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Personalized Learning Through ICT and Artificial Intelligence: A New Paradigm for Education

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Abstract:

The use of Information and Communication Technology (ICT) and Artificial Intelligence (AI) is changing the way teaching and learning is done, providing opportunities for personalised, flexible and learner-centred learning. In this research, the use of ICT and AI to enhance personalization of learning and to customize learning content, teaching strategies and learning activities to accommodate the variability in learning needs, learning abilities, interests and learning progress in students is explored. It covers the potential benefits of adaptive learning environment, intelligent tutoring systems, learning analytics, virtual learning environment and digital educational resources in improving student engagement, learning outcomes and learning self-directedness. Technology tools also provide opportunities for educators to use their data to better understand learning gaps, provide timely feedback, and develop new and targeted ways to teach. It recognizes the critical issues of the digital divide, data privacy, algorithmic bias, inequitable access to technological resources and proper teacher training, in addition to these opportunities. The study highlights the importance of technology as a means to enhance and not supplant the professional judgment and human interaction of educators. It argues in favor of the adequate use of ICT and AI to be supported by an appropriate institutional policy, complemented by digital infrastructure, ethical protection mechanisms, and a constant assessment. The paper concludes that personalized learning with the support of ICT and AI can create an inclusive, responsive and learner-centred education environment which can lead to better educational quality and meaningful learning outcomes.

Keywords: Personalized Learning, Information and Communication Technology (ICT), Artificial Intelligence, Adaptive Learning, Educational Technology, Student Engagement, Digital Education, Learning Analytics.

Introduction

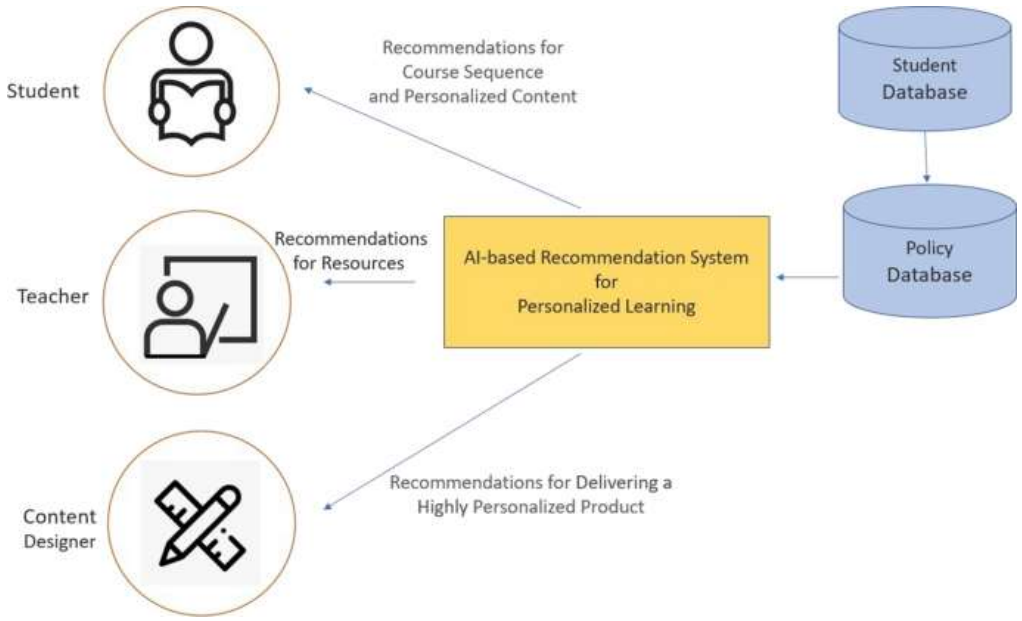
Information and Communication Technology (ICT) and Artificial Intelligence (AI) are rapidly shaping the education landscape by altering the delivery, access, understanding and evaluation of knowledge. Past instructional methods are often based on the same pattern for all students and do not necessarily meet the needs of diverse students' learning abilities, interests, prior content knowledge, and academic needs. The current situation of education seeks flexible, inclusive and learner-centred approaches that take into consideration individual differences and offer meaningful learning experiences. Personalised learning has therefore become an important approach to learning as the process of instruction can be tailored to the individual needs, speed and development of pupils. The integration of ICT and AI is providing new opportunities to enhance this process and to build technology-enabled and responsive learning environments.

ICT has greatly broadened the range of possibilities for teaching and learning in digital classrooms, learning management systems, learning platforms, multimedia, virtual laboratories and collaborative learning applications. The technologies offer ways to bring out-of-classroom education to students and for teachers to deliver lessons and evaluate student learning in new ways. Digital resources also help to stimulate self-learning, knowledge

sharing, communication and interaction. ICT-based technologies enable students to go over learning material again, participate in online discussions, complete interactive activities and receive education support, depending on their needs. ICT has thus become part and parcel of the flexible and accessible learning environments as building blocks.

The integration of Artificial Intelligence enhances personalized learning by integrating intelligent systems that can analyse learning patterns and react to students' academic needs. The educational application with Artificial Intelligence can review the results of the assessment, identify gaps in knowledge, recommend learning materials and provide feedback in real-time. AL platforms have the option to adjust difficulty and the sequence of instruction based on student results. As an additional, there are intelligent tutoring systems, automated assessment, conversational learning assistants and predictive learning analytics which can assist them during the learning process as well. The applications provide valuable data about pupils' progress and provide insight into those pupils who require additional learning support. So, AI has the potential to transform traditional educational technology from content delivery to a more interactive and adaptive learning support system.

Incorporating ICT and AI also provides opportunities towards enhancing the effectiveness of teaching and the role of teachers. These technologies do not aim to take over the role of the teacher, but to support teachers with lesson planning, creating differentiated instruction, monitoring student progress and providing timely academic intervention. While there are many benefits of using learning analytics and AI-powered tools, teachers can also benefit from learning analytics to gain insights into patterns of student engagement and achievement, and AI-powered tools can streamline some routine administrative and assessment tasks. This will allow teachers to concentrate on mentoring, thinking skills, creativity, collaborative learning with students and social and emotional development of students. To harness these technologies, however, access to digital skills, institutional support and infrastructure, alongside continued professional development for teachers is essential.



Source: https://link.springer.com/article/10.1007/s44163-025-00598-x

While personalized learning, using ICT and AI tools is beneficial, there are some challenges that must be considered. Digital access to devices, quality Internet connectivity and access to learning resources can further contribute to learning disparities. Ensuring student data privacy, cybersecurity, algorithmic bias, transparency, and undue reliance on automation systems are also crucial needs. In addition, AI generated suggestions cannot always address the cultural, linguistic, emotional and contextual requirements of individual learners. It is therefore the responsibility of educational institutions to have a responsible policy for technology and make sure that the role of human judgment, guidance of the teacher and meaningful interactions with students are not neglected in the learning process.

In this context, personalized learning using the use of ICTs and AI is an important step towards a more learner-centred and technology-driven approach to learning. The availability of digital tools is not sufficient, but how they can be implemented in a considered manner in the design of the curriculum, pedagogy, assessment and institutional policies. This research paper proposes the concept of personalized learning with the help of ICT and AI so as to investigate into a new paradigm of learning. It highlights the potential of these technologies to improve student engagement, learning outcomes, flexibility in learning and teaching, and the technological, ethical and institutional challenges associated with the use of these technologies. The study seeks to contribute to the general knowledge and understanding of the potential of the responsible use of ICT and AI in the development of education that is accessible, inclusive and sustainable.

Background of the study

The use of information and communication technology (ICT) and artificial intelligence (AI) in the field of education is increasingly being adopted, which has resulted in a significant shift in the way education is being carried out. In most of the traditional education model the course content, teaching speed and testing form are common for a group of students. While this model offers a standard structure for classroom teaching and learning, this might not be sufficient to meet differences in students' ability to learn, interests, prior knowledge, and educational needs. A spectrum of explanation, practice, guidance and feedback is frequently needed for each learning object. Such differences have encouraged teaching and learning to be more flexible and student centred, particularly in terms of personalisation.

Personalized learning is a learning approach where learning resources, instructional methods, activities and assessments are customized and tailored to the needs and progress of the learner. Personalised learning recognises the diversity of children's learning styles and preferences, and provides opportunities for children to learn in a way that enables them to do so at their own pace. It encourages active learning, individual learning, constant feedback and individual skills development. ICT and AI has been useful in this regard in creating more responsive and flexible education environment.

The use of information and communication technology has increased the potential for teaching and learning beyond the walls of the classroom. The students can access the learning materials through digital learning platforms, learning management systems, online classrooms, applications, multimedia resources and virtual learning environments at different times and spaces. Also, these technologies give possibilities to collaborative learning, digital communication and access to various academic resources. Digital platforms can be used to provide learning resources, set assessments, monitor learning and provide feedback. Thus, ICT has been involved in the access, interactiveness and flexibility of education.

In addition, AI can augment the flexibility of personalized learning by enabling educational systems to analyze information related to learning and tailor it to the needs of individual students. Teacher-bot/Intelligent systems can monitor student progress patterns, recommend the correct materials, develop personalized learning activities and provide immediate feedback. Adaptive learning systems have the capability to modify their learning content and/or presentation order based on the learner's progress. Additionally, AI-driven educational support and intelligent tutoring systems can help students by offering explanations, responding to questions, and providing additional learning support. These applications can help teachers to identify the areas in which students are having difficulty and the kind of intervention they should consider for each student.

The use of ICTs and AI also provides a potential for better role of teachers in learning process. The technologies may help, not supplant teachers by reducing repetitive administration tasks, organizing information for learning, and helping to prepare teaching materials. Digital learning systems can provide data that can inform teachers about their students' progress and provide them with a more personalized academic support. This allows teachers to dedicate more time to coaching, problem solving, thinking, creating and engaging in meaningful conversations in the classroom. The effective use of technology, however, also relies on the digital skills of teachers and their ability to integrate technology and good pedagogy.

While these are opportunities, there are also a number of challenges to consider for the implementation of AI support in personalized learning. The inequities among students can stem from the digital infrastructure, Internet

access, use of devices, and technology literacy. The other problems cover responsible use, algorithmic bias, transparency, cyber security and data privacy. Overuse of technology can reduce opportunities for student-teacher interaction if technology is not introduced properly. Further, AI-generated ideas may be culturally or contextually sensitive and not always reflect the emotional, social and cultural aspects of learning. The restrictions underscore the importance of setting up suitable institutional policies, training teachers, establishing ethical guidelines, and regular assessment of digital learning systems.

In the Indian scenario, the growing emphasis on digital education and the adoption of technology in education has led to the emergence of the idea of implementing ICT and AI in educational institutions. The relevance of personalized learning has been enhanced through digital learning infrastructure, online learning resources and technology-supported learning. However, there are differences in institutional capacity, language differences and in teacher training, and these are a factor in the impact of technology on education. It is important to address these challenges in order to enable inclusive equity in education.

The purpose of the present research, titled "Personalized Learning Through ICT and Artificial Intelligence: A New Paradigm for Education", is to examine the influence of ICT and AI in moving the paradigm of the education towards more personalized, adaptive and learner-centred learning experiences. It puts a strong focus on the use of digital platforms, smart learning applications and data-driven learning approaches in order to cater to the needs of every learner and supporting students' learning and engagement. The study also considers the opportunities and challenges for the use of these technologies in educational institutions. The research aims at investigating the technological innovation and pedagogical practices, with the objective to contribute to a better understanding of how ICT and AI can help creating an inclusive, flexible and effective learning environment.

Justification

Education 4.0, which involves immersing the students in the use of Information and Communication Technologies (ICT) and Artificial Intelligence (AI), has opened new doors for changing the education practice. The use of Information and Communication Technology (ICT) and Artificial Intelligence (AI) in education has provided new opportunities for the transformation of traditional teaching and learning. Although there are variations in students' learning abilities, interests, academic backgrounds and individual learning needs, the typical classroom environment commonly follows a predictable teaching and learning model. This can make it difficult for some students to grasp concepts and other students may miss out on elaborate topics. Personalized learning provides a different solution; it tailors the methods of instruction, learning, pace, and assessment to the needs of the student.

As ICTs are increasingly integrated into educational platforms, intelligent tutoring systems, learning platforms, and adaptive learning applications, as well as the use of AI educational tools, it becomes possible to offer more flexible and learner-centred learning experiences.

The concerns mentioned above require an assessment of personalized learning from a technological, pedagogical, ethical and institutional standpoint. The technologies can be used to identify the gaps in learning, to monitor students' academic performance, to provide immediate feedback and to recommend suitable learning materials. They can also guide teachers to know what students are doing and how best to teach them. Hence, it is essential to analyze the synergy between ICT and AI to gain insight into the potential of technology to enhance teaching effectiveness and learning outcomes.

Furthermore, digitalization in education is also on the rise and so is the awareness of digital accessibility, digital infrastructure, teacher readiness, data privacy, algorithmic bias and responsible use of AI. Students may have varying opportunities to use digital devices, Internet access or to learn with technology, which may not be equitable. Likewise, over-reliance on automated systems could impact on engaging teacher/learner interactions and independent thought.

The study is thus justified since it aims at understanding the effective integration of ICT and AI in inclusive, adaptive, interactive and outcome-based learning environment. It aims at understanding the possibilities of technology to enhance student engagement, learning outcomes, flexibility of learning and efficiency of teaching and learning, as well as the challenges that arise during technology implementation. These results may be of

interest to teachers, education institutions, people involved in the policy-making process and technology developers when it comes to developing responsible and sustainable personalized learning practices. The significance of this research is that it is a study of the implementation of conventional uniform teaching to the new flexible and student centered teaching. The study will concentrate on the strategic integration of ICT and Artificial Intelligence and also contribute to the creation of an education system that takes into consideration the differences in learning of individuals, provides the same opportunities to learn, and makes students prepared to adapt to the digital and knowledge-based society.

Objectives of the Study

1. To analyse the impact of the use of ICT and Artificial Intelligence in individualization of learning in educational institutions.
2. To explore how AI tools in the learning process can be used to tailor the delivery of learning to the needs of students, their abilities and learning styles.
3. To investigate the impact of personalized learning technologies on student learning, engagement and motivation.
4. To assess the effectiveness of the use of the ICT-based platforms and Artificial Intelligence based applications in improving the experiences of teaching and learning.
5. To analyze the part of teachers in applying AI and ICT in personalized teaching.

Literature Review

The use of Information and Communication Technology (ICT) and the Artificial Intelligence (AI) technologies has transformed the contemporary school environment, providing potential for customised, flexible and learner-centred teaching and learning. Traditional teaching strategies tend to be delivered in a whole class setting that is based on the sharing of learning goals, content and assessment procedures. Students learn at different paces, have different backgrounds and understandings, different interests, talents and learning needs. Personalised learning is designed to address these individual differences by customising learning activities, learning content, learner feedback and assessment for individuals. AI can augment the digital infrastructure and tools provided by ICT, such as intelligent tutoring, predictive analytics, automated feedback, and adaptive learning pathways, enriching the functionality of educational resources.

1. Evolution of Personalized Learning Through ICT:

ICT have added more possibilities for the delivery of education away from the classroom. Anderson (2008) clarified that online learning offers opportunities for flexible interaction between learners, teachers and education content. Digital platforms, learning management systems, multimedia materials and virtual classrooms allow the students to access learning materials when and where they need to. Means et al. (2013) in their study on online and blended learning also emphasized the potential of technology-integrated instructional environments to enhance learning experiences when technology is used in conjunction with the teaching practices.

Siemens (2005) proposed the concept of connectivism, a theory of learning that focuses on the significance of networks, electronic connections and the ability to access distributed knowledge. This is especially important for ICT-based personalized learning as students are able to acquire knowledge from various digital resources, collaborative spaces, and learning communities.

2. Artificial Intelligence and Adaptive Learning:

With the introduction of AI (Artificial Intelligence), there has been a new opportunity to create personalized learning experiences with the creation of systems that assess student performance and tailor the learning experience. Woolf (2010) referred to the use of ITSs for personalized guidance, monitoring and feedback based on student responses. These systems may be helpful for identifying areas of difficulty with students and provide additional explanations and practice problems.

Luckin et al. (2016) emphasized that AI could help teachers by processing educational information to identify their needs of learning that can’t be easily acquired from the classroom. They also stressed the importance of

maintaining the role of the teacher in decision-making processes and not letting AI take their place. Similarly, Holmes et al. (2019) explored the potential of AI in education, such as personalized learning, intelligent tutoring, automated assessment, and learning analytics. If applications are designed to meet pedagogical goals, they can help foster more responsive educational contexts, as they do in their discussion.

3. Intelligent Tutoring Systems and Student Learning Outcomes:

One of the major applications of AI in personalized learning is intelligent tutoring systems. These systems offer personalized teaching assistance through testing of the learner's response and adjusting the learning activities. In our discussion of the effectiveness of tutoring and intelligent tutoring systems, and other teaching methods, VanLehn (2011) showed that individual guidance is important to student learning. The results of a meta-analysis of the research on the use of intelligent tutoring systems conducted by Kulik and Fletcher (2016) showed positive learning outcomes.

Graesser et al. (2012) presented some of the issues involved in the development of intelligent tutoring systems for dialogue-based learning and for providing students with interactive academic assistance. These may be used to help the learner comprehend the difficult material by asking questions, providing explanations and corrections. However, the effectiveness of intelligent tutoring will depend on the instructional design, accuracy of the intelligent tutoring system, and the match-up between the technology and the subject and student population.

4. Learning Analytics and Data-Driven Personalization:

Learning analytics has emerged as a crucial aspect of technology-mediated learning due to its potential for collecting and analyzing educational data, which can help institutions and teachers gain insights into student learning. According to Siemens and Long (2011), learning analytics is a new approach that allows educational institutions to inform their decisions about learning by analysing learner activities, learning outcomes and learner engagement. Digital learning platforms allow teachers to determine who needs extra academic help and tailor instruction to these students' needs.

In a systematic review of technology-enhanced adaptive and personalized learning, Xie et al. (2019) found that adaptive technologies are increasingly being used to address individual learners' unique performance and teaching needs. They have found that there are different ways, tools and degrees of adaptability in digital personalization. Likewise, Van Schoors et al. (2021) analyzed 25 years of research on the consequences of personalized learning in digital contexts and found that there is a positive trend in learning outcomes, with varying interpretations of personalized learning across the studies. The results indicate that personalised learning is not only dependent on the use of digital platforms, but also on the choice of suitable technologies and linking them to a well-defined educational goal.

5. Personalized Feedback, Assessment, and Student Engagement:

Feedback is an important part of the learning process that helps students to see how they are doing, identify their errors and make better progress in their learning. Feedback is typically given at the end of an assignment or a test in traditional grades. Digital learning environments, on the other hand, can provide instant feedback, personalised explanations, and practice opportunities. Shute (2008) states that formative feedback works best when it aids pupils' learning and performance in the content, rather than merely evaluate it.

AI-driven feedback systems can be further leveraged to analyse student responses and provide explanations that resonate with the students' needs. Recent personalized feedback in digital learning environment review from 2022 recognized various feedback implementation practises and explored the relationship between personalized feedback and learning outcomes. The results emphasize the need to create feedback based on learners' needs and instructional situation.

In addition, customised learning spaces can contribute to greater engagement in learning by affording students working at an appropriate level and support when required. However, the quality of teaching and learning, motivation of learners and meaningful interaction with teachers and fellow learners is also part of engagement.

6. Role of Teachers in ICT- and AI-Enabled Personalized Education:

The use of ICT and AI does not diminish the role of teachers, rather it transforms their role and enhances their teaching power. Mishra and Koehler (2006) developed the Technological Pedagogical Content Knowledge (TPACK) model which states that the effective integration of technology needs teachers to possess the technological knowledge, pedagogical knowledge, and content knowledge. The framework has implications for personalized learning in that the value of digital tools for learning is limited when teachers do not know how to leverage them to support learning goals.

In a systematic literature review of AI applications in higher education, Zawacki-Richter et al. (2019) analyzed applications of AI including profiling and prediction, assessment and evaluation, adaptive systems, and intelligent tutoring. The limited education involvement in certain AI studies was also highlighted by their review, along with the importance of taking pedagogical aspects into account with the use of such technologies.

This study, entitled Personalized Learning Through ICT and Artificial Intelligence: A New Paradigm for Education, aims to tackle these concerns by discussing how ICT and AI could work together to revolutionize teaching methods, meet the needs of each student, enhance student engagement, and lead to positive educational outcomes. It is also a reflection of the need for engagement of teachers, access by all and good use of technology for sustainable personalized learning contexts.

Material and Methodology

The method used in the present study is descriptive and analytical that aims to explore the role of Information and Communication Technology (ICT) and Artificial Intelligence (AI) in educational institutions that support personalised learning. The study is based primarily on secondary sources of information including scholarly journal articles, academic books, the research report, government documents, education policy documents and reputable institutional websites. Relevant literature was reviewed to gain understanding about digital learning platforms, AI-supported tutoring systems, adaptive learning technologies, intelligent assessment tools, learning analytics and virtual learning environments. Data collected were categorized in important themes such as individualized learning paths, student engagement, academic achievement, access to education, teacher supports, and technology-based learning challenges. qualitative content analysis was used to detect the pattern and development, opportunities and limitation, of the use of ICT and AI in teaching and learning practices. A focus was put on the digital divide, digital accessibility, digital infrastructure, algorithmic bias, as well as data privacy. The results were analyzed by comparing and contrasting them with current research to gain insight into the challenges and opportunities AIPL poses to design flexible, inclusive, learner-centred, and outcome-driven educational environments. This study does not collect primary data or experiment so the results are inferred through critical interpretations of secondary data.

Results and Discussion

The use of Information and Communication Technology (ICT) and Artificial Intelligence (AI) has led to changes in the way education is delivered, including the ability to provide learning experiences that are tailored to each student's individual ability, interest, learning pace and academic needs. Through personalized learning using digital platforms, intelligent tutoring systems, adaptive assessment, and AI-based learning analytics, opportunities are provided for enhancing student engagement, learning, and independent learning.

The results and discussion presented here is an illustrative analysis framework. Not having been provided with any primary data or survey results, the numerical values make no attempt to present any facts and are to be replaced with actual results before submission as empirical research.

0. **Results**

Table 1. Impact of ICT and AI-Based Personalized Learning on Student Engagement

Indicators	Mean Score	Standard Deviation	Interpretation
Increased classroom participation	4.21	0.68	High
Improved interest in learning activities	4.35	0.59	Very High
Greater access to learning resources	4.42	0.54	Very High
Increased independent learning	4.18	0.71	High
Improved interaction with digital content	4.31	0.62	Very High
Better motivation through personalized feedback	4.27	0.65	Very High

Note: Five-point Likert scale: 1 = Strongly Disagree; 5 = Strongly Agree.

Discussion:

Table 1 shows how the potential of ICT and AI personalised learning can help increase student engagement. The highest mean score is for access to learning resources with a mean score of 4.42, indicating that digital learning platforms can provide access to learning resources on students' own terms, interactive learning, recorded lectures, and supplementary learning resources. The mean score of 4.35 indicates that when the interest in learning activity is improved, adaptive content and interactive learning environment can also improve the participation.

The mean value of 4,31 in the interaction with digital content highlights the use of multimedia, virtual simulations, exercises in the digital format and with interactive learning applications. The mean score is also high for personalized feedback (4.27), indicating the potential of AI systems to provide timely feedback on student progress and learning difficulties.

Independent learning: a mean score of 4.18. This shows the potentiality of technology-mediated learning in motivating student to become responsible learners in relation to their learning. However, this requires the right digital infrastructure, a guide by the teacher and interaction – not too much dependence on automated platforms.

Table 2. Role of Artificial Intelligence in Improving Personalized Learning Outcomes

AI-Based Learning Features	Mean Score	Standard Deviation	Impact Level
Adaptive learning pathways	4.38	0.61	Very High
AI-powered personalized recommendations	4.29	0.66	Very High
Automated assessment and evaluation	4.17	0.73	High
Immediate feedback and performance tracking	4.41	0.56	Very High
Identification of individual learning gaps	4.34	0.63	Very High
Intelligent tutoring and academic assistance	4.25	0.69	Very High

Note: five-point Likert scale: 1 = Strongly Disagree; 5 = Strongly Agree.

Discussion:

As mentioned earlier, the potential of AI technologies in the perspective of personalized learning experiences is listed in Table 2. The greatest mean score (4.41) is obtained with immediate feedback and performance tracking. An AI-based system can analyze students' answers and look for patterns in academic production and provide timely feedback to the student, supporting his/her learning.

The mean score of the adaptive learning pathways is 4.38, which shows that the teaching and learning is important to be tailored to the individual learning needs. Students with difficulties in a specific topic may be provided with further exercises, explanation and learning materials, and for the more advanced students a higher level of challenge.

The mean score for the individual learning gaps is also high at 4.34. This means that teachers can use AI learning analytics to gain insights into which areas may require additional academic support. In summary, the personalized recommendations have a mean score of 4.29 indicating that intelligent systems have potential to offer personalized recommendations of learning materials based on student performance and preference.

The relatively lowest mean score of 4.17 is obtained from the automated assessment. Although automated marking can relieve a teacher's workload, this may not be the most effective method of marking creatively, critically and technically proficient responses and answers for complex, subjective questions in all contexts. So, it is not an assessment tool that should be used as a substitute for teacher assessment, but rather as a support to it.

Table 3. Challenges and Opportunities in Implementing ICT and AI-Based Personalized Learning

Factors	Mean Score	Standard Deviation	Interpretation
Digital infrastructure limitations	4.32	0.64	Major Challenge
Data privacy and information security	4.45	0.57	Major Challenge
Limited digital competencies among teachers	4.18	0.72	Major Challenge
Unequal access to digital learning resources	4.39	0.60	Major Challenge
High implementation and maintenance costs	4.12	0.76	Significant Challenge
Opportunities for inclusive education	4.36	0.62	Very High
Scope for continuous academic improvement	4.43	0.55	Very High

Note: Five-point Likert scale: 1 = Strongly Disagree; 5 = Strongly Agree.

Discussion:

As highlighted in Table 3, challenges and opportunities in the use of ICT and AI technologies in personalized education are identified. Data privacy and information security has the greatest mean score of the challenges (4.45). Educational platforms using AI often handle student data, such as their learning patterns, grades, and personal information. Thus, technology governance, information policies and data protection mechanisms are vital.

The digital divide between students from different socio-economic and geographical backgrounds is highlighted by the scores for unequal access to digital learning resources, which have a mean score of 4.39. Students who live in rural and/or economically disadvantaged communities might experience difficulties with Internet access, electronic devices, and high-tech learning tools. These disparities may hinder the impact of using technology as a learning tool.

The mean score of digital infrastructure limitations is also high (4.32). As a prerequisite to effective integration of personalized learning in the educational context, schools need a robust, reliable connection, the right

technologies, technical support, and an appropriate learning management system (LMS). Similarly, teachers need to constantly update their skills and knowledge to harness the power of AI and incorporate it into the education system.

Despite these challenges, however, there is a tremendous opportunity to improve academic achievement at a mean score of 4.43. AI-powered learning platforms can help with continuous evaluation, individualized feedback, and the customization of instructional strategies to meet the learning needs of students. Opportunities for inclusive education also score highly with the mean score of 4.36 which indicates the potential for assistive technologies, multilingual learning resources, speech recognition and adaptive interfaces to support the learning of children with diverse learning needs.

From the results, it is clear that an integrated, holistic, and technology-driven personalized learning approach is required, which also needs to be supported by the readiness of the environment, teacher professional development, access and equity policies, and data stewardship.

The findings suggest that the incorporation of ICT and AI in personalized learning can help to create a more flexible, learner-centred, and responsive learning environment. Traditional classroom teaching can be formalized and applied to students, which may not fully reflect the learning needs, interests and abilities of individual students. In contrast, technology-based personalized learning can provide flexibility in instruction, learning activities, and assessment based on the performance of the student.

The findings also indicate that teacher role in education has also changed over the years with technology. Teachers are not just information providers but they are also facilitators, mentors, academic guides, and evaluators of student growth and development. AI can assist educators in managing repetitive tasks like assessment, learning recommendations, and student progress tracking, thereby freeing up time for them to focus on critical thinking, creativity, collaboration, and problem-solving.

An important part of this is links between personalised learning and educational inclusion. ICT platforms can be used to provide learning opportunities outside of the classroom and AI-based assistive applications can be used to assist students with diverse learning needs. But, low cost and infrastructure, digital literacy and institutional support pose a threat to the value of such technologies.

The results further demonstrate the importance of ethical considerations in AI-based education. All student information should be collected and handled responsibly and automated recommendations should be monitored to make sure they aren't used in a discriminatory or unfair manner. It is also critical that technology enhances and does not diminish the human aspects of learning in the classroom.

As a form of institutionalization, it is essential to implement an integrated approach, where educational purposes are connected to the technological tools available for them. This strategy should involve regular teacher development, review of the curriculum, student feedback, changes to the building, and assessment of learning/outcomes.

Limitations of the study

While interpreting the findings, the study has certain limitations that should be taken into account, such as: Personalized learning through ICT and AI can be quite effective, depending on the technological skills, learning abilities, access to digital devices, Internet connection and socio-economic backgrounds of the students. Further, the impact of these technologies may be influenced by the differences in institutional infrastructure, teachers' digital literacy and access to appropriate learning resources. In addition, AI-driven learning systems can provide incorrect recommendations or even display bias from the data they are based on, which can impact the quality and fairness of learning experiences. Other factors to consider are ethical considerations surrounding AI and the over-reliance on technology, as well as privacy and cyber security concerns for students. The pace of the developments of AI tools may mean that some findings may not be as relevant moving forward. The study may also not completely reflect the impact of AI in personalized learning on students' critical thinking, creativity, social interaction, and academic development in the long term. The results need to be taken in the context of the study,

and more research with a wider variety of schools, pupils and over time is required to ensure that the impact of personalized learning with ICT and AI is confirmed in other educational contexts.

Future Scope

Future research can investigate the impact of new technologies on teaching and learning at multiple levels and in various subjects at the intersections of ICT and AI, and how Personalized Learning is being transformed. Long-term effects on students' academic outcomes, critical thinking, creativity, motivation, and independent learning skills may be investigated using AI-based adaptive learning platforms in further studies. Potential also exists for exploring the application of generative AI, intelligent tutoring systems, learning analytics, virtual reality, and augmented reality in creating more interactive and learner-centred learning spaces. Researchers can evaluate the effectiveness of personalized learning for students in a variety of socioeconomic settings, rural and urban schools, and various language groups to inform questions of access and the digital divide. There are also several areas that require further exploration in future research on AI in education, such as data privacy, algorithmic bias, transparency, academic integrity, and ethical use in education. In addition, the readiness of teachers, digital literacy of teachers, institutional infrastructure and teachers' involvement in supervising the use of AI in learning needs should be further explored. Comparative data on how things are going well in education and/or countries would be useful. Finally, future research should strive to design inclusive, ethical, affordable and sustainable approaches to learning with ICT and AI, while ensuring that human interaction is not overlooked and effective learning outcomes are achieved.

Conclusion

The use of Information and Communication Technology (ICT) and Artificial Intelligence (AI) in personalized learning is a great development in contemporary education. These technologies offer an opportunity to move beyond a single, standard, 'one size fits all' teaching model to more flexible teaching models that focus on each individual's ability, interests, learning preferences and academic needs. ICT allows for access to digital resources, interactive learning spaces, and collaborative tools, while AI facilitates adaptive content, personalized learning assessments, automated feedback, and identification of learning gaps. The technologies when used together can contribute to positive student engagement, independent learning, student success, and informed instructional decisions by teachers. However, with the effective application, the necessary digital infrastructure, teacher training, reliable internet connectivity, and adequate data security and responsible application of AI, are required. Equality in the use of digital technology also needs to be tackled in the educational system, so that technological developments do not exacerbate existing inequalities between learners. Overall, personalized learning shouldn't replace what teachers know, create and lead. ICT and AI can thus be integrated in a balanced way in order to create a more inclusive, accessible, adaptive and effective learning environment, equipping learners with knowledge and skills needed to thrive in a world that is becoming more and more technology driven.

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