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The Use of Artificial Intelligence in Lesson Delivery and Evaluation in Large-Scale Teaching Environments

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Abstract: Artificial intelligence has been increasingly utilised in lesson delivery and assessment, revolutionising the way students learn. It has the potential to be employed in the administration, evaluation, and grading of exams and coursework, as well as overseeing remote assessments. However, these applications are currently in the initial phases of development, and educators are hesitant to fully rely on AI for significant assessments. Therefore, this study aims to explore the effectiveness of artificial intelligence in enhancing educational outcomes and improving the overall assessment experience for students. This study is grounded in the principles of cognitive psychology and educational technology, emphasising the importance of personalised learning and adaptive assessment strategies. By leveraging artificial intelligence algorithms, educators can tailor instruction to meet the individual needs of students, promoting a more engaging and effective learning environment. The materials and methods employed in this study include a systematic literature review of academic articles, research papers, and case studies related to the use of artificial intelligence in education. The results of this study revealed that artificial intelligence has the potential to significantly enhance the quality of education by providing personalised learning experiences, automating administrative tasks, and facilitating real-time feedback for students. It is therefore recommended that educators, policymakers, and researchers collaborate in developing ethical guidelines, implementing professional development programmes, and fostering a culture of innovation in education. Embracing artificial intelligence as a tool for enhancing teaching and learning can help stakeholders harness its full potential to create a more inclusive, engaging, and effective educational system.

Keywords: Generative Artificial intelligence, lesson delivery, lesson evaluation, cognitive psychology, educational technology.

1. Introduction

Artificial Intelligence (AI) has increasingly permeated individuals' lives over the past few decades, exerting a considerable influence across various domains, including education (Mureşan, 2023). Holmes, Bialik, and Fadel (2019) emphasise that AI technologies have been the focus of research within educational contexts for approximately five decades. The field of education has undergone a series of transformations due to the emergence of AI, which possesses the potential to revolutionise and personalise the methodologies employed in the teaching and learning processes (Allam, Dempere, Akre & Flores, 2023). AI is defined as the capability and advancement of computer systems or other machines that rely on information technology to perform tasks typically requiring human intelligence and logical reasoning (Jain & Jain, 2019). AI in education refers to the utilisation of AI technologies, such as machine learning and natural language processing (NLP), to enhance the learning experience (Harry, 2023). Moreover, Chaushi, Ismaili, and Chaushi (2024) assert that the application of AI in education encompasses a range of technologies, including gamification strategies to enhance student engagement, predictive analytics for providing insights that facilitate timely interventions, adaptive learning platforms that tailor content to individual student needs, intelligent tutoring systems that offer customised support, and NLP that assists in language acquisition and

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automated assessment. Jackson (2024) elucidates that the integration of AI into educational environments signifies a profound transformation within the field of education. Chassignol, Khoroshavin, Klimova, and Bilyatdinova (2018) highlighted the extensive implementation of AI across diverse sectors, encompassing content generation, pedagogical strategies, student assessment, and teacher-student interaction. This shift in the teaching and learning landscape heralds a new era where AI technologies are seamlessly integrated to enhance the educational experience (Jackson, 2024).

Tahir, Hassan, and Shagoo (2024) point out that the growing accessibility of AI and its associated tools and technologies has facilitated the integration of AI into the field of education. This shift towards AI integration in education is driven by the potential to enhance teaching methods, improve student outcomes, and streamline administrative tasks. Likewise, Owan, Abang, Idika, Etta, and Bassey (2023) posit that AI-driven tools and software have enhanced educational assessment practices, such as testing, evaluation, and assessment. These technologies offer educators valuable information on student progress, academic achievements, and teaching efficiency (Owan et al., 2023).

The worldwide market for AI in education, valued at $2.75 billion in 2023, is projected to demonstrate a Compound Annual Growth Rate (CAGR) of 36.0% from 2022 to 2030 (Grand View Research, 2021). According to Chaushi et al. (2024), the incorporation of AI in the educational sector provides significant advantages by revolutionising conventional teaching methods and improving the overall learning experience. It enhances the efficiency and quality of education tailored to the needs and demands of students (Apolzan & Cîmpineanu, 2024). However, the adoption of AI in education also presents several challenges, including technical difficulties related to data security and privacy, as well as ethical issues such as algorithmic bias and the dynamics of human-AI interactions (Chaushi et al., 2024). Moreover, Nsoh, Toateba and Adablanu (2023) argue that elevated costs are a significant hurdle in integrating AI into educational institutions. Forecasting expenses through budget planning and strategy often proves complex; for example, if every school were to adopt a robotic assistant, the anticipated energy consumption would significantly increase (Nsoh et al., 2023). Furthermore, Harry (2023) notes that AI systems may exhibit bias, especially when based on data that reflects existing prejudices. This can lead to inequitable treatment of specific students, potentially exacerbating pre-existing disparities (Apolzan & Cîmpineanu, 2024). Additionally, a considerable number of AI systems lack transparency, complicating the understanding of decision-making processes for both educators and learners, which may undermine trust in technological solutions. Addressing these challenges necessitates legal clarifications and suitable financial solutions.

1.1 Problem statement

Contemporary education increasingly prioritises active student engagement over traditional passive learning dictated by instructors (Huang, Mao & Zhang, 2024). Nevertheless, many educators persist in employing antiquated, teacher-centred approaches, despite the advancements brought about by digitalisation (Huang et al., 2024). This may be due to the limited accessibility of digital resources, particularly AI, within the context of the Global South. Various factors, including infrastructure limitations, economic disparities, and educational barriers, significantly influence the extent to which these technologies can be integrated. In many regions, inadequate internet connectivity and high costs associated with technology adoption hinder widespread access, thereby exacerbating existing inequalities.

Currently, numerous priorities for enhancing teaching and learning remain unaddressed (Cardona, Rodríguez & Ishmael, 2023). Despite the integration of AI into applications for over three decades, ongoing research remains essential to support large-scale teaching and extensive educational practices. Cardona et al. (2023) note that educators are still in search of technology-driven solutions that effectively meet these priorities while ensuring safety and scalability. The optimisation of existing educational resources has become a significant concern in the field of educational

technology. Despite the widespread availability of these resources, their potential as effective learning tools remains largely untapped, creating a stark contrast between their abundance and underutilisation (AlShaikh, Al-Malki & Almasrec, 2024).

Felix and Webb (2024) raised apprehensions regarding excessive dependence on AI, as it may weaken the bond between educators and learners. Subsequently, there are concerns about the adverse effects AI might have on the development of learners' writing and critical thinking abilities due to its involvement in their work (Felix & Webb, 2024). The potential over-dependence on AI in lesson planning and grading is causing worry among education specialists, as it may result in educators losing their skills and negatively affect the teacher-student dynamic. Consequently, this could lead to less individualised and impersonal educational outcomes (Felix & Webb, 2024). AI has the potential to be utilised in the administration, evaluation, and grading of exams and coursework, along with overseeing remote assessments. However, these applications are currently in the initial phases of advancement, and educators are hesitant to fully integrate AI into their curriculum. Therefore, this study aims to explore the effective utilisation of AI in the context of lesson delivery and evaluation in large-scale teaching environments.

1.2 Literature review

1.2.1 Theoretical framework

The emergence of new technologies has transformed educational methodologies and the knowledge base necessary for engaging with young individuals (Mota-Valtierra, Rodríguez-Reséndiz & Herrera-Ruiz, 2019). In this evolving landscape, AI stands out as a significant development (Mota-Valtierra et al., 2019). The incorporation of AI in education aligns seamlessly with constructivist learning theory, which highlights the significance of learners' active involvement and knowledge construction. Jonassen and Rohrer-Murphy (1999) emphasise that constructivism serves as a theoretical framework for designing constructivist learning environments. This long-established philosophical framework stipulates that knowledge is not simply transmitted but actively constructed by learners through their existing understanding and experiences (Grubaugh, Levitt & Deever, 2023). Isik (2018) indicates that educators who embrace a constructivist approach are more likely to integrate educational technologies into their teaching practices and actively engage their students in the learning process. AI technologies can facilitate active learning by providing interactive scenarios and simulations that encourage problem-solving. Hence, Isik (2018) asserts that the constructivist approach emerges as a model aimed at enhancing the effectiveness and sustainability of education, utilising current instructional strategies while providing them with a novel orientation. With the advent of AI, there is now potential to personalise, adapt, and enrich educational practices in alignment with constructivist ideals (Grubaugh et al., 2023). An example of this is Intelligent Tutoring Systems (ITS) powered by AI, which can provide immediate feedback, adaptive assessments, and scaffolded learning experiences (Jackson, 2024). Roll and Wylie (2016) explain that ITS employs interactive simulations, tailored feedback mechanisms, and flexible environments to facilitate active learning among students. These features enable students to actively engage in the learning process, aligning with the constructivist principles that emphasise learning through exploration and collaboration (Jackson, 2024). AI algorithms analyse vast amounts of data, such as students' performance and learning patterns, to tailor educational content and activities to their individual needs.

According to Mota-Valtierra et al. (2019), one effective method for enhancing interactive learning is the incorporation of practical laboratory sessions, enabling students to apply the knowledge gained in the classroom across various learning modalities. Through the use of AI, educators can create immersive and interactive learning environments that promote critical thinking, problem-solving, and collaboration among students. Based on this viewpoint, Ruiz-Martín and Bybee (2022) explain that the teacher is responsible for facilitating students' collaboration in problem-solving tasks, either

as a whole class or in small groups. This involves encouraging students to support each other by leveraging their collective knowledge, seeking clarification through questioning, and proposing strategies to progress towards the group's objectives. Studies indicate that engaging in cooperative problem-solving tasks and participating in discussions among peers can significantly boost students' growth (Ruiz-Martín & Bybee, 2022). This interactive approach not only facilitates the acquisition of technical knowledge but also fosters the development of essential communication skills, including reading comprehension, understanding, and research capabilities related to technical subjects (Mota-Valtierra et al., 2019).

1.2.2 The functions of AI in education

AI is undeniably the predominant technological catalyst of the first half of the 21st century, poised to revolutionise nearly all sectors and human pursuits on a grand scale (Holmes et al., 2019). Institutions and governments across the globe are investing substantial financial resources into a wide range of AI applications. Allam et al. (2023) state that AI received its initial formal academic introduction in 1956. Chen et al. (2020) point out that the education sector has witnessed a surge in the utilisation of AI, surpassing the traditional perception of AI as merely a supercomputer and encompassing embedded computer systems. The emergence of computers led to simplistic ideas about the potential of AI among the public. Tahir et al. (2024) suggest that the integration of AI in education can be traced back to the 1970s, with the introduction of LOGO programming and Turtle robots to young learners. Nevertheless, these tools primarily emphasised computational thinking and programming concepts rather than AI itself (Tahir et al., 2024). However, nowadays, according to Chen et al. (2020), AI is utilised within educational settings through various means, such as streamlining administrative duties, facilitating instruction, and enhancing students' learning experiences.

1.2.3 Administrative functions of AI in education

Ahmad, Alam, Rahmat, Mubarik, and Hyder (2022) state that educators bear the primary duty of instructing in educational environments, yet they also undertake a range of additional responsibilities. They are burdened with various tasks, such as grading, assessment, evaluation, addressing parental concerns, creating course outlines and plans, and handling numerous administrative duties (Ahmad et al., 2022). Each of these tasks demands considerable time and attention from educators. In addition to their academic obligations, educators allocate a significant portion of their time and resources to administrative tasks. Those proficient in utilising AI tools can enhance their teaching effectiveness and manage their day-to-day administrative responsibilities and repetitive paperwork (Ng, Leung, Ng, & Chu, 2023). By working with intelligent tutoring systems (ITS), instructors can improve their efficiency in administrative tasks and focus on their primary responsibilities of guiding and instructing students to excel in their studies (Rus et al., 2013). Researchers have achieved notable success by developing precise models that replicate the problem-solving approaches of human experts in mathematics (Cardona et al., 2023).

Bhutoria (2022) argues that AI technology plays a crucial role in automating repetitive evaluation tasks, including grading assessments and offering feedback on assignments. Celik (2023) notes that this automation significantly saves educators' time, enabling them to concentrate on personalised instruction, mentorship, and other meaningful interactions with students. Chaudhry and Kazim (2022) argue that AI-powered technologies are increasingly tailored towards assisting educators in recognising successful teaching methods through the analysis of student learning information. These tools also streamline administrative duties, create evaluations, automate grading processes, and provide feedback, ultimately improving time management for educators and boosting overall effectiveness (Chaudhry & Kazim, 2022). AI technologies are not solely supporting education in academic and administrative capacities but also amplifying efficacy.

1.2.4 Instructive functions of AI in education

Holmes et al. (2019) posit that intelligent, adaptive, and personalised learning systems are being implemented more widely in educational institutions globally, despite varying levels of acceptance among students, educators, parents, and policymakers. Intelligent education systems offer instructors and learners timely and tailored guidance and feedback, thereby enhancing the learning experience (Chen et al., 2020). These systems are designed to adapt to the individual needs and preferences of each learner, providing personalised instruction that caters to their unique learning styles. They collect and analyse extensive student data, exerting a substantial influence on the educational experience for both students and educators (Holmes et al., 2019). The integration of AI-powered tools in education not only facilitates students' access to educational materials but also promotes a self-paced learning approach that accommodates diverse learning styles and preferences (Mureşan, 2023). These advanced technologies use data analytics to identify areas for improvement and provide targeted feedback to help learners progress effectively. Additionally, instructors can benefit from these systems by gaining insights into their students' learning progress, allowing them to adjust their teaching strategies accordingly. As a result, students can experience a more individualised learning journey, receiving personalised guidance and support that leads to improved academic performance and a deeper understanding of the subject matter (Mahendra, 2023). In essence, AI-driven tutorials and interactive virtual assistants have the potential to revolutionise the educational landscape by equipping students with the necessary tools and resources to thrive in their learning journey.

1.2.5 Enhanced learning functions

AI can be utilised efficiently to predict students' performance by analysing data and recognising patterns and trends (Mureşan, 2023). Aina, Gbenga-Epebinu, Olofinbiyi, Ogidan, and Ayedun (2023) argue that intelligent systems in education offer personalised learning experiences by adapting to individual learner needs, providing instant feedback, and creating interactive environments that cater to diverse learning styles and abilities. Okunade (2024) explains that the customisation of learning experiences is made possible by AI technologies, which can tailor them to suit the specific needs and learning preferences of individual learners. AI technologies such as adaptive learning platforms, intelligent tutoring systems, and virtual simulations are used to enhance the educational experience for students (Aina et al., 2023). The versatility of this method supports the integration of a broad spectrum of student capabilities, promoting inclusivity in the educational environment (Okunade, 2024). Mureşan (2023) believes that through the collection and analysis of data about students' performance and behaviour, AI can offer valuable insights into individual performance and forecast a student's likelihood of success or failure. This enables educators and schools to make well-informed decisions and provide timely intervention to support students (Mureşan, 2023).

Table 1 presents a comprehensive encapsulation of the functions of AI in education, as skilfully achieved by Chen et al. (2020).

Table 1: *The functions AI provides in educational scenarios (Chen et al., 2020)*

The work AI does in education	
Administrative	• Perform administrative tasks faster that consume much of instructors' time, such as grading exams and providing feedbac • Identify the learning styles and preferences of each of their students, helping them build personalised learning plans. • Assist instructors in decision support and data-driven work. • Give feedback and work with students in a timely and direct.
Instruction	• Anticipate how well a student exceeds expectations in projects and exercises and the odds of dropping out of school.

	• Analyse the syllabus and course material to propose customisec content. • Allow instruction beyond the classroom and into the higher-lev education, supporting collaboration. • Tailor teaching methods for each student based on their data. • Help instructors create personalised learning plans for each student.
Learning	• Uncover the learning shortcomings of students and address the early in education. • Customise the university course selection for students • Predict the career path for each student by gathering study data • Detect learning state and apply intelligent adaptive interventior to students.

2. Materials and Methods

This study utilises a systematic literature review characterised by a structured and methodical process aimed at identifying, evaluating, and synthesising all relevant research on the use of AI in lesson delivery and evaluation in large-scale teaching environments. This process follows predefined criteria and protocols to minimise bias and ensure comprehensive coverage of the existing literature.

2.1 Search strategy

Various keywords and search strings were utilised to explore a range of databases, including Google Scholar, EBSCOhost, ProQuest, Scopus, JSTOR, ERIC, and Web of Science. These databases were essential resources for retrieving scholarly articles and research studies related to a wide array of topics. Furthermore, the keywords and search strings were employed to enhance the search process. The search incorporated a combination of keywords, including "AI," "AI in lesson delivery," "AI in lesson evaluation," "large-scale teaching environments," and "educational technology." Boolean operators were utilised to refine the search results, with phrases such as "artificial intelligence AND lesson delivery" and "evaluation AND large-scale teaching environments" being pivotal in narrowing the focus. These search engines allowed the researcher to access a wealth of information and stay abreast of the latest developments at the intersection of AI and education. Additionally, filters for publication dates spanning from 2017 to 2024 were applied, including four original sources published in 2015, 2014, 2013, and 2011, as well as peer-reviewed articles, to ensure the inclusion of the most current and credible research. The iterative process involved reviewing abstracts and full texts to identify studies that specifically addressed the integration of AI in educational practices, ultimately leading to a curated selection of literature that supports the conclusions drawn in this study, as shown in Table 2.

Table 2: *Screening process*

Items	**Number**
Number of articles identified based on keywords	340
Number of articles excluded based on titles	121
Number of articles excluded based on abstracts	43
Number of articles excluded based on full articles	97
Duplicates	26
Number of articles included in this review	53

2.2 Exclusion criteria

Following the selection process, the analysis yielded a total of 340 articles identified through the application of specific keywords. After a preliminary review, 121 articles were excluded based on

their titles, and an additional 43 articles were dismissed after examining their abstracts. A further evaluation of the full articles resulted in the exclusion of 97 more articles. Additionally, 26 duplicates were identified and removed from the dataset. Ultimately, this review encompasses a total of 53 articles that met the inclusion criteria. This systematic analysis narrowed the articles down to a final sample size of 53, which was deemed adequate for drawing meaningful conclusions and making informed inferences regarding the use of AI in the context of lesson delivery and coursework evaluation.

3. Presentation of Results

Table 3 presents the results of this study.

Table 3: *The final sample of articles used*

Themes	**Sub-themes**	**Authors**
1. AI in lesson delivery	1.1 Facilitate learner-centred pedagogical approaches	Bao and Liu (2024) Felix and Webb (2024) Tahir et al. (2024) Owan et al. (2023) Ahmad et al. (2022) Huang (2018)
	1.2 Differentiated instruction	Hudson (2024) Ruslim and Khalid (2024) Krishan and Al-rsa'i (2023) Schifeling (2023) Sulistianingrum, Fauziati, Rohmah and Muhibbin (2023) Pozas, Letzel, Lindner and Schwab (2021) Zakarneh, Al-Ramahi and Mahmoud (2020)
	1.3 Personalised learning to enhance student engagement	Bao and Liu (2024) Oklahoma Education (2024) Tahir et al. (2024) Abhay (2023) Harry (2023) Ng et al. (2023) Owan et al. (2023 Shrivastava, Suji Prasad, Yeruva, Mani, Nagpal and Samad, Hamza, Muazzam, Ahmer, Tariq, Ahmad and Mumtaz (2022) Kabudi, Pappas and Olsen (2021) Tahiru, 2021 Chen et al. (2020) Renz and Hilbig (2020) Jain and Jain (2019) Huang (2018)
2. AI in coursework evaluation	2.1 The automation of assessments	Colonna (2024) Gao et al. (2024) Munisamy et al. (2024) Calderon, Serrano, Blanco and Gutierrez (2023). Paiva, Leal and Figueira (2022) Holmes et al. (2019) Skalka, Drlík and Obonya (2019)

		Zawacki-Richter (2019) Ullah, Lajis, Jamjoom, Altalhi, Al-Ghamdi and Saleem (2018) Mekterović & Brkić (2017)
	2.2 The automation of grading and instant feedback	Bao and Liu (2024) Felix and Webb (2024) Adiguzel, Kaya and Cansu (2023) Huang, Zou, Cheng, Chen and Xie (2023) Harry (2023) Owan et al. (2023) Nazaretsky, Ariely, Cukurova and Alexandron (2022) Holmes and Tuomi (2022) Ahmad et al. (2022) Munir, et al. (2022) Chen et al. (2020) Smutny and Schreiberova (2020) Jain and Jain (2019) Rus, D'Mello, Hu, and Graesser (2013) Mikropoulos and Natsis (2011) Munir, Vogel and Jacobsson (2022) Wilcox (2015) Jain, Gurupur, Schroeder and Faulkenberry (2014)

4. Discussion of Findings

In recent times, renowned companies like Amazon, Google, and Facebook have made substantial financial investments in the development of AIED products. They have joined the ranks of well-established AIED companies such as Knewton and Carnegie Learning, which have received multimillion-dollar funding. Additionally, the Global Learning XPrize, with a budget of $15 million, has sought software solutions that enable children to manage their learning process independently (Holmes et al., 2019). Tahir et al. (2024) suggest that AI has found multiple applications within the education sector, encompassing tasks such as content creation, delivery, evaluation, feedback provision, and student support.

4.1 AI in lesson delivery

AI is utilised in various aspects of the education sector, including curriculum and content creation, as well as instructional methods that incorporate technologies such as virtual reality, web-based platforms, robotics, video conferencing, audio-visual materials, and 3D technology (Chen et al., 2020). These advancements have improved the learning experience for students (Chen et al., 2020). Similarly, Ouyang and Jiao (2021) note that AI can support learner-centred pedagogical approaches, differentiated instruction, and personalised learning to enhance student engagement in the learning process.

4.1.1 Adaptability in learning: The role of AI in facilitating learner-centred pedagogical approaches

Adaptability is increasingly recognised as a crucial factor in enhancing educational outcomes through technology. AI serves as a valuable resource for augmenting the adaptability of educational technology. By leveraging AI, these technologies can better align with individual student needs, capitalise on their strengths, and facilitate the development of their knowledge and skills. Given AI's capabilities to process natural inputs and the inherent advantages of its models, it stands out as a

powerful tool for enhancing the adaptability offered to learners. However, it is important to recognise that, particularly in the context of AI, the concept of adaptivity is often more nuanced and constrained than the general notion of "meeting students where they are" might imply (Cardona et al., 2023).

AI enhances the efficiency and flexibility of content delivery by replacing traditional classroom instruction, allowing students to access learning materials from any location and at any time. In the wake of the COVID-19 pandemic, Ahmad et al. (2022) note that educational institutions have transitioned to online learning platforms such as Learning Management Systems, MOOCs, and MOODLES. Felix and Webb (2024) assert that educational support platforms offer educators a variety of tools and materials, including lesson plans, quizzes, and activities, to enhance classroom instruction. Platforms like TeacherMatic and the Oak National Academy provide valuable resources for educators to utilise in their teaching practices (Felix & Webb, 2024). AI can create various types of content such as textbooks, customised learning materials, and interactive courses that cater to specific target audiences. Tahir et al. (2024) add that by utilising AI-driven technologies like cloud computing, educators can effectively deliver learning materials to students in a format that meets their diverse needs.

Huang (2018) demonstrated that the incorporation of AI in education has successfully facilitated learner-centred learning (Owan et al., 2023). Bao and Liu (2024) argue that AI enhances learning experiences and boosts student outcomes, offering a promising solution through data analysis, personalised instruction, and automated administrative processes. However, educators should ensure that AI tools are used to complement, rather than replace, traditional teaching methods, fostering critical thinking and creativity among students. Additionally, learners must be aware of the importance of maintaining their engagement and agency in the learning process, as excessive dependence on AI could hinder their ability to develop essential skills and competencies.

4.1.2 Differentiated instruction: the role of AI in creating differentiated instruction plans

Zakarneh et al. (2020) observe that educators face difficulties in addressing the diverse needs of weak, average, and advanced learners within mixed-ability classrooms. According to Schifeling (2023), differentiated instruction represents a pivotal advancement in educational practices. Hudson (2024) explains that differentiated instruction is an educational strategy that acknowledges the varied requirements of learners and modifies teaching techniques to meet those needs. Ruslim and Khalid (2024) describe it as an educational strategy designed to address the diverse needs of students within a classroom setting. In contrast to conventional teaching methods, which often employ a uniform approach for a large group of students, differentiated instruction emphasises tailored learning experiences that cater to the individual needs of each student (Schifeling, 2023). AI significantly contributes to the development of differentiated instruction plans by streamlining the evaluation of student data and recommending adjustments to lesson materials, pacing, and assessment strategies. Schifeling (2023) provides a compelling example of the application of this approach in a classroom setting.

Consider a straightforward scenario involving two students: Lola and Rhonda. Lola faces challenges with adding fractions but excels in reading comprehension, while Rhonda struggles with understanding the stories presented but demonstrates exceptional skill in solving fractional problems. In a conventional classroom environment, instruction typically targets the average student in both subjects, which may lead to Lola feeling overwhelmed during math lessons and Rhonda experiencing boredom, and vice versa in reading comprehension.

Tomlinson (2017) asserts that differentiated instruction prioritises the varied needs of students. Schifeling (2023) states that by offering tailored support—providing foundational fraction assistance and advanced reading tasks for Lola, while doing the opposite for Rhonda—it is possible to alleviate

both frustration and disengagement, allowing each student to learn at the peak of their potential. This approach enables educators to effectively cater to the diverse learning preferences present in a single classroom (Hudson, 2024). Kilbane and Milman (2023) argue that dynamic and personalised instruction can be achieved when educators purposefully create tailored learning experiences. Thus, differentiated instruction is a pedagogical strategy designed to address the varied needs of students within a classroom setting. It entails adjusting the content, instructional methods, assessment products, and learning environments to align with the unique learning preferences, readiness levels, and interests of each student (Ruslim & Khalid, 2024). Educators advocate for differentiated instruction based on the premise that students possess distinct learning styles, and its effectiveness is often bolstered by administrative support (Ruslim & Khalid, 2024). In implementing differentiated strategies, educators create adaptable learning experiences by modifying key instructional components such as content, process, product, and the learning environment to address the inherent diversity in student readiness, interests, and backgrounds (Kilbane & Milman, 2023).

Human productivity is inherently restricted by the finite number of hours available each day; however, the latest generative AI technologies operate without such limitations (Schifeling, 2023). The successful application of differentiated instruction requires a deliberate effort, coupled with sufficient knowledge and a commitment to engage in the instructional process (Sulistianingrum et al., 2023). Sulistianingrum et al. (2023) highlight that educators with extensive educational experience and tenure are more adept at accommodating students' sensory learning preferences, thereby facilitating effective classroom management through differentiated content. Research by Krishan and Al-rsa'i (2023) indicates that integrating technology into differentiated instruction can enhance student motivation in science education. These tools can produce a wide variety of lesson plans and educational resources in mere seconds (Schifeling, 2023). Pozas et al. (2021) demonstrated a positive correlation between educators' differentiated instruction practices and students' well-being, social inclusion, and academic self-concept. Nonetheless, the implementation of differentiated instruction remains infrequent among educators due to its demanding and complex nature.

Educators must exercise caution when integrating AI into the creation of differentiated instruction plans. They should be mindful of the potential for over-reliance on technology, which may diminish the emphasis on the human elements of teaching, such as empathy and interpersonal connections. Additionally, learners might become overly dependent on AI-driven tools, potentially hindering their ability to develop critical thinking and problem-solving skills independently. Educators need to strike a balance between leveraging AI's capabilities and maintaining a supportive, interactive learning environment that fosters student engagement and growth.

4.1.3 Personalised learning: the role of AI in enhancing student engagement

The integration of AI in education represents a burgeoning area within educational technology, offering significant opportunities to enhance large-scale teaching settings and provide immediate feedback to learners, thereby facilitating personalised learning experiences (Gao, Merzdorf, Anwar, Hipwell & Srinivasa, 2024). Shrivastava et al. (2023) contend that one of AI's most notable benefits is personalised learning, which allows students to learn at their own pace and in a manner that aligns with their learning style. This integration has transformed the approach to student education (Harry, 2023). Personalised learning is an instructional approach that customises learning experiences based on the unique requirements, capabilities, limitations, and preferences of individual students (Samad et al., 2022). Harry (2023) asserts that the use of AI in education offers substantial advantages. The implementation of AI in personalised learning allows for individualised instruction, a feat previously unattainable in traditional large class settings (Renz & Hilbig, 2020). Additionally, Jain and Jain (2019) point out that AI can be used in adaptive and personalised learning to meet the individual needs of students. By assessing students' comprehension levels, AI assists educators in providing suitable guidance and hints to enhance their understanding (Jain & Jain, 2019).

Furthermore, large groups of students can be taught effectively without placing additional burdens on educators, which is particularly relevant for massive open online courses (MOOCs) (Skalka et al., 2019). The learning process becomes more efficient as error tracking enables the fragmentation, quantification, and analysis of various components, such as challenging topics, difficult examples, and the number of attempts required for mastery (Skalka et al., 2019). Educators can create customised instructional materials that cater to the individual needs of their students, thereby automating certain tasks and personalising the learning experience (Ng et al., 2023). Ng et al. (2023) explain that through data analysis, educators can modify their teaching methods and create tailored learning materials to address the individual needs of students throughout the course. They can adapt their instructional approaches to accommodate evolving learning environments and objectives set by educators or online learning platforms.

Significant progress has been achieved in the field of education with the introduction of creative approaches that go beyond traditional teaching and learning methods (Negoiță & Popescu, 2023). The authors point out that the integration of AI in educational environments aims to transform conventional pedagogical techniques, enhancing the personalisation, efficiency, and adaptability of learning experiences. AI provides a significant advantage in education by enabling flexible and convenient learning opportunities. According to Tahir et al. (2024), AI can alleviate workloads by aiding in educational planning and production through various means. Furthermore, AI can automate or assist in administrative tasks, such as generating emails, reports, or seating plans (Felix & Webb, 2024).

AI has the potential to support personalised learning for students, thereby enhancing their learning requirements (Tahir et al., 2024). Learners can engage in educational activities at their own pace and in their preferred locations through the utilisation of AI technology and resources (Kabudi et al., 2021; Tahiru, 2021). Owan et al. (2023) argue that AI-driven assessment tools offer various advantages, such as improving assessment precision and efficiency, delivering tailored feedback to students, and allowing educators to adjust their teaching methods to cater to individual student needs. Adaptive learning systems can thoroughly analyse the performance, preferences, and learning styles of students (Oklahoma Education, 2024). Subsequently, these systems can make appropriate adjustments to the content, pacing, and difficulty levels of the learning materials (Oklahoma Education, 2024). Adaptive learning systems ensure that each student receives a personalised and tailored learning experience that addresses their individual needs and abilities. This adaptability facilitates a more efficient and effective learning process, optimising the educational content to match the unique requirements of each student. Chen et al. (2020) conclude that AI has significantly enhanced the effectiveness of various administrative duties that would typically demand a substantial amount of time from instructors if AI were not in place.

Student engagement can be enhanced through the utilisation of AI, which offers interactive and captivating learning experiences. This is supported by Harry (2023), who argues that the use of AI has the potential to enhance student engagement through the provision of interactive and engaging learning experiences. In this optimised setting, students can actively participate in their learning process, as AI systems can adapt to their individual needs and preferences. Harry (2023) points out that one way this can be achieved is through the implementation of chatbots and virtual assistants, which add an element of enjoyment and interactivity to the learning process. Additionally, adaptive learning technologies can ensure that students remain engaged by delivering educational content that aligns with their comprehension levels (Harry, 2023). Through personalised feedback, interactive simulations, and virtual reality applications, AI can create a dynamic and immersive learning environment that fosters student engagement and motivation. Furthermore, AI can analyse vast amounts of data to identify patterns and trends in student performance, enabling educators to tailor their instructional strategies and interventions accordingly.

Educators and learners must exercise caution when integrating AI into personalised learning environments. Educators should remain vigilant in ensuring that AI tools are used ethically and transparently, fostering an environment where students are encouraged to think critically and independently. Additionally, learners should be aware of the implications of their data being used by AI systems, advocating for their rights and understanding the importance of maintaining a balance between technological assistance and traditional learning methods.

4.2 AI in coursework evaluation

The incorporation of AI into automated assessment and feedback systems represents a significant advancement in educational practices (Analytikus Education, 2024). These AI-based tools have the potential to fundamentally change how educators assess student performance and deliver feedback, thereby enhancing both the learning experience and educational outcomes (Analytikus Education, 2024).

4.2.1 Automated assessments

In the field of education, the method of assessment significantly impacts learners' choices regarding their study techniques (Calderon et al., 2023). Paiva et al. (2022) point out that assessment encompasses the evaluation, quantification, and communication of students' academic preparedness, learning advancement, skill development, and educational deficiencies. Assessments are often portrayed as significant factors in educational discussions, contributing to the preservation of institutional resistance (Holmes et al., 2019). They play a crucial role in the educational process by facilitating a reciprocal feedback mechanism. Assessments not only inform students about their progress toward learning objectives but also equip educators with insights into overall learning dynamics, ranging from the performance of an entire class to the understanding of individual students in particular subjects (Paiva et al., 2022). Colonna (2024) emphasises that assessments should not only measure students' achievement of the specified learning outcomes but also foster and promote their attainment. They offer educators immediate insights into students' learning progress and highlight areas that require further clarification (Gao et al., 2024). Consequently, Calderon et al. (2023) note that assessment is regarded as a crucial component of the learning process, encompassing the various phases that learners experience in their pursuit of new knowledge. Technology significantly aids in the development of diverse automated assessment (AA) tools (Calderon et al., 2023). Colonna (2024) states that the integration of AI in assessments has revolutionised higher education by providing innovative methods for comprehending student learning that were once deemed impractical. Evaluations conducted through software that analyses various factors and attributes are now common (Munisamy et al., 2024). This software generally employs an assessment framework grounded in a rubric that outlines the specific characteristics to be examined (Munisamy et al., 2024).

According to Calderon et al. (2023), the initial application of digital tools often avoided intricate assessment formats due to the challenges associated with creating the necessary algorithms. Nonetheless, such assessments failed to compel students to engage deeply with the concepts they studied, potentially resulting in a superficial understanding of the material (Calderon et al., 2023). Today, the technical infrastructure of automatic assessment systems (AAS) has become more efficient, along with a growing body of research that highlights promising opportunities for AI in education. Zawacki-Richter (2019) argues that recent advancements in AI allow for the categorisation of applications into main areas, including assessment and evaluation tools focused on automated grading, providing feedback, evaluating student comprehension, engagement, academic integrity, and teaching effectiveness. For Skalka et al. (2019), AA is the process of evaluating and grading programming assignments or coding tasks using computerised systems. It involves running tests and analysing the output produced by the submitted code to determine its correctness and efficiency (Skalka et al., 2019). AA uses software or digital platforms to assess student performance in a

classroom context (Munisamy et al., 2024). Colonna (2024) states that a significant advantage of AI-driven applications in assessment lies in their ability to analyse various data points gathered throughout the learning journey, thereby facilitating more iterative feedback mechanisms and enabling personalised or adaptive learning pathways. Rather than focusing solely on a limited number of high-stakes assessments that can induce stress for both students and institutions, as well as restrict the time available for formative assessments, AI has the potential to encourage ongoing evaluation of student learning (Colonna, 2024). Various types of exercises featured in these assessments encompass single-choice and multiple-choice questions, fill-in-the-blank tasks, as well as activities involving the ordering of words or sentences, among others (Calderon et al., 2023). Moreover, Gao et al. (2024) observe that, in the realm of higher education, both formative and summative assessments play a crucial role in fostering active learning. Thoughtfully crafted assessments stimulate students' engagement in critical thinking, problem-solving, and metacognitive processes, facilitating the integration of learning activities with deeper conceptual comprehension (Gao et al., 2024). Ullah et al. (2018) explain that AA offers advantages by providing students with immediate feedback on the correctness of their work, allowing them to learn at their own pace (Ullah et al., 2018). Educators also benefit from saved time, as they no longer need to spend excessive hours grading assignments or addressing recurring mistakes (Mekterović & Brkić, 2017). For instance, students in higher education could respond to open-ended questions and receive immediate feedback aligned with model answers from educators, which could enhance the quality of student submissions and allow instructors to allocate their time to other important responsibilities (Colonna, 2024).

AI technologies facilitate the rapid analysis of large volumes of data. However, both educators and learners need to exercise caution in their reliance on these systems. Educators must remain vigilant about the potential biases inherent in AI algorithms, ensuring that assessments are fair and equitable. Meanwhile, learners should be aware of the limitations of automated assessments, recognising that while AI can offer valuable insights, it may not fully capture the nuances of human understanding and creativity. Therefore, a balanced approach that combines AI capabilities with traditional assessment methods is advisable to foster a comprehensive educational environment.

4.2.2 Automated grading and feedback systems

The emergence of AI technology has brought about a substantial shift in the evaluation and appraisal of learning (Bao & Liu, 2024). Jain and Jain (2019) argue that the education system now utilises AI for grading purposes, enabling educators to automate the grading process for specific predetermined questions. Likewise, Holmes and Tuomi (2022) state that AI can facilitate automated assessment, with a practical application in the automation of grading homework and tests, which typically consumes a considerable amount of time. Wilcox (2015) conducted research aimed at enhancing average final exam scores through the implementation of automated grading, specifically focusing on AA. The findings indicated that automating essential processes, such as programme grading, could conserve valuable resources in introductory courses while maintaining academic performance levels. Wilcox (2015) reported that students utilising automated grading achieved notably higher exam scores.

Ahmad et al. (2022) specify that evaluating a student involves gathering and examining data, making sense of it, and making decisions based on that data regarding the student's progress towards educational objectives. Various forms of evaluation exist, but the selection of a specific method is determined by the intentions and preferences of the evaluator. Ahmad et al. (2022) believe that evaluating a significant number of students can be a challenging endeavour. Conventional approaches to assessing student learning have frequently been constrained by their fixed characteristics and inability to offer personalised real-time feedback.

In April 2023, the Department for Education published the 'Working Lives of Teachers and Leaders' report, which surveyed more than 10,000 educators and leaders in English state schools (Felix & Webb, 2024). The findings revealed that 72% of educators perceived their workload as excessively high, with this issue identified as the primary factor prompting many to contemplate leaving the state school system. Additionally, 66% of educators indicated that they dedicated less than half of their working hours to actual teaching, as a significant portion of their time was consumed by lesson planning, grading, monitoring student data, and fulfilling administrative responsibilities.

Felix and Webb (2024) contend that various marking technologies, such as Graide and Progressay, are utilised to aid in the assessment and evaluation of student assignments through a combination of teacher input and AI-driven grading systems. Virtual teacher assistants in the form of chatbots can ask students questions using straightforward instructions and offer guidance through a variety of inquiries (Smutny & Schreiberova, 2020). Another illustration of AI-driven automated grading involves the utilisation of automated essay grading systems (Harry, 2023). These systems leverage natural language processing and machine learning algorithms to assess student essays and provide immediate feedback and scoring (Harry, 2023). Rus, D'Mello, Hu, and Graesser (2013) suggest that intelligent tutoring systems (ITSs) have a wide range of functions, including grading and providing feedback to students. Through ITSs, educators can offer personalised instruction, track student progress, and pinpoint specific areas where additional support is required. These platforms can also automatically provide feedback to students, enhancing the learning process (Felix & Webb, 2024). Likewise, Owan et al. (2023) argue that immediate feedback is a key feature of these systems, which can effectively keep students motivated and engaged in their learning. This feedback aids students in recognising their strengths and weaknesses in specific areas (Nazaretsky et al., 2022). Notable examples of immediate feedback systems include ALEKS, Carnegie Learning, and Knewton (Owan et al., 2023). Moreover, instructors can benefit from specific programmes like Knewton, as they offer a platform for students to receive feedback based on their interactions on the platform (Chen et al., 2020). Mikropoulos and Natsis (2011) reveal the availability of programmes like TurnItIn and Ecree, which enable educators to conduct administrative functions such as providing feedback on assignments and detecting plagiarism.

Huang, Zou, Cheng, Chen, and Xie (2023) specify that automated assessment tools utilising AI can evaluate students' written work and offer insights on grammar, organisation, and substance, thereby diminishing the workload of educators when assessing assignments. These systems enable the evaluation of different question formats, including short-answer questions and multiple-choice questions (Ahmad et al., 2022). Moreover, the Intelligent Knowledge Assessment System offers a systematic method for evaluating a student's understanding of a specific subject (Jain et al., 2014). These systems aid in adapting and enhancing learning by assessing the student's existing knowledge and identifying any areas that may require further attention. Additionally, the knowledge assessment system utilises concept maps created by domain experts to analyse the student's comprehension of various concepts (Jain et al., 2014).

According to Adiguzel, Kaya, and Cansu (2023), automated grading systems powered by AI have the potential to streamline the grading process, allowing educators to save time and provide students with prompt feedback on their assignments. Through the analysis of essays, reports, and other written tasks, AI can effectively evaluate grammar, spelling, and syntax. This technological advancement enables educators to allocate their time more efficiently towards crucial responsibilities, such as lesson planning and providing support to students, resulting in notable time savings (Adiguzel et al., 2023). The customised evaluation system that facilitates adjustment and learning offers an analysis of a student's current knowledge and helps to pinpoint any knowledge gaps the student may have (Jain et al., 2014). Several significant aspects of this system include: a) recognising the student's existing knowledge; b) diagnosing unfamiliar concepts to the student; and

c) determining the enhancement in the student's comprehensive grasp of the subject matter (Jain et al., 2014).

Bao and Liu (2024) conclude that AI plays a pivotal role in the automation of various administrative tasks, such as grading, scheduling, and lesson delivery. AI has revolutionised the educational sector by streamlining the grading process through automated systems that can efficiently evaluate and provide feedback on student assignments. Additionally, AI algorithms have been instrumental in optimising scheduling procedures by analysing data to create personalised timetables that cater to the specific needs and preferences of students and educators. This automation enables educators to dedicate more of their time to teaching and mentoring, ultimately enhancing the overall educational experience (Munir, Vogel & Jacobsson, 2022), which can result in improved student outcomes. Furthermore, AI technologies such as intelligent tutoring systems, chatbots, and automated grading and assessment can enhance efficiency, save educators' time, and provide precise and consistent feedback.

Harry (2023) argues that automating routine tasks like grading, data analysis, and administrative duties can save a significant amount of time for both educators and learners, allowing them to focus their efforts on more substantial and valuable activities. Streamlining these processes through automation enables educators to allocate more time to provide personalised attention to students, fostering a more engaging and interactive learning environment. Students, on the other hand, can utilise the extra time to delve deeper into their studies, explore new concepts, and engage in critical thinking exercises that enhance their overall academic experience. However, it is essential to exercise caution regarding the potential biases inherent in AI algorithms, which may inadvertently perpetuate existing inequalities or misinterpret student responses. Therefore, while the integration of AI in grading systems offers numerous advantages, it is crucial to ensure that these technologies are developed and implemented with a focus on fairness, transparency, and continuous improvement to safeguard the integrity of the educational process.

4.3 Implications of the results

The literature suggests that AI holds significant promise for improving educational outcomes in large-scale teaching environments. However, it is crucial to adopt a careful and systematic approach when integrating such technologies into educational settings. This approach should begin with a comprehensive assessment of the specific needs and objectives of the educational institution, ensuring that the technology aligns with the curriculum and enhances the learning experience. Stakeholder engagement is vital, involving educators, students, and parents in discussions to gather diverse perspectives and foster a sense of ownership. Additionally, professional development for educators must be prioritised, equipping them with the necessary skills and knowledge to effectively utilise technology in their teaching practices. Continuous evaluation and feedback mechanisms should be established to monitor the impact of the technology on student learning outcomes, allowing for adjustments and improvements as needed. These deliberate steps, if undertaken carefully, can drive educational institutions to create a supportive environment that maximises the benefits of technological integration while minimising potential challenges. However, the complexities associated with AI, including ethical considerations, data privacy concerns, and the need for adequate training for educators, necessitate a thorough evaluation before widespread adoption. Furthermore, the variability in student needs and learning styles must be taken into account to ensure that AI tools are effectively tailored to support diverse learners. Therefore, while the benefits of AI in education are promising, a prudent strategy that prioritises thoughtful implementation and ongoing assessment is essential to maximise its positive impact on learning outcomes.

5. Conclusions and Recommendations

Numerous AI applications have been developed to support the various academic responsibilities and duties of educators. On one hand, these applications play a crucial role in enhancing the learning process and aiding learners in improving their skills. In the realm of content delivery, educational institutions have shifted towards online learning platforms such as Learning Management Systems, MOOCs, and MOODLES. These platforms provide educators with a range of resources and tools, including lesson plans, quizzes, and activities, to enrich classroom teaching. Notable examples include TeacherMatic and the Oak National Academy. These AI tools assist educators in enhancing their instructional methods, reducing their workload, and optimising their time for teaching and mentoring students. On the other hand, AI applications are also utilised for tasks such as grading and evaluation, as well as assessing academic papers. Consequently, various marking technologies, such as Graide and Progressay, are employed to assist in evaluating student assignments. Moreover, chatbots interact with students by asking them questions using clear instructions. In addition, automated essay grading systems utilise natural language processing and machine learning algorithms to evaluate student essays and provide instant feedback and scoring. Intelligent Tutoring Systems (ITSs) have a broad range of functionalities, including grading assignments and offering feedback to students. These AI tools not only assist in providing valuable feedback to learners but also contribute to the evaluation of their progress. In conclusion, the incorporation of artificial intelligence in large-scale teaching environments represents a transformative approach that can lead to improved educational outcomes and a more adaptive learning ecosystem.

To create suitable learning environments for students to effectively tackle real-world challenges using AI in the classroom, educators must focus on enhancing their pedagogical and technological competencies. By developing a deep understanding of pedagogy, educators can effectively design instructional strategies that align with the needs and abilities of their students. Additionally, educators need to stay updated with the latest technological advancements and tools related to AI, as this will enable them to integrate AI seamlessly into their teaching practices. By combining their pedagogical expertise with technological know-how, educators can create engaging and authentic learning experiences that empower students to solve problems using AI.

Educators can enhance their use of AI for assessing learners' progress by ensuring that the AI tools employed are reliable and accurate in their assessments. It is important to thoroughly vet the AI technology being used to ensure that it aligns with the specific learning objectives and outcomes. Additionally, educators should provide clear guidelines and instructions to learners on how to effectively use the AI tools for assessment, ensuring that learners understand the process and can utilise the technology to its full potential.

To facilitate the provision of feedback using AI, educators should establish a system for collecting and analysing the data generated by the AI tools. This data can provide valuable insights into learners' progress and performance, allowing educators to tailor their feedback and support accordingly. Educators should also encourage learners to actively engage with the feedback provided by the AI tools, using it as a means for self-reflection and improvement. By creating a feedback loop that incorporates AI technology, educators can help learners track their progress and make informed decisions about their learning journey. Moreover, educators should acquire the necessary skills to utilise a diverse range of AI technologies to effectively monitor learners' progress, evaluate their advancements, provide constructive feedback, and adjust their teaching methodologies accordingly. By harnessing the power of AI tools, educators can enhance the learning experience for students and tailor their instructional approaches to better meet the individual needs of each learner.

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