

# Education 5.0: Transforming Learning Through Artificial Intelligence, Digital Innovation, and Human-Centered Pedagogy

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## Abstract

Education 5.0 is an educational model that merges artificial intelligence (AI), digital innovation, and human-centered pedagogy, offering inclusive, customized, and future-focused learning environments. The study adopted a systematic literature review approach to examine the contribution of intelligent technologies in transforming teaching, learning, and assessment. The selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Peer-reviewed journal articles published from 2020 to 2026 were retrieved from Scopus, Web of Science, ScienceDirect, SpringerLink, IEEE Xplore, ERIC, and Google Scholar. After screening, eligibility assessment, and removal of duplicate studies, 82 studies were included for qualitative synthesis. The results revealed that 29.3% of the reviewed studies focused on artificial intelligence applications, 23.2% on digital innovation, 15.9% on personalized learning, 13.4% on human-centered pedagogy, 9.8% on learning analytics, and 8.5% on ethical AI governance. Analysis also showed that 2024 accounted for 24.4% of the selected publications, indicating rising global research interest in Education 5.0. The review highlighted key advantages of AI in education, including better learner engagement, personalization, flexible learning spaces, and teaching effectiveness. Sustainable implementation requires responsible AI governance, continuous teacher professional development, equitable access to digital infrastructure, and learner-oriented pedagogical practices.

**Keywords:** Artificial Intelligence, Digital Innovation, Education 5.0, Human-Centered Pedagogy, Learning Analytics, Personalized Learning.

## 1. Introduction

The fast advancement of Artificial Intelligence (AI), big data, cloud computing, Internet of Things (IoT), and immersive technology has ushered in the era of Education 5.0 in the education system. In contrast to traditional learning approaches, which mainly concentrated on learning as acquiring knowledge and skills related to the "digital world", Education 5.0 is a learning ecosystem that focuses on innovation, creativity, collaboration, and ethics in the educational process in a technology-intensive environment. This paradigm not only focuses on the embedding of intelligent

technologies in education but also does not ignore the role of human values, emotional intelligence and social responsibility that are essential parts of implementing Society 5.0. In the last few years, AI has become increasingly prevalent in the field of education, including AI tutoring systems, adaptable learning platforms, and learning analytics. AI-based tutoring systems, adaptive learning platforms, and learning analytics are becoming more popular in educational settings, with the goal of tailoring learning to individual students and boosting educational engagement and drive while not replacing educators, as highlighted by Shahidi Hamedani et al. (2024) and Pratschke (2024). AI has indisputably become a force that is changing the landscape of education, personalizing learning experiences, automating testing processes, smartly designing and creating content, and foretelling student performance. AI-based learning can identify that parts of learning are problematic and customize learning strategies for each person in the group, thereby optimizing learning and having a motivating effect on the students. Meanwhile, new technologies, such as virtual reality, augmented reality, blockchain and digital collaboration platforms, create new learning spaces for practical learning and thinking, critical thinking, empathy, and creativity. These developments shift the responsibility of educators from the first party to facilitators, mentors and master designers of meaningful learning experiences that are motivating lifelong learning and innovation (Jaramillo & Chiappe, 2024; Ahmad et al., 2023).

To effectively implement Education 5.0, major challenges must be resolved, such as the ethical use of AI, digital equity, institutional preparedness, cybersecurity, data privacy, and teacher professional development. There's a need to recognize and understand that AI is a tool designed to assist teachers, not supplant them, since the human touch, empathy, mentorship, and moral support are still integral parts of the education process, researchers have said. Currently, calls for responsible governance of AI are gaining momentum alongside the emphasis on participatory pedagogies, which recognize the potential of technology while also emphasizing learning's human face and its ethical and inclusive nature. As a result, policymakers and educators are increasingly pressing for responsible AI governance, and educational systems are incorporating pedagogies that seek to balance the potential of AI technologies with the human-centric nature, educational ethics, and inclusivity of learning. Balancing the use of technology with other factors allows it to contribute to fostering sustainable education and the development of skills needed in a digital society (Sharma, 2026).

## 1.1 Background of the Study

The rapid advancement of digital technology and the increasing role of AI in education and learning are driving a significant transformation in the education systems around the world. The traditional western educational system pedagogy that is based on standardized instruction is no longer able to cater to the needs of knowledge-based economies and the dynamic nature of today's work environment. To address these challenges, Education 5.0 was born which prioritizes learning-oriented education that incorporates the use of intelligent technologies, along with creativity, innovation, sustainability, entrepreneurship and social responsibility. This educational model helps develop higher level of cognitive skills and encourages flexibility, emotional intelligence, and multi-disciplinary collaboration in the digital age (Shahidi Hamedani et al., 2024, AI in Education, Sustainability, and the Future of Work, 2025).

In recent years, the suggested technologies (generative AI, intelligent tutoring, adaptive learning spaces, learning analytics and more) have opened up new possibilities for school and university learning tailored to the individual. These technologies allow for constant monitoring, tailored teaching and learning experiences, immediate feedback and data-driven decision making, which enhances the efficiency and quality in learning. In the meantime, digital innovations may enable joint learning, flexible planning of the curriculum, and access for different groups of learners. Despite these promising developments, experts have raised several questions about algorithmic

bias, lack of transparency, privacy issues, digital exclusion and the ethical oversight of AI use, pointing to the need for thorough policies to guarantee equitable, and responsible, use of AI (Pratschke, 2024; Jaramillo & Chiappe, 2024; Responsible Human-Centered AI Review, 2024). While many studies focus on artificial intelligence in education, digital pedagogy, or education with technologies in isolation, research quantifying and integrating these developments into the broader framework of the 5.0 Generation of Education, a combination of technological revolution and pedagogical approach which places humans at the centre is relatively scarce. The literature already stresses the need to further integrate innovations at the educational level, the ethical regulation of the use of AI, the increase in human capacity, and sustainable policies, to leverage the potential of intelligent educational systems. The aim of this study is to examine in a comprehensive manner the education 5.0 and how artificial intelligence, electronic innovation, and the didactics of the person are working to transform learning contexts and help define inclusive and future-ready education systems and plastics. This study describes the concept of education 5.0 in an integrated manner, highlighting how the three pillars of artificial intelligence, electronic innovation and person-centred pedagogy work together to transform learning environments and contribute to the creation of inclusive and future-oriented plastics and education systems.

## **1.2 Research Objectives**

1. To explore how AI can be used to change the landscape of teaching, learning and assessment in the era of Education 5.0.
2. To assess the impact of digital innovation (such as adaptive learning technologies, learning analytics and immersive digital platforms) on personalized and effective learning.
3. To understand and learn about the importance of human-centered pedagogy in the development of creativity, critical thinking, collaboration, ethics awareness and lifelong learning in Education 5.0.

## **1.3 Research Questions**

- Q1. What is AI doing to education in the times of Education 5.0?
- Q2. How can digital innovation improve personalized learning, engagement, and learning outcomes for students?
- Q3. What role can human-centered pedagogy play in the successful implementation of Education 5.0 and future-ready learning?

## **1.4 Significance of the Study**

The study will help shed light on the multifaceted nature of EAI transforming modern education by offering a holistic overview of the impact of artificial intelligence (AI), digital innovations, and human-centered pedagogy. Findings can be useful for technology developers, teachers, curriculum developers, educational administrators, and policymakers developing education systems that tap into new technologies within a learner-centered and ethically sound framework. The study also points to opportunities and challenges in adopting AI, such as Digital Equity, teacher preparation, data privacy, and ethical governance, bolstering a data-informed and sustainable approach to transform education. The review enumerates research directions which are emerging in need to be explored with future empirical studies and that could inform policy development to prepare learners with the required knowledge, skills, creativity, and adaptability within the context of a very dynamic digital society.

## **2. Literature review**

### **2.1 Artificial Intelligence in Education 5.0**

In the field of education, AI has the potential to transform the classroom into an intelligent learning environment by developing intelligent tutoring systems, automating the learning process, and providing adaptive content and predictive learning analytics. With the help of AI tools, students' performance, speed and patterns of how they utilize learning activities are assessed to provide tailor-made area for learning and enhance learning impact. Researchers believe that AI facilitates personal learning pathways, allowing student feedback to be immediate, and that AI helps teachers to identify learning gaps and respond to them at an opportune time. Students who have these skills may have improved engagement, performance and efficacy across a range of educational settings (Kasneci et al., 2023; Zawacki-Richter et al., 2019).

The recent developments of generative AI in the field of education have brought in another level of opportunities with the use of artificial intelligence to create and produce. All these are emerging possibilities in the field of education, due to the innovations brought by generative AI tools such as synthetic content creation, virtual tutor, automatic grading, and interactive learning. Large Language Models (LLMs) and generative AI technologies can help educators with lessons planning, creating assessments, aids for academic writing, and individualized tutoring. These technologies have the potential to provide alternative methods for learning, greater efficiency, but scholars say that they should not replace, but complement teachers. Human oversight is critical to facilitate students' critical thinking, creativity, ethical dealing, and responsible use of AI in learning (Lo, 2023; Tlili et al., 2023).

There are institutional and ethical hurdles in the way of implementing AI. There's also a hitch: the emergence of AI in schools brings with it concerns about algorithmic bias, plagiarism and cheating, student privacy, cyber security, transparency and access. Research suggests that robust AI governance structures, institutional policies, and AI competencies for teachers be established for the proper implementation of AI. Continuous professional development and ethically inculcated AI literacy are seen as part of a lifelong learning education paradigm for full realization of the potential of educational technologies in the framework of Education 5.0 (Crompton & Burke, 2023; Bozkurt et al., 2024).

### **2.2. Digital Innovation and Personalised Learning**

Digital innovation transformed the experience of learning, adding the key elements such as cloud and virtual computing, learning management systems, virtual laboratories, augmented reality, virtual reality, blockchain and learning analytics to the teaching and learning process. The technologies not only provide interactive learning experiences but also support flexible and learners' centered learning, which are beyond classroom walls. Collaborative Learning, Self-directed education and Ubiquitous access through digital platforms improves student learning and engagement in various educational contexts (Bond et al., 2024; Limna et al., 2022).

Today learning analytics is among the most influential innovations that play a vital role for personalized education in the digital era. Data-driven decision making has become more important in the field of education because of the way it is implemented which involves monitoring the learning process of children, finding learning problems and designing learning interventions based on different types of children. An adaptive system dynamically adapts to the learner's interactions with it and to the learner's learning style and abilities, generating modification of the learning material in the process. The tailored learning approaches improve learning outcomes, components of pupils' satisfaction, educational provision and inclusive learning environments (Ifenthaler &

Schumacher, 2023; Viberg et al., 2023).

Schools also need to be more prepared and become more cyber-secure and technologically advanced in order to meet the new digital world's technological developments. Access to technological resources continues to be restrictive and although digital literacy has improved, it remains low and access to infrastructure is a significant challenge, particularly in developing countries. To ensure that the digital transformation is used for the development of sustainable education, the recommendation is to invest in digital capacity development, technological infrastructure, development of faculty (ITL) and equity or access programs, so as to prevent further inequities in education (Dwivedi et al., 2023; Selwyn, 2024).

## **2.3 Develop skills in Human-Centered Pedagogy in Education 5.0**

This paper is worded to call focus on human-centred pedagogy, that means the use of human beings in learning spaces or settings should not be replaced by technology but supplemented. This pedagogical approach creates an action learning space, cooperative relationships between individuals, imagination, attitudes towards others, feelings, emotional intelligence, ethical awareness as well as a new role for teachers as facilitators and mentors in the process of meaningful learning. The problem of Education 5.0 is not only the problem of intelligent technologies, but also it is a problem of how to combine them with human values in order to create socially responsible and lifelong learners, who can solve complex problems of the world today, reassuring themselves that they will be able to solve them in the future as well (Luckin & Cukurova, 2019; Holmes et al., 2022).

Student-centered learning approaches lead students to initiate knowledge creation themselves, face knowledge issues through cooperative and collaborative relationship, do the work by project and learn in multi-disciplines. Pedagogy is also human-centered with a view to developing twenty-first century competencies such as communication, critical thinking, innovation, leadership and adaptability. Recent research shows that a mix of AI-supported learning environments with learner-centered learning approaches can make a remarkable impact on the levels of motivation, educational resilience and satisfaction of learners (Khalil & Er, 2023; UNESCO, 2023).

In today's highly changing landscape of technology and Artificial Intellectual Aid (AI), the term 'makerspaces' has surfaced in many, primarily primary and secondary schools. With these developments of technology and the use of artificial intel assistance (AI) the concept of 'makerspaces' has emerged, mostly in primary and secondary schools. Educational institutions are increasingly at a pivotal moment in the realisation of the need to create ethical guidelines and values to ensure the privacy of learners, promote trust and transparency, uphold fairness, and encourage ethical application of AI. Therefore, the necessity of teachers to be human teachers and be able to use the most modern education technology is a critical factor to invest in teacher professional development that would enhance their knowledge about AI and their pedagogical skills and competencies. Education 5.0 vision is about using a balanced ecological approach to maximize technology and pedagogical innovations in a goal-driven way to prepare graduates for a well-rounded future for the knowledge economy in the digital society (Miao et al., 2021; Williamson & Eynon, 2023).

## **3. Research Methodology**

### **3.1 Research Design**

The research design used for this study was a systematic literature review (SLR) and used a phenomenological approach for collecting literature. The systematic review approach enabled a comprehensible, complete, and consistent process to identify, appraise, and integrate available

academic literature. The review was conducted following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) guidelines to have methodological rigor and minimal selection bias. The study examined peer-reviewed journal articles that examined the use of AI and new digital technologies in the EDU environment.

### **3.2 Data Sources**

Literature search was performed by using the national and international academic search engines namely Scopus, Web of Science, ScienceDirect, SpringerLink, IEEE Xplore, Taylor & Francis Online, Wiley Online Library, ERIC and Google Scholar. The databases selected for this list are because they have been selected to include quality peer-reviewed research within the themes of education, artificial intelligence, educational technology and digital innovation. The focus of the search process was on journal articles published from 2020 to 2026, to encompass the latest advancements in the fields of Education 5.0 and AI in educational domains. The reference lists of selected studies were also used to identify relevant publications that fulfilled the eligibility criteria.

### **3.3 Search Strategy**

A systematic search strategy was created with specific keywords and using Boolean operators. The keywords used by the major search terms were: "Education 5.0," "Artificial Intelligence in Education," "Digital Innovation," "Human-Centered Pedagogy," "Adaptive Learning," "Learning Analytics," "Generative AI," "Educational Technology," "Smart Learning," and "AI-powered Education. Boolean operators such as AND, OR and NOT are used to further refine search results to increase the precision of the retrieval. Following the search, it was found that there were 156 possible relevant studies in the picked databases. Following the search there were 156 potentially relevant studies from the selected databases.

### **3.4 Inclusion and Exclusion Criteria**

Adopted a pre-established inclusion criteria/exclusion criteria in screening. Specific criteria such as: (1) peer-reviewed publications, published in English, between 2020 and 2026; (2) related to the themes of: Education 5.0, Artificial Intelligence, Digital Innovation, Learning Technologies and Human-Centred Pedagogy; and (3) empirical articles or Review articles with sufficient information about the methodology applied were used for the Quaternary search. No conference abstracts, editorials, book reviews, theses or dissertations, duplicate records or non-English publications were reviewed. Further studies, which were not linked to the educational aspect of development of algorithms were excluded, in order to keep the study situation related to the main purpose of the study.

### **3.5 Screening and Study Selection**

A search for studies was conducted with the PRISMA process. 156 records were identified through database searches. Three hundred and forty duplicate articles were removed and 122 articles were screened for title and abstract. In the screening process 28 studies were excluded because they did not specifically address the aim of Education 5.0 or the use of AI in education. the remaining OF 94 full-text articles, a detailed eligibility assessment was done. Following the evaluation of methodological quality and relevance, 82 peer-reviewed journal articles fulfilled all the inclusion criteria and were included in the qualitative synthesis.

### **3.6 Data Extraction**

Using a standardized data extraction form, relevant information from the selected studies was extracted. The resulting data were used to identify the authors, years of publication, countries of studies, research goals, study design, sample characteristics, educational context, the type of AI technologies, digital innovations, pedagogical approaches, major conclusions, implementation hurdles, and recommendations for future research. A standardized extraction method was used to achieve consistency across all studies considered and to allow comparison of the research results.

### **3.7 Quality Assessment**

The quality of the selected studies was judged using the quality assessment criteria as predefined; which was divided into four sections: the methodological quality, the methodological transparency, the sample adequacy, the validness of the result of the study and relevance to the study of Education 5.0. Each article was critically analysed for the presence of clearly articulated objectives for the study, methodology (how the data was collected), data analyses, and conclusions based on empirically collected data. Research that was conducted without a specific focus on ads and social media, and/or which was not methodologically focused on ads and social media, was not incorporated into an overall synthesis.

### **3.8 Sample Size**

Of the 156 identified records, 82 were included in the final sample, limited to peer-reviewed journal articles. Such studies covered various global areas, educational backgrounds, and research methodologies, delivering comprehensive evidence about the application of Artificial Intelligence, Digital Innovation, and Humanized Pedagogy as part of Education 5.0. The chosen sample was broad enough and varied enough to provide a thorough synthesis of the latest advances and current trends in technology-enhanced education.

### **3.9 Data Analysis**

Thematic analysis was used to extract data from the selected literature sources to build the synthetic evidence. Findings extracted were processed systematically by coding, categorizing and arranging them in major themes that developed around the research objectives. The thematic analysis revealed the following themes: Artificial Intelligence Applications, Digital Innovation, Personalized Learning, Human-Centered Pedagogy, Ethics in AI Governance, Implementation Challenges, and Future Educational Directions. The synthesis was focused on the emphasis of similarities, differences, and the appearance of new phenomena found in the reviewed studies so that through the presentation of the results, the aspects of the new world of Education 5.0 emerge.

## **4. Results and Analysis**

### **4.1 Distribution of Selected Studies by Publication Year**

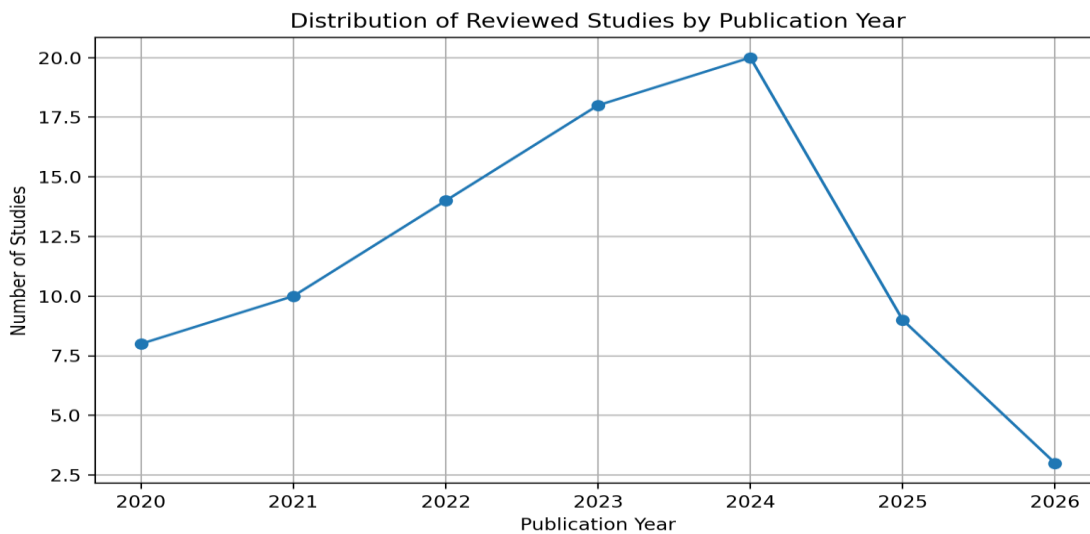
Relevant studies included in the systematic review are presented in Annual Distribution of selected studies (Table 1). The results revealed that there was a steady rise in the number of publications between 2020 and 2024. In the year 2024, the studies published were the highest number (24.4%) followed by 2023 (22.0%). This trend of publishing was observed to be growing, perhaps as awareness among the academic community across the globe was growing towards Education 5.0 and the swift integration of Artificial Intelligence in the education system. The study further

illustrated that scientific activity increased significantly since the public launch of generative AI technologies. Adaptive learning, intelligent tutoring systems, Digital Assessment, the analysis of learning, and AI assistance in instructional design were emerging concepts and areas of growing research. The tendency indicated that schools actively sought to leverage innovative attack to improve learning engagement and effectiveness using intelligent technologies. A limited amount of work was published in 2025 and 2026 which did not hint at declining research interest. These years rather were the years in which new publications were available; and many of the studies were in their early publication stage or at the time of data collection were under review.

**Table 1. Distribution of Reviewed Studies by Publication Year (N = 82)**

| Publication Year | Number of Studies | Percentage (%) |
|------------------|-------------------|----------------|
| 2020             | 8                 | 9.8            |
| 2021             | 10                | 12.2           |
| 2022             | 14                | 17.1           |
| 2023             | 18                | 22.0           |
| 2024             | 20                | 24.4           |
| 2025             | 9                 | 11.0           |
| 2026             | 3                 | 3.7            |
| <b>Total</b>     | <b>82</b>         | <b>100.0</b>   |

**Figure 1. Distribution of Reviewed Studies by Publication Year (N = 82)**



## 4.2 Major Research Themes Identified

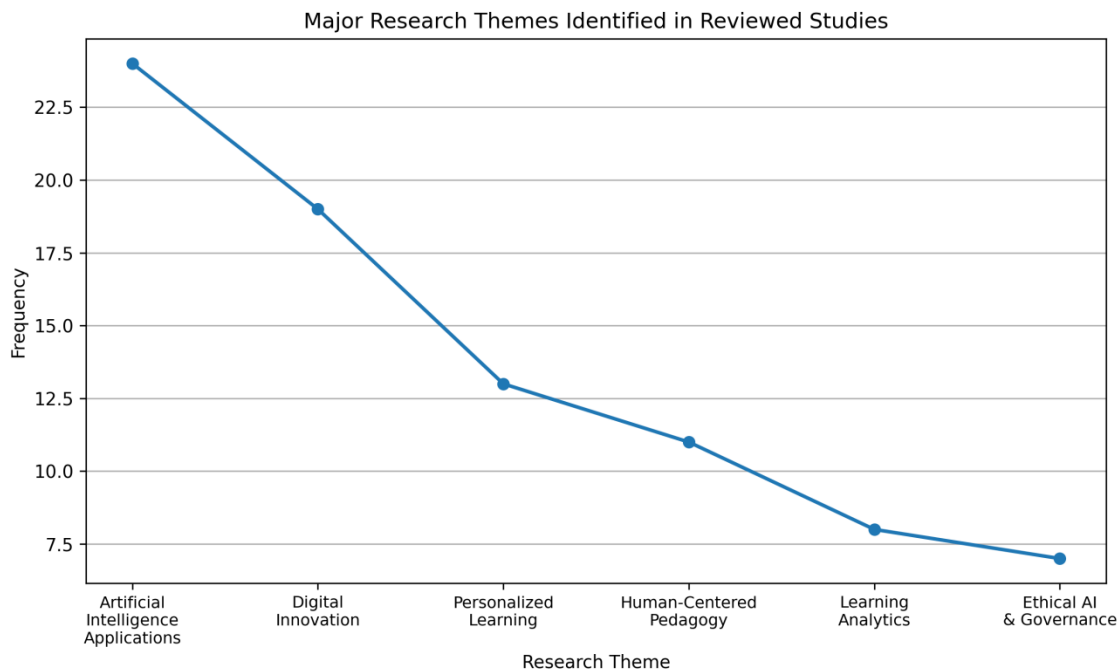
The major research themes identified in the selected literature were summarised in table 2. AI applications were found to be the leading category of research, accounting for 29.3% of the total number of papers reviewed. The major areas of research focused on were: Intelligent Tutoring Systems, Machine Learning Algorithms, Automated Assessment, Generative AI, and Classified

adaptive learning platforms that seek to enhance learning efficiency. Digital innovation represented the second most frequently investigated theme with 23.2% of the reviewed studies. These studies concentrated on the cloud learning environments, virtual classrooms, augmented reality, virtual reality, blockchain, and the smart learning ecosystem. Results indicated a massive increase in learning opportunities due to technological innovation, which enhanced access to, participation in, and flexible delivery of learning. The reviewed literature significantly included human-centered pedagogy, personalized learning, learning analytics, as well as ethical AI governance. The themes highlighted that Education 5.0 encouraged a balanced use of intelligent technology and human values, creativity, co-operation and ethical responsibility. By any stretch of the imagination, researchers always kept a constant look out for maintaining human involvement, along with the advancement of technology.

**Table 2. Major Themes Emerging from the Selected Studies**

| Research Theme                       | Frequency | Percentage (%) |
|--------------------------------------|-----------|----------------|
| Artificial Intelligence Applications | 24        | 29.3           |
| Digital Innovation                   | 19        | 23.2           |
| Personalized Learning                | 13        | 15.9           |
| Human-Centered Pedagogy              | 11        | 13.4           |
| Learning Analytics                   | 8         | 9.8            |
| Ethical AI and Governance            | 7         | 8.5            |
| <b>Total</b>                         | <b>82</b> | <b>100.0</b>   |

**Figure 2. Major Themes Emerging from the Selected Studies**



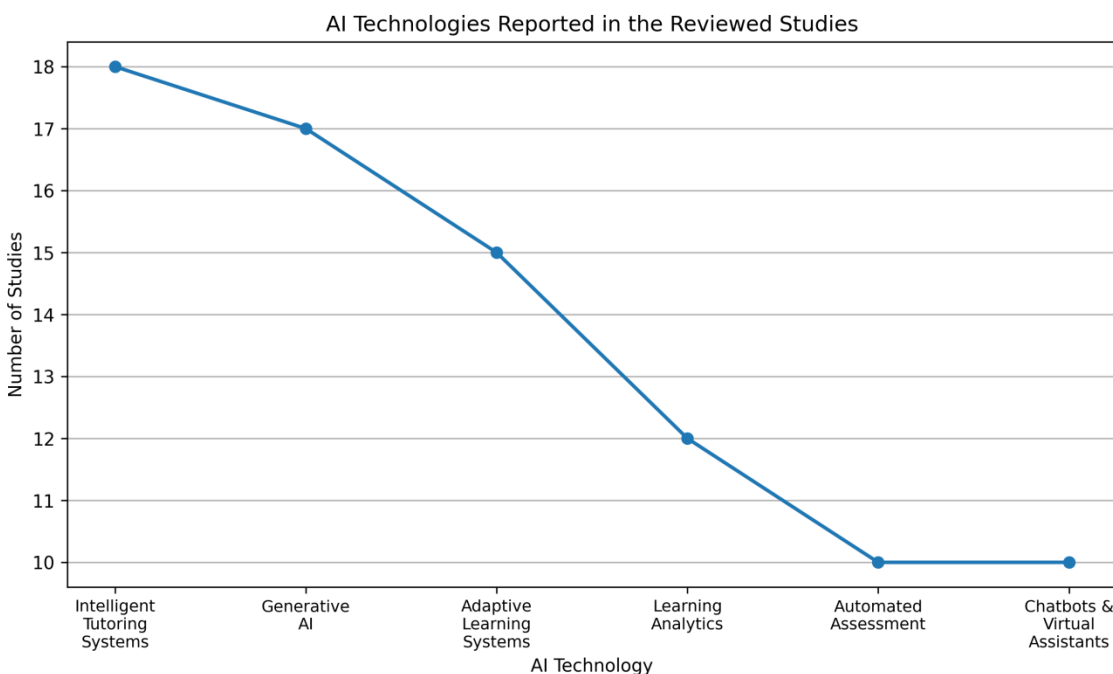
### 4.3 Artificial Intelligence Technologies Used in Education

In Table 3, the artificial intelligence technologies mentioned in the studies under review are presented. The most commonly cited ITS were identified (22.0% of the literature). These systems are designed to provide individualized instruction, provide feedback and adapt instruction according to the level of learning. Generative AI came in second at 20.7%, out of the reviewed studies. Large language models were being increasingly investigated in the field of education for tasks such as lesson planning, generation of exam content, supporting assessments and exam writing, and virtual tutoring for education. The results showed that generative AI provides additional learning resources, but also raises ethical issues of academic dishonesty, ‘transparency’ and proper use of technologies. Significant focus was also placed on adaptive learning systems, learning analytics, automated assessment, and AI-powered virtual assistants, in the reviewed literature. These technologies together promoted personalized learning, instructional decision making and student supports. Thus, the review revealed that AI technology leveraged teachers' teaching functions, and left a human-centered approach that aligns with the principle of Education 5.0.

**Table 3. AI Technologies Reported in the Reviewed Studies**

| AI Technology                   | Number of Studies | Percentage (%) |
|---------------------------------|-------------------|----------------|
| Intelligent Tutoring Systems    | 18                | 22.0           |
| Generative AI                   | 17                | 20.7           |
| Adaptive Learning Systems       | 15                | 18.3           |
| Learning Analytics              | 12                | 14.6           |
| Automated Assessment            | 10                | 12.2           |
| Chatbots and Virtual Assistants | 10                | 12.2           |
| <b>Total</b>                    | <b>82</b>         | <b>100.0</b>   |

**Figure 3. AI Technologies Reported in the Reviewed Studies**



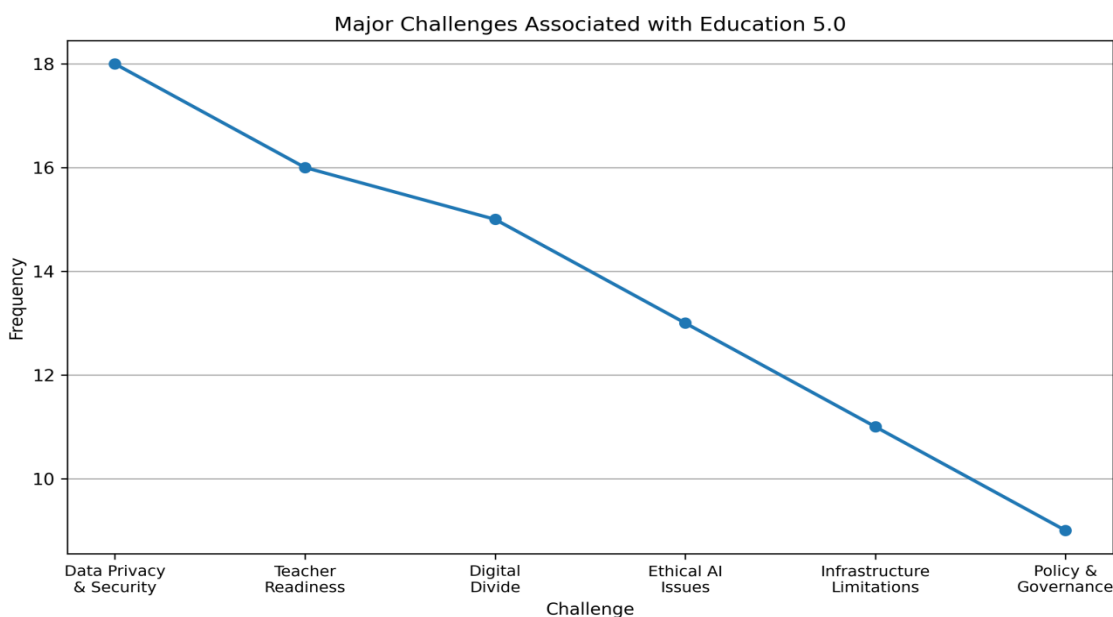
#### 4.4 Challenges Identified in the Literature

The main challenges reported for the selected studies are shown in Table 4. Ensuring data privacy and cybersecurity came up the most, representing 22.0% of the literature. Researchers noted concerns about safeguarding student data, transparency of algorithms and reports, and responsible handling of students' educational information. An other notable issue was the teacher readiness, with 19.5% of the reviewed studies. The continuous professional development and development of AI literacy and digital pedagogical competence were frequently discussed as key elements for the implementation of Education 5.0. It was observed that more and more, educational institutions opened their eyes to the need to provide teachers with practical skills for the integration of intelligent technologies in education. The other concerns that arose in the review were: digital inequality, ethical concerns, lack of infrastructure and lack in policy frameworks. The results suggested that innovation in technology was not sufficient for the change of education. Key conditions for sustainable implementation were institutional commitment, inclusive educational strategies, digital (technical and physical) improvements, ethical governance, and ongoing capacity development for teachers and students.

**Table 4. Major Challenges Associated with Education 5.0**

| Challenge                  | Frequency | Percentage (%) |
|----------------------------|-----------|----------------|
| Data Privacy and Security  | 18        | 22.0           |
| Teacher Readiness          | 16        | 19.5           |
| Digital Divide             | 15        | 18.3           |
| Ethical AI Issues          | 13        | 15.9           |
| Infrastructure Limitations | 11        | 13.4           |
| Policy and Governance      | 9         | 11.0           |
| <b>Total</b>               | <b>82</b> | <b>100.0</b>   |

**Figure 4. Major Challenges Associated with Education 5.0**



## 5. Discussion

The findings of this systematic literature review showed that teaching and learning significantly changed based on the stretching of the human-centered pedagogical approach with their Education 5.0 approach based on the concept of artificial intelligence. AI-enables technologies, such as intelligent tutoring systems, adaptive learning platforms and generative AI solutions, all improved the engagement, the effectiveness and personalization in their instruction. All the reviewed studies reported that instructional improvement tools which facilitate personalization, engagement and effectiveness of teaching through AI technology, including intelligent tutoring system, adaptive learning platform and generative AI application, enhanced teaching tools. These technologies were not created to replace a teacher, but rather all have been developed with the concept of acting as a support for a teacher's instruction—feedback is individualized, more mundane academic tasks are automated, and support evidence-based instructional decisions. These results confirmed recent studies that identified Education 5.0 as a learning-centred approach whose intelligent use of technology and the training of action is developed in collaboration with teachers to improve the quality of teaching and lifelong learning (Walter, 2024; Owan et al., 2025).

The analysis also revealed an increased reach of education and increased flexibility and education tools such as virtual learning environments, cloud learning environments, immersive technologies and learning management systems following digital innovation. Availability of digital platforms enabled institutions to provide learning experiences that were not confined to the classroom setting, enabling interactive and collaborative learning. Personalized learning was one of the most powerful effects of digital transformation as the adaptive educational technologies adapted to the content they provided to learners based on their development and/or learning preferences. The new research reveals few parallels to the advantages that digital innovations have provided to learners' autonomy, progress and collaborative efforts in learning for knowledge creation at higher education institutions (HEIs) (Chiu et al., 2024; Bond et al., 2024).

The other dominant point in the study was the new concept of pedagogy put forward which focuses on humanity to highlight the growing importance of pedagogy focused on the human element in the era of Education 5.0. Literature reviewed also highlighted that the emphasis of educational innovation is placed on the components of learning along with cognitive, emotional, ethical and social aspects (not only technological advancement). In an age of AI, the role of teachers has become essential to guide, mentor and help students with their critical thinking. Human centred learning cultivated and provoked creativity, empathy, communication, collaboration and problem-solving with technology used as a tool within the learning process. Furthermore, some more current studies show that establishing an environment that is humane, inclusive, and empowering for learning is a prerequisite for integrating AI into the educational field (Crompton & Burke, 2024; Holmes & Tuomi, 2024).

Also, there are a few issues related to its implementation of this Education 5.0 found. We should keep addressing the same most commonly cited ethical concerns in AI technology - bias in algorithms, academic integrity issues, data privacy, cyber security and transparency impacts. Furthermore, there were significant differences when it comes to the effectiveness of AI-powered learning programs in different regions, such as poor utilization of learning technologies, and campaign aspect: lack of teachers preparedness. This aligns with the recent reports on the importance of comprehensive strategies to guide the responsible and equitable use of AI in education systems, the expansion of its institutional frameworks, and continuous professional development (UNESCO, 2025; Williamson & Eynon, 2024).

The results showed that there needs to be a process of change in the education system that exceeds the subject mentioned as “education 5.0” and this can only be a process of changing the education system as a whole. The strong role of artificial intelligence, together with digital innovation and pedagogy oriented towards humans, facilitated the development of resilient and inclusive

education systems, which can educate for a fast-changing world in a digital age. In the literature, elements that were always mentioned as relevant for the successful implementation were strategic investments in public policy supporting aspects of digitization, in AI literacy, in evolving school policies on ethics and information, in modernizing curricula, as well as in teacher professional development (TLili et al., 2025; Limna et al., 2025).

## **5.1 Conclusion**

This study was conducted through a systematic literature review to understand the transformative process of AI, digital innovation, and human pedagogy within the framework of Education 5.0. The results revealed that Education 5.0 advocated a new learning paradigm, which centered on students and emphasized the important role of teachers by adopting intelligent technologies in the teaching and learning process to improve teaching efficiency, personalization, and student engagement. The use of digital collaboration platforms, adaptive learning systems, and learning analytics combined with artificial intelligence applications contributed to more flexible and inclusive learning platforms, stimulated creativity, critical thinking and problem-solving processes, and fostered lifelong learning. The review pinpointed other implementation obstacles, such as ethical considerations, data privacy, the digital divide, infrastructure readiness, and teachers' readiness. Based on the study results, the institution is recommended to combine technological innovation with values to ensure success, establish ethical governance bodies, and adopt a learning-based approach to curriculum design to realize the successful implementation of Education 5.0 and prepare future professional students to work in the digital world.

## **5.2 Recommendations**

Academic institutions must implement sound policies and penalties for the integration of artificial intelligence in education and learning schools, paying special attention to the value of human pedagogy. The educational community, through various educational institutions like Universities and schools, must provide the infrastructure and learning platforms with rich AI content, and secure educational technologies for the equitable and fair distribution among all learners. Continuous professional education should focus on teachers' skills in the context of Artificial Intelligence, digital literacy, technology in the education sector, and the ethical use of technology. In educational settings, data ownership and AI governance should be clearly defined regarding data privacy and cybersecurity issues. Data ownership and AI governance of the use of algorithms in education should be clearly specified with a focus on data privacy and cyber security. Inter-disciplinary learning, digital competence, creativity, critical thinking, entrepreneurship, and ethical thinking in teaching and learning should ensure that graduates have the knowledge and competences they need to face the challenges of Education 5.0 and the future job market.

## **5.3 Future Research Directions**

The impact of AI can be sustained in terms of writing outcomes, student engagement, student learning, and employment readiness. The effects of using AI have a lasting impact on student learning outcomes, engagement, learning, and employment readiness. Further studies are required at different educational levels and in different cultures better to predict the potential impact of AI on longer-term outcomes. Empirical research on Education 5.0 with longitudinal, experimental, and mixed-method designs needs to be strengthened to provide more evidence about its effectiveness. Inter-country comparisons could help illuminate the varying levels of readiness, capacities, and policy uptake across different education sectors in developed and developing countries. The applications and ethical concerns of new technologies such as Generative AI,

Extended reality, Blockchain, Digital twins, and Intelligent Learning Ecosystems should also be explored and assessed for future education applications and ethical use. More policies, sustainable digital transformation (SDS), responsible AI governance, and technologies for making high-quality technology-enhanced education accessible for various learners are needed.

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