To examine how generative artificial intelligence contributes to sustainable development goals on quality education, proposing policy/ practice directions.	Generative artificial intelligence can enhance equity, quality personalisation, and lifelong learning but raises ethical/ privacy concerns and risks widening the digital divide.

The thematic analysis of these 14 studies resulted in three overarching themes that capture how AI relates to lifelong learning, benefits of AI tools in education, and AI's potential for optimising and transforming learning. Many studies contributed to more than one theme. The included research employed diverse methods, such as surveys (A2, A3, A13), interviews (A12), case studies (A5, A9), and conceptual or framework proposals (A1, A4, A6, A7, A8, A10, A11, A14), thereby reflecting both empirical and conceptual perspectives. Table 3 presents an overview of these themes and their distribution across the reviewed studies.

Table 3: Themes identified in the thematic analysis

Theme	Description	Study
Perspectives shaping AI in lifelong learning	AI adoption and application are shaped by social, cultural, and contextual factors that influence design and use across diverse learning environments.	A1, A2, A3, A4, A7, A14
Benefits of AI tools in education	Adaptive platforms and other AI technologies enhance learning by personalising content, providing instant feedback, and supporting skill development.	A2, A3, A4, A8, A9, A11, A12, A13
AI's potential for optimising and transforming learning	AI enhances efficiency and outcomes through personalised learning resources, while its future promise lies in combining technology with human interaction to cultivate creativity, critical thinking, and problem-solving skills.	A2, A3, A4, A5, A6, A7, A10, A11, A12, A13, A14

The following sections elaborate on each theme in detail, highlighting key insights and patterns identified in the reviewed literature.

4.1 Perspectives Shaping AI in Lifelong Learning

The findings reveal that the design and effectiveness of AI in lifelong learning are influenced by diverse perspectives, as well as social and cultural factors. A1 illustrates how contextual challenges in Africa, such as limited financial support, reliance on mobile solutions, and work-family balance, affect AI adoption (A1). Similarly, A4 points to adaptability, as well as legal and economic barriers, as key influences on integrating AI into lifelong learning. A2 shows how attitudes and perceptions of students, faculty, and administrators shape AI adoption in higher education. While many expressed optimism, they also emphasised ethical concerns such as privacy, transparency, and bias, highlighting how social and ethical contexts influence the implementation (A2). A3 shows that factors such as age and digital competence shape how students use AI in education. Older learners face challenges in adapting to AI tools, while younger students integrate them more easily. These contextual differences highlight the importance of training and support to ensure equitable use of AI in lifelong learning contexts (A3). A7 underscores that successful adoption depends on ethical principles, collective responsibility, and national-level collaboration, ensuring AI platforms empower learners rather than constrain them (A7). Finally, A14 situates AI adoption within broader social and cultural perspectives, linking it to sustainability, equity, and inclusivity goals, while warning against the risk of deepening existing divides (A14).

4.2 Benefits of AI Tools in Education

A range of AI tools, such as adaptive learning platforms, were found to provide personalised content and immediate feedback, enabling learners to progress at their own pace while promoting skill acquisition. A1 highlights that adaptive platforms support flexible, personalised learning with feedback and practical projects. This helps adults in career transitions stay engaged while managing other responsibilities (A1). A2 shows strong benefits of AI tools, including personalised pathways, adaptive tutoring, real-time feedback, broader resource access, and streamlined administration, reinforcing AI's role in enhancing both teaching and learning outcomes (A2). A3 highlights several concrete benefits of AI, particularly tools like ChatGPT and recommendation systems. Students reported that AI supports personalised learning, improves access to resources, fosters motivation, enhances academic performance, and strengthens self-regulation (A3). Similarly, A4 notes that AI-enabled

platforms can provide flexible opportunities, interactive resources, and community engagement, supporting individuals from diverse backgrounds in maintaining professional development and continuous skill growth (A4). A8 demonstrates that generative AI, such as ChatGPT, can help learners build personalised study plans, organise resources, and develop specialised skills more effectively, especially in complex fields like cybersecurity (A8). A9 demonstrates how generative AI can enhance self-directed and interactive learning in vocational training through the MAR model (Motivation, Activity, Reflection, and Progression). Students developed programming, critical thinking, and teamwork skills, showing AI's value in guiding personalised learning. However, instructor support and ethical awareness remain essential to avoid over-reliance (A9). A11 highlights how tools like intelligent teaching robots, image and speech recognition, and deep learning enhance assessments, personalise learning, and improve classroom efficiency (A11). A12 shows that ChatGPT can act as a personal tutor by giving adaptive feedback, supporting language learning, and helping students improve essays and generate ideas. Students reported better autonomy and competence when using it as a learning partner (A12). Finally, A13 indicates that AI platforms offering personalised feedback and adaptive pathways can significantly boost motivation and autonomy in language learning (A13).

4.3 AI's Potential for Optimising and Transforming Learning

Personalised education models supported by AI also contribute to more efficient resource allocation. A1 points to future possibilities such as deep learning for finer personalisation and highlights AI's role in fostering creativity, critical thinking, and identity development in retraining (A1). A2 stresses AI's transformative potential in higher education. Participants envisioned AI reshaping teaching and learning, supporting collaboration, developing lifelong learning skills, and driving innovation, provided that ethical guidelines and implementation frameworks are in place (A2). A3 shows that AI can contribute to long-term transformation by fostering autonomy, critical thinking, and reflective practices. However, it also raises a debate about creativity: while AI can generate new ideas, it may risk limiting originality. These insights stress that AI's potential must be combined with careful pedagogical strategies to ensure balanced outcomes (A3). A4 presents AI as a lifelong learning companion, envisioning its role in transforming education beyond classrooms by integrating coaching, counselling, and industry certification opportunities. This positions AI as central to reshaping lifelong and continuing education for the digital era (A4). A5 shows how predictive models and personalised strategies enhance efficiency and accuracy in learning. It reinforces AI's potential to reduce barriers, adapt teaching to learner needs, and optimise outcomes without replacing traditional practices (A5). A6 envisions higher education transformed by AI, shifting from traditional coursework to problem-based learning tied to real-world and industrial challenges. Its proposed framework connects infrastructure, experts, and industry partners, underscoring AI's role in reshaping teaching, assessment, and institutional relevance (A6). A7 shows how AI-powered platforms that update themselves can give continuous, real-time personalised learning. These systems could turn lifelong learning into an ongoing journey for personal and professional growth, making AI an important part of future education (A7). A10 highlights ChatGPT's transformative role in education, offering personalised learning and research support, while stressing the need to address ethics, equity, and human-AI balance (A10). A11 positions AI as a key driver of educational reform, reshaping classrooms, teaching methods, and learning goals, while fostering innovation and future-ready competencies (A11). A12 highlights that ChatGPT promotes critical thinking, as students evaluated its outputs rather than relying blindly. This suggests AI tools can transform learning by fostering reflection, autonomy, and more responsible use of technology (A12). A13 demonstrates AI's transformative role in fostering critical thinking, emotional regulation, and resilience, thereby strengthening autonomy and engagement in lifelong learning (A13). Finally, A14 shows generative AI's transformative potential for optimising learning, from literacy and skill development to resilient, inclusive education systems, while warning that impact depends on responsible use, privacy safeguards, and strong human-AI collaboration (A14).

In summary, the reviewed studies show that AI in lifelong learning is shaped by social, cultural, and ethical contexts (Theme 1), offers clear benefits such as personalised feedback and flexible learning (Theme 2), and holds strong potential to transform education by fostering autonomy, critical thinking, and innovation (Theme 3). At the same time, its successful integration depends on responsible implementation, sensitivity to learner and contextual differences, and active collaboration between educators, institutions, and policymakers.

5. Discussion

Lifelong learning has long been seen as essential for adapting to changing labour markets and societal needs (Frey & Osborne, 2017; Laal & Salamati, 2012). In this review, three themes emerged that reveal how AI shapes lifelong learning through adoption perspectives, the benefits it brings, and its transformative potential. These

themes build directly on the view of lifelong learning as both an individual and collective responsibility (Jaldemark et al., 2021; Jarvis, 2007), where technology can either widen or reduce learning opportunities depending on its design and use.

First, the findings on perspectives shaping AI in lifelong learning showed how contextual elements, financial support, digital competence, cultural attitudes, and ethical concerns strongly influence AI adoption. For instance, A1 illustrated how financial and infrastructural challenges affect AI uptake in African contexts, while A3 pointed to differences in adoption depending on learners' age and digital competence. A2 highlighted how perceptions of students, faculty, and administrators shape the uptake of AI in higher education, where optimism is balanced with concerns about ethics, transparency, and bias. Similarly, A7 emphasised the importance of ethical principles and collective responsibility, and A14 underscored the broader societal context, linking AI adoption to inclusivity and sustainability. This connects back to Jaldemark (2021), who stresses that lifelong learning is embedded in broader social and institutional systems. Without supportive policies and inclusive design, AI risks reinforcing rather than reducing inequality.

Second, the findings on the benefits of AI tools in education revealed strong evidence that adaptive platforms, tutoring systems, and generative AI can personalise learning, boost motivation, and support self-regulation. A1 and A2 highlighted how adaptive systems provide flexible learning pathways, while A3, A8, and A9 demonstrated how tools like ChatGPT and similar systems can support motivation, collaboration, and skill development. A12 and A13 showed ChatGPT's role as a tutor and feedback provider, fostering competence and autonomy, and A11 pointed to the value of robots and recognition technologies improving assessment and efficiency. These findings align with Hwang (2014) and Hwang et al. (2020) on personalisation and Kristiansen et al. (2025) on professional development. At the same time, several studies stressed risks, including bias, privacy, inequality, and overreliance on AI (A2, A3, A10, A11, A12, A14). These cautionary findings underline the need for teacher guidance and ethical safeguards, echoing Escotet (2024) and Fahimirad and Kotamjani (2018), who view AI as a support, not a substitute, for human educators.

Finally, the theme on AI's potential for optimising and transforming learning highlighted its capacity to foster creativity, reflection, and autonomy, and to reshape education as a lifelong journey rather than a one-time stage. A1 suggested the role of deep learning for finer personalisation and creativity, A4 envisioned AI as a lifelong learning companion integrating coaching and industry certification, and A6 proposed frameworks linking higher education to real-world and industrial challenges. A7 described AI-powered platforms that update in real time, supporting continuous lifelong learning, while A10, A11, A12, and A13 all pointed to AI's transformative potential in reshaping classrooms, promoting critical reflection, and strengthening resilience and autonomy. A14 further extended this view by linking AI directly to the global agenda for sustainability and inclusivity, but also warning against risks such as inequity, bias, and over-reliance. This extends Jarvis's (2007) view of lifelong learning as identity development and resonates with Reis-Andersson (2024), who stresses lifelong learning as key to societal progress. Yet, as the findings and the background both point out, realising this transformative potential requires responsible governance, attention to ethics, and safeguards to ensure that AI fosters equity rather than exclusion.

In relation to the first research question, this review shows that AI contributes to lifelong learning by enabling personalised and adaptive pathways, providing flexible access to resources across contexts, and supporting continuous competence development. Regarding the second research question, the findings indicate that AI can empower learners by fostering autonomy, critical thinking, and resilience; empower educators by reducing routine tasks and enhancing pedagogical practices; and empower institutions by supporting innovation and wider access, while also raising important ethical and equity considerations.

In summary, this discussion shows that AI is reshaping lifelong learning in three interconnected ways: by being shaped through social and cultural contexts, by offering concrete benefits for learners and educators, and by holding potential for long-term transformation. These themes underline AI's dual role as both a practical tool for personalisation and access, and as a broader driver of change in how education is understood and practiced in a lifelong perspective.

5.1 Implications

One implication of this review is that much of the existing scholarship on AI in lifelong and personalised learning consists of secondary literature, such as reviews, bibliometric analyses, opinion pieces, and trend reflections, rather than empirical studies involving participants, interventions, or observed practices. While these secondary contributions help to map the field and signal areas of interest, they do not provide robust evidence about how

AI is actually integrated into lifelong learning in practice or how learners, educators, and institutions experience empowerment through AI. This imbalance suggests a pressing need for empirical, data-driven research, for example, case studies, experimental designs, or longitudinal investigations, that can validate claims made in conceptual and review papers. Without such work, the field risks being shaped primarily by theoretical or market-oriented narratives rather than by grounded evidence of impact.

6. Conclusion

Lifelong learning is increasingly recognised as essential in a rapidly changing society, where individuals are required to continuously update their knowledge and skills. AI plays a significant role in this context by enabling new forms of educational support. A core objective of AI in education is to provide personalised learning pathways through adaptive guidance and feedback that take into account learners' progress, preferences, and individual characteristics. In doing so, AI contributes to the broader goals of lifelong learning by facilitating continuous competence development and enhancing learners' ability to participate actively in society.

6.1 Future Research

Building on the limitations identified, future research should move beyond conceptual discussions and focus on empirical investigations of how AI is actually used in lifelong and personalised learning. Such research would generate the kind of grounded evidence currently missing in the field and provide a stronger foundation for policy and practice.

Ethical declaration: An ethical declaration was not required.

Generative AI statement: Artificial intelligence tools, specifically ChatGPT, were used during the writing process of this paper to support language editing and improve clarity. All content and ideas remain the sole responsibility of the author(s).

References

- Bankins, S., Jooss, S., Restubog, S. L. D., Marrone, M., Ocampo, A. C., & Shoss, M. (2024). Navigating career stages in the age of artificial intelligence: A systematic interdisciplinary review and agenda for future research. *Journal of Vocational Behavior, 153*, 104011.
- Block, M. (2024). Balancing AI in SMEs: Overcoming Psychological Barriers and Preserving Critical Thinking. Proceedings of the International Conference on AI Research,
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.
- Braun, V., & Clarke, V. (2021). *Thematic analysis: a practical guide*. SAGE Publications.
- Cummins, P. A., Harrington, A. K., & Yamashita, T. (2022). Individual learning accounts: A comparison of implemented and proposed initiatives. *Adult Learning, 33*(4), 147–157.
- Escotet, M. Á. (2024). The optimistic future of Artificial Intelligence in higher education. *Prospects, 54*(3), 531–540.
- Espinoza, M. (2025). AI in Adult Education: Transforming Lifelong Learning and Workforce Development. In *AI, Personalization, Equity, and the Future of Learning* (pp. 265–296). IGI Global Scientific Publishing.
- Fahimirad, M., & Kotamjani, S. S. (2018). A review on application of artificial intelligence in teaching and learning in educational contexts. *International Journal of Learning and Development, 8*(4), 106–118.
- Frey, C. B., & Osborne, M. A. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological forecasting and social change, 114*, 254–280.
- Hamal, O., El Faddouli, N. E., Alaoui Harouni, M. H., & Lu, J. (2022). Artificial Intelligent in Education [Article]. *Sustainability (Switzerland), 14*(5), Article 2862. <https://doi.org/10.3390/su14052862>
- Hwang, G.-J. (2014). Definition, framework and research issues of smart learning environments-a context-aware ubiquitous learning perspective. *Smart Learning Environments, 1*(1), 4.
- Hwang, G.-J., Xie, H., Wah, B. W., & Gašević, D. (2020). Vision, challenges, roles and research issues of Artificial Intelligence in Education. In (Vol. 1, pp. 100001): Elsevier.
- Jaldemark, J. (2021). Formal and informal paths of lifelong learning: Hybrid distance educational settings for the digital era. In *An introduction to distance education* (pp. 25–42). Routledge.
- Jaldemark, J., Håkansson Lindqvist, M., Mozelius, P., & Ryberg, T. (2021). Editorial introduction: Lifelong learning in the digital era - Jaldemark - 2021 - British Journal of Educational Technology - Wiley Online Library. *British Journal of Educational Technology*. <https://doi.org/10.1111/bjet.13128>
- Jarvis, P. (2007). *Globalization, lifelong learning and the learning society: Sociological perspectives*. Routledge.
- Kristiansen, L., Villand, M., & Boe, O. (2025). Lifelong Learning for Work Life: A Perspective from Norway. *Athens Journal of Education, 401*.
- Laal, M., & Salamati, P. (2012). Lifelong learning; why do we need it? *Procedia-Social and Behavioral Sciences, 31*, 399–403.
- Mariyono, D., & Nur Alif Hd, A. (2025). AI's role in transforming learning environments: a review of collaborative approaches and innovations. *Quality Education for All, 2*(1), 265–288.

- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., & Moher, D. (2021). Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. *Journal of clinical epidemiology*, *134*, 103–112.
- PRISMA. (February 21, 2024). *PRISMA Flow Diagram*. <https://www.prisma-statement.org/prisma-2020-flow-diagram>
- Reis-Andersson, J. (2024). Leading the digitalization in K–12 education at the municipality level. *Cogent Education*, *11*(1), 2368997.
- Rial-Gonzalez, P., Sarceda-Gorgoso, M. C., & Santamaría Queiruga, O. (2024). Lifelong learning as a response to the challenges of Industry 5.0 within the context of Horizon 2030. *Educar*, *60*(2), 305–319.
- Seo, K., Yoo, M., Dodson, S., & Jin, S.-H. (2025). Augmented teachers: K–12 teachers' needs for artificial intelligence's complementary role in personalized learning. *Journal of Research on Technology in Education*, *57*(4), 876–893.