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Chapter 1

Applications of artificial intelligence in education: Implications for pedagogy, learning outcomes, and policy development

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Abstract: Researchers have documented the advantages and impact of artificial intelligence (AI) on the field of education well. All stakeholders in the educational sector will benefit from improved outcomes by implementing AI systems. This study discusses the integration of AI into a desired system called "Smart Education." It explains the transformative potential of customized educational content to individual learners' needs. AI technologies become assistants to education and help them in instruction design and content development. The system considers each student's unique pace, preferences, and capabilities and generates content accordingly. Such learning will be more effective and engaging. AI systems in education have three key sub-systems: intelligent tutoring systems, adaptive learning platforms, and predictive analytics. These innovations identify learning gaps, provide real-time feedback, and support differentiated instruction. Students with such content exposure and tools can achieve their full potential. Institutions are concerned with challenges and ethical concerns connected with the deployment of AI in Education. Despite this, there is a need for continued exploration and adoption of AI technologies. They create dynamic, responsive, personalized learning experiences that prepare students for future demands. Educators and Institutions can significantly improve learning outcomes and promote a culture of innovation and adaptability in education by using AI.

Keywords: Adaptive Learning, GenAI, Inclusive Learning, Learning Gaps, Personalized Learning, Smart Education, Student Engagement

2.1 Introduction

Over the years, technology has helped shape and improve the quality of our education and academic systems. Artificial Intelligence (AI) is an Industry 4.0 technology that immensely shapes our education system. AI benefits almost all aspects of academics, from

the admission process of students to curriculum design and delivery to assessment and evaluation. The impact can be witnessed at all levels of academics – from kindergarten and schooling to university and higher education and at different stakeholder levels – students, teachers, and policymakers (Sanusi et al., 2024). Further, the impact is on the core academic processes and all allied sectors connected with education. Stakeholders in research, library management, training and placements, sports, healthcare (especially mental health) of students, and academic conference management – all benefit from AI. AI helps overcome challenges in the education sector and facilitates the achievement of United Nations Sustainability Development Goals (SDG goals), especially the SDG 4 goal themed on "Quality Education" (Artyukhov et al., 2024). Like any technology, AI provides opportunities and threats for education, necessitating customization and optimization before use (Aaron et al., 2024).

2.1.1 Background

Generative AI (GenAI)-based systems enhance learning performance by improving self-efficacy and fostering creative engagement. These tools are often implemented in chatbots or as part of Large Language Models (LLMs). These technologies simultaneously raise critical discussions about fairness and ethics. So, educators and researchers should carefully examine AI integrations, weighing the potential benefits and challenges in learning environments. Consequently, AI should be one of the several tools, but it should not be the sole tool for students (Shahzad et al., 2024). Educators can deliver customized instruction that adapts to each student's learning style, pace, and preferences, making learning more effective and engaging. AI powers intelligent tutoring systems, adaptive learning platforms, and predictive analytic tools. Students can identify their learning gaps by looking at real-time feedback. They can cope with the class by following the supporting differentiated instruction. This ensures that every student can achieve their full potential (Kabudi et al., 2021).

As AI becomes more embedded in education technology (EdTech), it shapes the future of learning, particularly at the university level. This shift can potentially redefine educators' roles, mainly university professors' roles (Shin et al., 2024). Predictive analytics in educational settings has enabled educators to identify at-risk students and intervene proactively. It involves using statistical modeling and machine learning. Educators and administrators can gain insights into which students may be at risk of poor performance or dropping out. The recommendations given by the system ensure timely support and personalized interventions (Doleck et al., 2020).

Several challenges and ethical considerations are encountered during the deployment of AI in education, including data privacy, equity, and the role of teachers (Farooqi et al., 2024). A comprehensive analysis shows the importance of AI in taking institutions towards educational excellence and inclusivity. So, AI technologies continue to be explored and adopted in the sector (Khan et al., 2025). By adopting AI, educators, and institutions can significantly improve learning outcomes and promote a culture of innovation and adaptability in education. The journey towards Smart Education is about using AI and promoting a culture of inclusivity, continuous improvement, and lifelong learning (Roshanaei et al., 2023).

2.1.2 Chapter Objectives and Structure

This chapter explains the benefits of integrating AI into education systems. Such integration will make educational content more suitable to individual learners' needs. In the process, the chapter also examines how it positively impacts the education system. The "Introduction" section overviews AI's transformative role in education. It explains the potential of AI to shape the future of academic systems. The second section explains how AI is applied or used in the education system. Figure 2.1 shows key applications of AI in education.

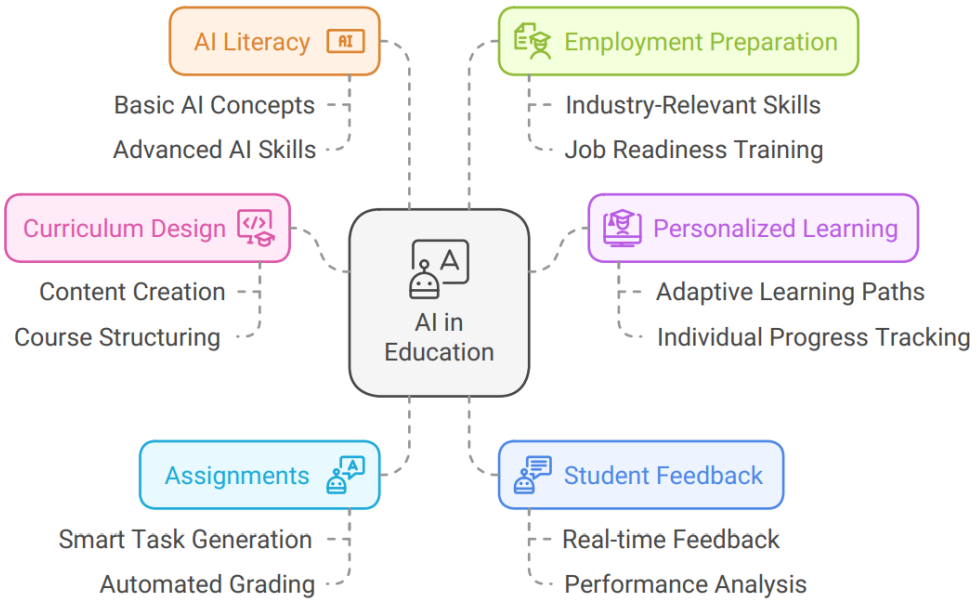

Fig. 2.1 Key applications of AI systems in education

The third section is on “Existing System.” It analyzes the current educational system’s limitations in fully integrating AI capabilities and creating personalized learning experiences. This leads the way to the fourth section, “Proposed System.” The section details the “Smart Education” system that leverages AI components to create personalized and adaptive learning environments. The fifth section follows this, “Results and Analysis.” It presents the outcomes and insights from implementing AI-driven educational systems, including improved student engagement and enhanced learning outcomes.

The sixth section discusses the issues in the Adoption of AI in Education, followed by the seventh section, which discusses ethical considerations. The eighth section lists some “Future Research Considerations,” pointing out potential areas for future research. The final “Conclusion” section summarizes the potential of AI in education. It duly acknowledges the need to address ethical considerations and implementation challenges.

2.2 AI in Education

Figure 2.2 shows the three primary areas of AI implementation in schools (Ng et al., 2025).

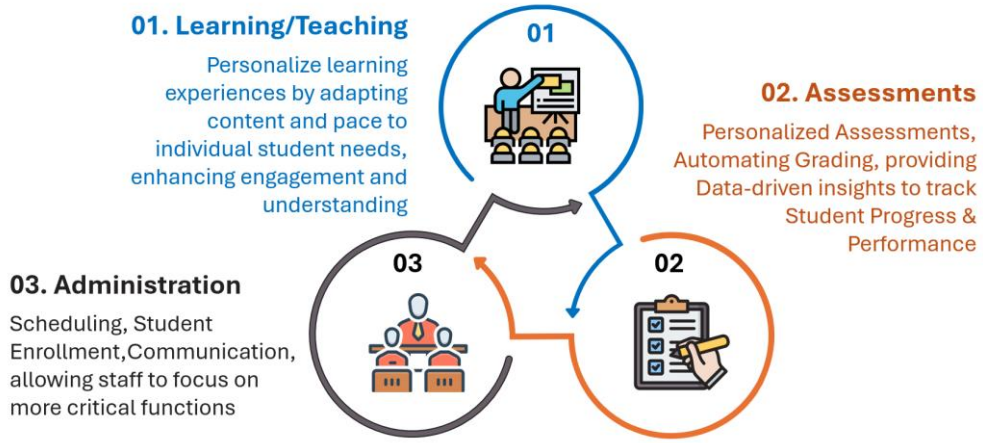

Fig. 2.2 Three primary areas of AI implementation in schools

2.2.1 Curriculum & Content Design

Modern education demands a continuously updated curriculum and instructions to educate the younger generation (ULM, 2022) effectively. The rapid advancements in

technology and shifts in societal norms have necessitated more frequent updates to educational programs (W&M, 2022). AI systems can help identify trends, propose changes or revisions, or develop a fresh curriculum while considering various factors (Rauf et al., 2024). A curriculum framework with three-stage processes is proposed in the new system. The stages comprise observation, strategy formulation, and implementation. LLM-based curriculum design has a significant edge over expert teachers. The content generated by LLMs often better aligns with learning objectives and is accessible to students working below grade level (Malik et al., 2024). While AI can potentially develop almost all areas of study, it can be more useful in certain areas where AI implementation has been historically underutilized, such as Asset Appraisal Major (Zhang et al., 2024). Choosing the right AI tool to design domain-relevant scenarios is important. It enhances relevance and engagement across diverse fields (Anthis & Zacharioudakis, 2024).

Generative AI, such as ChatGPT for text or DALL·E for image generation, are excellent content generation and design tools. As time progressed, AI could generate text (paragraphs, poems, or lyrics), images, videos, and other multimodal formats. Furthermore, there are AI tools that convert text to diagrams that are appropriate to the student's grade.

2.2.2 Personalized Learning

Different students have different levels of learning different subjects, requiring educators to spend more time on individual students, which is impossible. GenAI tools can provide personalized lesson plans and have chatbots that students can use to ask unlimited questions (Banjade et al., 2024). Chatbots and virtual assistants can handle students' and parents' most commonly asked inquiries and questions. Automating specific communication and coordination functions can drastically reduce the burden on teachers and faculty. Research on Emirati private universities showed that students using AI are less dependent on faculty members to acquire knowledge. This does not mean the educator is no longer needed. Educators still provide vital human connections. They facilitate the learning process (Muthuswamy & Nithya, 2024). Because of this, their role changes from being an antagonist to becoming a mentor. AI shifts the center of gravity from a teacher-centered to a more learner-centered approach (Gentile et al., 2023). It also improves the teaching methods of the faculty (Alderbashi, 2024).

Students using AI are outperforming their peers. A study used students with English as a Foreign Language (EFL) as a sample. The students used AI to write programs. Such students outperformed in areas like developing new ideas and arguments and enhancing their essay-writing skills (Rym, 2024). Another study examined the use of WOLFRAM in providing dynamic and personalized learning environments. Students from the AI and CS domains were allowed to use the tool in the study. AI students showed higher

motivation, engagement, and learning clarity than CS students. One possible reason is that the content matches their curriculum better. The study shows that integrating AI tools intimately with domain/discipline/subject-specific purposes maximizes learning impact. Even educators agree with this (Ng et al., 2025). The tool helped improve conceptual understanding and practical application of AI-related principles like randomness, cryptography, and ML dynamics (Anthis & Zacharioudakis, 2024).

2.2.3 Assignments

With AI, educators can prepare challenging assignments according to the student's understanding of the subject and the grade. Students can complete their assignments quickly and effortlessly. Academicians can also prepare assignments using prompts as a part of their search for newer and better ways to engage with students.

2.2.4 Student Feedback

Student feedback is the key to improving the educators' teaching and the course. LLMs can automatically evaluate student feedback and convert it into understandable and meaningful textual explanations for reformulation (Villagrán et al., 2024). AI-based assessment tools have significantly impacted retention compared to traditional computer-based assessment models in education research. Hence, researchers suggest using AI-based computer adaptive tests (CAT) (Christian et al., 2024). Assessments can be more detailed and personalized, allowing for suggestions that can have an impact.

Besides predicting student performance and providing personalized learning paths, AI systems can provide deep feedback analysis and emotional and engagement detection services. The current education system already uses a range of digital tools. Examples are Learning Management Systems (LMS), digital collaboration platforms, and social learning networks. AI fits into existing software or broader learning ecosystems. The captured feedback can be multi-model feedback, such as interactive visual, audio, video, gamified, or AR/VR (John, 2025).

2.2.5 Academic Assessment and Evaluations

AI can help evaluate various student assessments connected with academics, including student evaluation (formative and summative assessments), grading, pedagogical evaluation, technological evaluation, accessibility, and DEI evaluation (Aaron et al., 2024). Rubrics offered by the institution can be used as a benchmark for the evaluation criteria. The rubrics can be uploaded to the AI system, which helps evaluate student papers and generate marks, scores, and grades.

2.2.6 AI Literacy, Student Performance & Satisfaction

Imparting AI Literacy will increasingly become important as AI gets wider penetration and acceptance in society and becomes an everyday tool. Imparting this at the secondary education level can be a good starting point. Elements of AI, ENARIS, and CRAFT are tools/frameworks to impart AI literacy (Stephan & Steinbauer-Wagner, 2024). High AI literacy levels increase student interaction with AI technologies and learning tools. This further translates to improved learning results and academic performance (Singh et al., 2024). A meta-analysis study found that GenAI tools significantly improve college students' academic achievement. Intervention duration, discipline types, and assessment tools improved the performance, though the differences were insignificant. (Sun & Zhou, 2024).

Student satisfaction with using AI systems in education depends on the information quality the AI system produces. The AI-powered educational solution is expected to deliver outstanding service quality. The AI-based educational tools and services should meet their learning goals and improve performance (Jie, 2024). Studies confirmed that mobile learning environments and AI tools enrich the learning process. They provide personalized, accessible, and engaging educational experiences. AI tools with visual aids like videos, infographics, and simulations cater well to these preferences.

2.2.7 Making students job-ready

As time progresses, AI will become omnipotent and penetrate various devices deeper. Universities will begin adding AI topics to all their courses and learning materials. Universities have already taken up the responsibility of helping their students get jobs. A study compared the course contents of various UK university programs and job advertisement portals. It found that university curricula in the AI domain are well-balanced in most technical skills like programming and machine learning. However, there is a gap in data science, maths, and statistics skill categories. The study identified 12 skill categories (Jaiswal et al., 2024). AI is important not just for academic students but also for upskilling and reskilling the workforce. Control group studies tested the implementation of AI-based systems to improve the English writing skills of engineering students. These studies found several weaknesses in the system. Such systems require more customization and pilot testing in specific areas of the system (Widodo et al., 2024).

2.3 Existing System

The current educational system is already incorporating various technological advancements. However, it often struggles to fully integrate the capabilities of AI to create

personalized learning experiences. Traditional classrooms typically follow a one-size-fits-all approach. The same teaching methods and materials are applied to all students regardless of their learning styles, paces, and preferences. Such classrooms cannot engage and be effective for many students.

In many educational institutions, technology is used for administrative tasks, essential computer-based learning, and standardized testing. While tools like LMS and online resources have become commonplace, their ability to adapt to the unique needs of each student remains limited. Several routine tasks of teachers and academic administrators can be automated using AI, allowing these two stakeholders to move to a supervisory role. AI is powering LMS, allowing for the monitoring of student engagement. Teachers can plan their lesson delivery better. AI can provide subject/domain-specific help. For example, AI can help in psychological education. Specifically, it can provide tools for emotion recognition, mental health assessment, and early intervention for psychological issues. Current systems cannot often provide real-time feedback, personalized content, and adaptive learning paths catering to students' diverse abilities and interests. Moreover, the existing system faces challenges in effectively using data to enhance learning outcomes. The existing LMSs are popular for providing data on student performance. The analytical capabilities to turn this data into actionable insights are underdeveloped. The proposed AI system should use valuable information about student progress, strengths, and areas needing improvement to its full potential. It should also provide insights.

Another limitation is the reliance on human educators. The presence and involvement of educators are required to address the individual needs of each student. Smaller classrooms make students enjoy the subject and significantly positively affect academic scores (Shen & Konstantopoulos, 2021). However, educator tasks are overwhelming because of various factors. These include large class sizes (marginal role), diverse student populations, teacher category (e.g., subject teacher vs. class teacher), principal status, grade level taught, number of students with support needs, opinions on ability grouping, and TA availability. These factors eventually lead to burnout (Saloviita & Pakarinen, 2021). Educators find it difficult to provide the level of personalized attention that each student requires. They find it challenging to balance accountability requirements (e.g., external standards, assessments) and personalized attention (i.e., tailoring support for individual students) and often end up redefining their roles (Segal, 2022). The current educational system has made some progress with technology. However, it has not fully used AI to create personalized learning experiences for each student. AI can help by offering customized, real-time, and data-driven learning solutions. Existing systems have not taken full advantage of these possibilities. Figure 2.3 lists various types and names of AI tools that help in education.

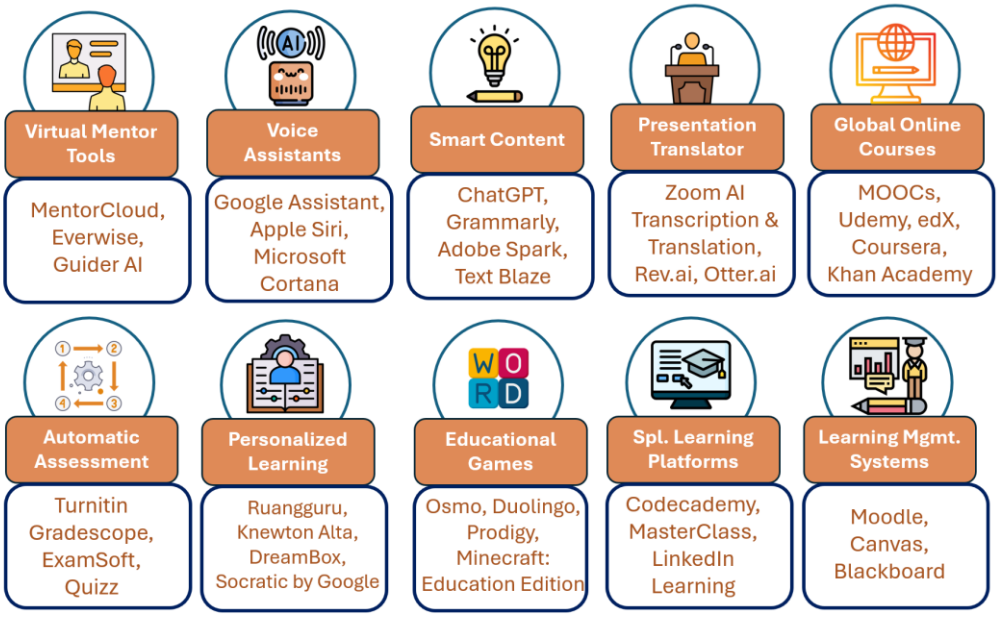

Fig. 2.3. Types and names of various AI tools that help in education

2.4 Proposed System

The proposed system wants to use AI for Education to the fullest extent. It is expected to create a personalized and adaptive learning environment. The system will change how education is delivered and experienced. This system can be called “Smart Education”. It should include several AI-driven components that help customize educational content for individual learners. The goal is to improve student engagement and learning effectiveness.

2.4.1 Key aspects of the proposed system

1. **Intelligent Tutoring Systems (ITS):** AI-driven ITS will provide personalized instruction to students. They mimic one-on-one tutoring. These systems will adapt to each student’s learning pace and style, offering customized explanations, hints, and feedback.

2. **Adaptive Learning Platforms:** These platforms adjust instructional content based on individual learner comprehension. They use machine learning algorithms to continuously assess students’ knowledge levels. They adjust the curriculum accordingly, looking into the difficulties faced by the learners. They

identify learning gaps and strengths and make the adaptive learning platforms propose the right content at the right time for the learner. These platforms also have opportunities and post challenges (Er-Rafyg et al., 2024).

3. **Predictive Analytics:** Predictive analytics collects and analyzes vast data about student performance. It helps teachers find students who might struggle and take action early. This data-driven approach will provide timely support and personalized interventions to improve learning outcomes. Much research on this topic is on prediction. Interpretability (that explains the model to the user) or prescriptive analytics (giving data-driven remedial advice) is hugely neglected (Susnjak, 2024).

4. **Real-time Feedback Mechanisms:** AI-powered tools will provide instant feedback on assignments and assessments. The tools allow students to understand their mistakes and learn from them immediately. This continuous feedback loop will facilitate deeper learning and retention.

5. **Personalized Learning Paths:** Each student will have a unique learning path tailored to their goals, preferences, and abilities. AI will curate content, resources, and activities that align with each student's interests and career aspirations.

6. **Virtual Learning Assistants:** AI-driven virtual assistants will be available 24/7. They answer student queries, provide study tips, and offer additional resources. These assistants will support students outside traditional classroom hours, enhancing the learning experience.

7. **Enhanced Data Privacy and Security:** The proposed system will prioritize data privacy and security, ensuring that all student information is protected. Robust encryption and compliance with data protection regulations will be fundamental aspects of the system's design.

8. **Teacher and Parent Dashboards:** AI generates comprehensive dashboards for teachers and parents. The dashboards provide insights into student progress, strengths, and areas for improvement. These dashboards will facilitate better communication and collaboration between educators and parents.

9. **Inclusive and Equitable Learning:** The system will cater to diverse learning needs, including students with disabilities. AI will offer accessible content and support, ensuring all students have equal opportunities to succeed.

2.4.2 Potential Benefits

1. **Personalized Instruction:** It involves customizing educational content to suit the individual student needs. This way, each student can learn at their own pace and style.
2. **Increased Engagement:** AI tools make learning interactive and engage well, thereby creating interest and curiosity in the subject for the student.
3. **Improved Outcomes:** Students will report improved academic performance because of timely interventions and continuous feedback.
4. **Scalability:** Enabling large-scale implementation of personalized learning without overwhelming educators.
5. **Data-Driven Decisions:** Leveraging data to make informed decisions about teaching strategies and student support.

Implementing these features in the proposed system can positively change educational institutions. It can make the learning experience more dynamic, inclusive, and effective. Integrating AI into education promises to prepare students for future challenges, fostering a culture of innovation and adaptability.

2.5 Results and Analysis

2.5.1 Results

The proposed AI system in Smart Education to create personalized learning experiences has shown promising outcomes. The key results observed from the system include:

1. **Improved Student Engagement**: AI-powered adaptive learning platforms have increased student engagement. This is done by offering interactive, personalized content that keeps learners motivated and interested.
2. **Enhanced Learning Outcomes**: Students have significantly improved academic performance due to real-time feedback and personalized learning paths. Identifying learning gaps so that timely interventions can be implemented. Students can thereby get a better understanding and retention of concepts.
3. **Efficient Use of Data**: Predictive analytics help educators make data-driven decisions. This allows them to provide proactive support to at-risk students. Analyzing student performance data allows them to develop targeted teaching strategies.

4. **Increased Teacher Efficiency**: Virtual assistants and intelligent tutoring systems have reduced the burden on teachers. So they can focus on more critical aspects of teaching and mentoring. Teachers have been able to allocate their time more effectively, resulting in improved classroom dynamics.

5. **Inclusivity and Accessibility**: The system has successfully catered to diverse learning needs, including students with disabilities. AI has provided accessible content and support, ensuring equal opportunities for all students to succeed.

2.5.2 Analysis

The analysis of the proposed AI-driven educational system gives us several key insights:

1. **Personalization and Customization**: The ability to make educational content suitable to individual students has proven to be a significant advantage. Personalized learning experiences have led to higher engagement and better academic outcomes. Students who received customized instruction showed increased enthusiasm for learning and demonstrated improved performance.

2. **Data-Driven Decision Making**: Integrating predictive analytics changes how educators approach student support. Educators can identify trends, predict outcomes, and implement targeted interventions by analyzing vast data. This proactive approach has resulted in timely student support, preventing potential academic struggles.

3. **Teacher and Student Support**: The deployment of AI-driven virtual assistants and intelligent tutoring systems has provided continuous support to both teachers and students. Teachers have benefited from reduced administrative tasks and enhanced classroom management, while students have received immediate assistance and feedback, fostering a more conducive learning environment.

4. **Challenges and Ethical Considerations**: While the proposed system has demonstrated numerous benefits, it also presents challenges and ethical considerations. Data privacy and security are essential because the tools collect and analyze student data. The systems must comply with strict regulations. Additionally, addressing equity and preventing bias in AI algorithms is crucial to maintaining fairness in education.

5. **Scalability and Implementation**: The proposed system requires significant technological and infrastructure investments. Scalability is critical. Educational institutions must ensure that AI-driven tools are accessible to all students, regardless of geographic or socio-economic barriers. High speed and low latency of optical

network transmission can help offer a sound AI-based online education system. Machine learning and wireless sensor networks are used in such systems (Li, 2024).

The AI-driven "Smart Education" system demonstrates significant promise in transforming the learning landscape. It provides transformative opportunities for students and educators alike. By providing personalized, adaptive, and data-driven instruction, the system has enhanced student engagement, improved academic outcomes, and supported teachers in their roles. Ethical considerations must be at the forefront of AI system development and deployment to protect user privacy, prevent bias, and promote transparency (Christy et al., 2024). Educational institutions must address challenges as they continue exploring and adopting AI technologies. They must keep ethical considerations to ensure a fair, inclusive, and effective learning environment for all students. Some popular case studies on AI in Education are:

1. Georgia Institute of Technology's Jill Watson
2. University of Murcia's AI Chatbot
3. Knewton's Adaptive Learning Program

Some success stories of the implementation of AI in Education include:

1. Personalized Learning in the UAE
2. Supporting West African Learners
3. Raising Literacy Levels in Brazil

These examples show how institutions enhanced learning experiences, improved student outcomes, and supported educators' teaching efforts.

2.6 Issues in the Adoption of AI in Education

The implementation of any new system comes with resistance to change. Technology implementations have historically faced initial resistance, but as stakeholders began understanding the benefits of the change, they began embracing it. The ecosystem, of course, should be prepared for the change. Institutions should be first made ready to allow AI integration. They need to establish clear rules about AI usage. Software licenses and technical support need to be procured, which requires budget allocations. Teachers' proficiency and competencies in using AI tools should be improved. Professional development programs such as Faculty Development Programs (FDP) and workshops are the need of the hour. Business educators have reported a lack of knowledge on applying

AI tools and related technologies for classroom teaching. They do acknowledge that AI helps their personal growth. Of course, they do not fear that AI will replace their jobs (Saeger et al., 2024). AI Edtech does not have standardization, comes with maintenance costs, and requires continuous development (Shin et al., 2024).

A degree of uncertainty prevails in the minds of librarians. AI requires them to change their role from being traditional bookkeepers to positively facilitating digital content and AI usage. Library staff requires requires reskilling (Grote et al., 2024). There are always concerns about data security used in AI model building. Further, there is a need to develop specialized AI software and applications for students and faculty (Alderbashi, 2024). A cost is involved in all these.

2.7 Ethical Considerations

AI will surely bring ethical issues/challenges that need to be addressed in AI in Education (Ceylan & Mnzile, 2025). There are several ethical considerations to be looked at in the educational setting, including:

1. **Bias and Discrimination**: The AI system could give unjust results that impact the outcomes of students and teachers. The results from AI systems may or may not be suitable for a diversified set of learners. Hence, it is important to make them inclusive and accessible (Ceylan & Mnzile, 2025). Hence, bias identification and mitigation are required to bring trust in AI-driven tools such as e-learning recommender systems (Akanbi et al., 2024).
2. **Privacy and Data Protection**: Personal details of students and teachers would make their way into the AI system in the form of datasets. Failure to protect personal data privacy can result in issues related to privacy and rights.
3. **Autonomy and Agency**: AI systems might affect critical thinking and creativity. After completing a training module, human interaction might sometimes appear better than an AI system-generated feedback system. The system-generated feedback might not match the student's goals, interests, values, and abilities.
4. **Accountability and Responsibility**: Setting accountability and responsibility for mistakes or consequences of decisions is necessary. Inputs from AI-driven systems cannot always be taken for being right or granted.
5. **Explainable AI (XAI)**: XAI is critical for addressing AI models' "black-box" nature in e-learning recommendation systems. It promotes trust, reduces biases, and promotes fairness in personalized learning environments. Popular XAI techniques include SHAP (SHapley Additive Explanations), LIME (Local Interpretable Model-Agnostic Explanations), and Counterfactual Explanations

(Akanbi et al., 2024). A review identified 15 definitions of XAI and 62 challenges that XAI poses in education. These challenges are grouped under seven heads:

a. **E**xplainability
b. **E**thical
c. Technical
d. Human-computer interaction (HCI)
e. Trustworthiness
f. Policy, and
g. Guidelines

The study needed policies, guidelines, and regulations related to XAI (Altukhi & Pradhan, 2024).

2.8 Future Research Considerations

The implementation of AI-driven personalized learning systems in education has shown remarkable promise. However, several future enhancements can be made to optimize further and expand the effectiveness of these systems:

1. **Integration of technologies**: AI tools will be more integrated with other technologies. AI with Augmented and Virtual reality (A/VR) can lead to immersive learning environments. Such environments help students visualize 3D realistic environments or experiment in virtual labs.
2. **Multimodal AI**: As technologies improve, more sophisticated modality groups, such as Natural Language, Video, Sensors, Human-Centered, and Environment Logs, are now available that can help in better understanding the behaviors and outcomes of learners and trainees (Cohn et al., 2024).
3. **AI Literacy**: AI has a growing impact on human lives. It is necessary for the future workforce in both technical and non-technical roles. AI literacy is necessary to fight against misinformation and bias. It bridges the digital divide and promotes an innovation mindset. AI and other education tools are necessary for students with disabilities and underserved communities. It promotes equity and inclusion by providing educational intervention suggestions (Rai et al., 2024) and empowers them to be better individuals. These needs are to be incorporated from the design and development stage itself. Unfortunately, within the three layers of development of an education system (presentations, logical modeling, and data dimension), the researcher's interest was mainly in logical modeling. It was felt unimportant in the remaining two (Zhai et al., 2021). The development process also calls for ethical considerations because AI tools might consider

people with disabilities as outliers (Pierrès et al., 2024). The area deserves the researcher's attention because the quantum of work so far is slim, and the patterns identified are troubling (Rice & Dunn, 2023).

4. **Metrics**: There is a need to frame metrics to evaluate the effectiveness of AI literacy initiatives (Stephan & Steinbauer-Wagner, 2024).
5. **Advanced AI Algorithms**: AI algorithms of improved sophistication are required to understand better and predict student learning patterns, preferences, and emotional states. Such systems can provide more precise personalization of learning experiences.
6. **Integration with Emerging Technologies**: Researchers can study the benefits of integrating AI with other emerging technologies. Augmented Reality (AR), Virtual Reality (VR), and the Internet of Things (IoT) are good neighbors of AI technology. Sub-areas of the above integration, such as Swarm Intelligence, Deep Learning, and Neuroscience, consider future research trends (Zhai et al., 2021). Integrating systems by bringing technologies together helps create immersive and interactive learning environments. They can provide hands-on experiences and real-world simulations that increase student understanding and retention. However, sufficient empirical studies on the impact and outcome of the integration are yet to come.
7. **Enhanced Data Analytics**: Big data analytics is used to process and analyze larger educational data sets. This will help identify trends, understand student behavior in greater depth, integrate big data into curriculum, and make more informed decisions to improve educational outcomes, making the system a warehouse (Baig et al., 2020). There are three challenges with this, which future research can focus on (Fischer et al., 2020):
    a. Balancing data privacy and protection with the need for data sharing and research
    b. Training researchers in educational data science methodologies.
    c. Managing the tension between the need for explanations (why something happens) and predictions (what will happen).
8. **Continuous Feedback and Assessment**: Implement AI systems that provide continuous and adaptive feedback on academic performance and soft skills development. This will offer a more holistic view of student progress and areas for improvement.
9. **Collaborative Learning Platforms**: Develop AI-driven platforms that facilitate collaborative learning, where students can collaborate on projects and problem-solving activities. AI can help form study groups with complementary skills and learning styles.

10. **Personalized Career Guidance**: Extend the use of AI to provide personalized career guidance based on individual strengths, interests, and market trends. AI can help students navigate educational and career pathways that align with their goals.
11. **Enhanced Accessibility Features**: Future research can focus on improving accessibility features. The features ensure that AI-driven educational tools are inclusive for all students, including those with disabilities. This can include advanced speech-to-text, text-to-speech, and customizable learning interfaces.
12. **Ethical AI and Fairness**: Develop frameworks to ensure that AI algorithms are fair and unbiased. Implement continuous monitoring and auditing systems to detect and mitigate potential biases, ensuring equitable treatment of all students.
13. **Teacher and Parental Involvement**: Create more advanced dashboards and tools that allow teachers and parents to participate actively in the learning process. These tools can provide insights into student progress and facilitate better communication and collaboration.
14. **Scalability and Cost-Effectiveness**: Make AI-driven educational technologies scalable and cost-effective, so educational institutions of all sizes and in various geographic locations can adopt them.
15. **Lifelong Learning Support**: According to existing literature, adult education benefits and suffers drawbacks when AI is incorporated. Researchers suggest that care should be taken to prevent restricting or distorting the educational process or endangering academic integrity (Asad & Ajaz, 2024). Extending AI-driven personalized learning beyond formal education helps support lifelong learning. AI can help individuals develop new skills and knowledge, primarily because digital technologies increasingly mediate human lives (Poquet & De Laat, 2021). Being a lifelong learner makes it easy for them to adapt to changing career demands and personal interests.

By incorporating these future enhancements, the proposed AI-driven educational system can continue to evolve and provide increasingly effective, inclusive, and engaging learning experiences. These advancements will further solidify the role of AI in transforming education and preparing students for the challenges and opportunities of the future.

2.9 Conclusion

The education sector can provide personalized learning experiences, enhance student engagement, and improve academic outcomes using artificial intelligence (AI). The

proposed AI-driven intelligent tutoring system involves sub-systems such as adaptive learning platforms, predictive analytics, and real-time feedback mechanisms. AI promotes a more inclusive and effective learning environment by addressing learning gaps, providing timely interventions, and supporting diverse learning styles. AI-driven tools reduce the teacher's administrative burden and allow them to focus on more critical aspects of instruction and student mentorship. Implementing AI in Education needs careful consideration because of potential ethical issues, data privacy, and equity. AI systems help educators and institutions to create a positive, dynamic, and responsive learning environment. Such environments make students better prepared for future challenges and opportunities.

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