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INTEGRATION OF ARTIFICIAL INTELLIGENCE IN 21ST CENTURY EDUCATION CURRICULUM

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Abstract

The integration of artificial intelligence (AI) in the 21st century education curriculum is an important step to prepare learners for the digital age. AI can be used to support the learning process and develop skills needed in the future. The application of AI in education brings positive impacts, especially for students, by transforming teaching methods and learning experiences. The integration of AI into the curriculum aims to build students' technological literacy and critical thinking skills. This is in line with the literacy needs of Science, Technology, Engineering, Arts, and Culture in the 21st century which includes data literacy and STEMAL (Science, Technology, Engineering, Mathematics, Arts, and Language). Understanding the influence of AI and the appropriate steps to integrate it into the curriculum is an important urgency. This is done to prepare learners for the Golden Indonesia 2045 and build relevant education in the future.

Keywords: Integration, Artificial Intelligence, Curriculum, 21st Century Education.

Introduction

Each century has been ruled by different technologies but this is the first century that is marked by information technology not just in our communication but in all spheres of life as well, education included. One of the most promising technologies that can empower the education system is Artificial Intelligence (AI) (Sitopu et al., 2024); (Guna et al., 2024). They have set the stage for novel ways of learning, teaching and administering the educational sector.

This growth of technology in education has shifted from a pre-internet stage to an artificial intelligence technology stage. Educational technology started with classroom use of the 'hard' educational resources like blackboards and text books, however it began to advance when affordable personal computers were started being used in schools and universities in the late 1980s (Jayadiputra et al. 2020). The wider use

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of the Internet that emerged in the 1990s enabled instantly access to more resources in a new format called elarning. Further, the onset of the web 2.0 platform and mobile learning just at the beginning of the 21 st century led to dramatic changes where interactive learning methods appeared, as well as Learning Management Systems and Massive Open Online Courses (Schiff & Rosenberg-Kima, 2023).

In the 2010s, the industry managed to improve the recently observed increases in enhancement of education technology together with big data and analytics to assess the learning behavior of students and create healthy learning ecosystems. The incorporation of Virtual Reality (VR) and Augmented Reality (AR) technologies in the learning process marked a new design direction of the educational content by enhancing it with level of immersion and interactivity that had not been experienced previously. This, however, brings forth there is room for further enhancement of the customer experience through deeper and more effective customization of the experience. (Godase et al., 2023).

According to Komba and Shuki, 2023, there has been a significant improvement in educational technology since the emergence of Artificial Intelligence (AI) and Machine Learning (ML) around 2015. A chatbot and virtual assistant capabilities are presently used as part of the learning support system, while an artificial intelligence (AI) based system recommends learning materials that best suit a user. The employment of Natural Language Processing for automated evaluation is increasing, and there is growing activity in the field of Intelligent Tutoring Systems (ITS) which aim at improving and personalizing the instructional process. These developments not only enhance the efficiency the effectiveness of the process of learning as well as create better ways to cater for each student's learning preferences.

In the 21st century, education is aiming at developing important 21st century skills in the learners: Critical Thinking, Creativity, Collaboration, Digital literacy. However, the conventional ways of education prevail in undercutting such requirements. In contrast, artificial intelligence becomes one way that may enhance learning. It improves learners' processes by customising learning and administrative processes (Su & Zhong, 2022).

However, embedding artificial intelligence in the syllabus isn't an easy task. Of these, the following ones seem particularly pressing and challenging: 1) The inequitable ownership of resources with which to learn AI constructs across institutions. 2) Ignorance or the unpreparedness of teachers in regards to AI instruments and their incorporation into services. 3) Unfounded apprehension about privacy, security, and the apparent bias that may attach to AI technologies and/ or methodology. 4) The importance of Education in Technology and its use to help pursuit of outlined goals without excessive neglect of human transmission of information (Aiyedun, 2024).

In all this against backdrop of potentialities and aspects of leading countries and educational institutions are giving innovations a trial at AI components incorporation in their syllabus. There is however still 'The knowledge gap' regarding the integrating AI

into the practices of 21st education i.e. the available best practices, the impact and the arrangements towards the achievement of these. (Vázquez-Cano, 2021).

Thus, an in-depth analysis is required in order to establish a clear understanding on the matter of integrating AI in the 21st century education system.

Research Methods

The study in this research uses the literature research method. This method is a research method that focuses on analysing and synthesising information from various written sources relevant to the research topic. (Sahar, 2008); (Arikunto;, 2000); (Adlini et al., 2022).

Results and Discussion

Forms of AI Integration in the 21st Century Education Curriculum

Artificial intelligence is defined as a subdivision of computer science that deals with the creation of computer systems that can do activities that would otherwise require human intelligence (Gellers & Gunkel, 2023). The overall goal of AI is to produce devices or applications that are able to think, learn and behave rationally or more than the human brain. It is highly cut across the nature of concepts as it includes machine learning, logical reasoning, natural language processing, matching of patterns and problem solving of more complex types (Almeida et al., 2024).

While implementing AI, several techniques and algorithms are employed to process data, forecast and choose an optimal alternative. To remedy this more scientific approaches have been in place some of these being machine learning, deep learning, neural networks and expert systems (Rasenberger, 2020). Over the last few decades, AI has advanced in an exponential rate, and it is used across various domains like robotic applications, speech and image detection, self driving cars, data mining, etc. As AI advances, further changes are expected in all fields of human activity bringing along new perspectives and more reasons for society to adapt to social and ethical problems that must be addressed (Wilson, 2020).

The advancement of AI in education is impressive as it has brought changes and new inventions. An example is the creation of adaptive educational systems that use AI to modify the educational content and its presentation style to suit the specific characteristics and skill level of each learner. Such AI systems facilitate the design of virtual tutors who can respond to students and offer support as they learn. Moreover, it is useful in eliminating the need to perform primary tasks like grading and writing reports, freeing up teachers' time which can be devoted to students' engagement and development (Yang, 2022). Furthermore, analyzing data using an AI based approach helps the educational institutions in recognizing patterns, forecasting learner's acquisitions and exercising strategies aimed at enhancing the education provided. There are numerous opportunities to harness the technology, even though we are currently at the early stages as far as the use of artificial intelligence is concerned, it is

without reasonable doubt that it will redefine the approaches of learning and teaching in a great way, as it becomes possible to have more personalized, effective and inclusive education into the future (O'Neil-Gonzalez et al., 2023).

AI's incorporation in education coursework in the 21st century involves adopting many innovative and robust perspectives. Such capability includes the provision of AI based adaptive instructional technology which is one of the main tendencies. These systems evaluate the learner's response and in the process change the instructional materials employed, the speed at which the teaching takes place, as well as the types of instruction offered to each of the learners (Syakhrani & Aslan, 2024); (Sartika & Fransiska, 2024). For instance, if a learner is grappling with such concepts, the system would assume the responsibility of supplying extra resources or offering a different way of explaining the ideas. On the other hand, as the level of specific students' success begins to lie outside of the ordinary, then the AI ought to provide more difficult tasks, so that introduced levels of boredom do not affect learned behavior (Akhtyamova, 2021).

Chatbots and virtual assistants also present an opportunity for further integration in this learning environment. For example, an AI-based chatbot can be on standby, responding to students' general questions, offer additional subject explanations, or help with task and schedule management at any time of the day. These assistants help enhance information and assistance access for students and also promote self-learning among them (Durso & Arruda, 2022). Furthermore, Technological devices powered by AI are being applied even in complex simulations and virtual settings that enable students to learn activities or tasks that would be impossible or risky to carry out in reality (Moroianu et al., 2023).

To foster algorithmic literacy among learners, applicable courses that develop students' skills in programming and/or artificial intelligence are being introduced. It is becoming common for schools to embrace topics or modules that deal with the principles of AI, the principles of ML, and ethical issues surrounding AI. Not only are the learners prepared for such careers in the future but also there are key skills such as computational thinking and problem-solving that are developed. Learning programs that are tailored towards the young people and encompasses such elements like programing for kids and educational robots with the concepts of AI are quite on the rise nowadays. Students develop insight, not just into the functioning of AI, but also how to create and use AI systems for solving problems, through hands-on and group-oriented activities, fostering a sense of innovation from a young age.

Impact of AI Integration on the Learning Process

The integration of AI in the learning process has brought significant and multifaceted impacts to education. One of the most prominent impacts is the personalisation of learning experiences. AI enables education systems to analyse

individual learning data in real-time, identify each student's strengths and weaknesses, and tailor teaching materials and methods to their specific needs (Segbenya et al., 2023). This results in a more effective and efficient approach to learning, where each student can learn at a pace and style that best suits them. As a result, the level of comprehension and retention of material increases, while frustration and boredom that often arise in traditional education systems can be minimised (Gong, 2023).

The second impact of AI integration is increased accessibility and flexibility in education. Through AI-based online learning platforms, students can access high-quality educational materials anytime and anywhere. AI-powered virtual tutor systems can provide instant assistance and feedback, reducing dependence on the availability of physical teachers (Lucci et al., 2022). This is especially beneficial for students in remote areas or those with unconventional schedules. In addition, AI also facilitates lifelong learning, allowing adults to improve skills or learn new areas in a more flexible and customised way (Dakakni & Safa, 2023).

AI integration also impacts the role of teachers and teaching methods. With AI taking over routine tasks such as basic assessment and administrative management, teachers have more time to focus on aspects of teaching that require the human touch, such as the development of social-emotional skills, critical thinking, and creativity (Hilal, 2024). AI also assists teachers in analysing student performance data in greater depth, allowing them to make data-driven decisions about the most effective teaching strategies. However, these changes also require teachers to continuously improve their digital skills and adapt to new roles as facilitators of technology-enabled learning (Kausar & Ahmad, 2023).

Finally, the integration of AI in the learning process brings new challenges and opportunities in terms of assessment and evaluation. AI-based assessment systems can provide faster and more detailed feedback, and track student progress more comprehensively over time (Tuomi, 2022). This enables early identification of students who may need extra help, as well as recognition of special talents that may be missed in traditional assessment systems. However, the use of AI in assessment also raises ethical and practical questions, such as concerns about student data privacy and potential bias in AI algorithms. Therefore, it is important to develop a strong ethical framework and clear policies regarding the use of AI in educational assessment to ensure fairness and transparency.

AI Integration in 21st Century Education Curriculum

21st century education is characterised by a set of characteristics that reflect rapid changes in technology, the global economy, and labour market demands. The main focus is on the development of skills known as the '4Cs': Critical thinking, Creativity, Communication, and Collaboration. Modern education also emphasises digital literacy, flexibility and lifelong learning (Elmoneim, 2022). Curricula tend to be

interdisciplinary, combining different fields of study to create a more holistic understanding. Teaching methods are more student-centred, with an emphasis on project-based learning, real-world problem solving and intensive use of technology. Assessments tend to be more diverse and authentic, relying not only on standardised tests but also portfolios, projects and demonstrations of practical skills (Sreelakshmi & Anoop, 2023). In addition, 21st century education also prioritises the development of emotional intelligence, global awareness and leadership skills to prepare students for the challenges of an increasingly complex and connected world.

The key competencies in 21st century education include a set of essential skills required for success in the digital and globalised era. At the core of these competencies are the '4Cs': Critical thinking (the ability to critically analyse information and solve complex problems), Creativity (the ability to innovate and generate new ideas), Communication (the ability to express ideas effectively through various media), and Collaboration (the ability to work together in diverse teams) (Darbellay et al., 2023). In addition, digital literacy is crucial, including the ability to use information and communication technologies effectively and ethically. Flexibility and adaptability are also crucial, given the rapid changes in the work and technology landscape. Social and emotional skills, such as empathy and self-regulation, are increasingly recognised as important components of professional and personal success. Global awareness and cross-cultural understanding are also becoming highly valued competencies in an increasingly connected world. Finally, the ability to learn independently and continuously (lifelong learning) is considered a key competency that enables individuals to remain relevant in the face of rapid change in the 21st century (Pahrudin et al., 2024).

The integration of Artificial Intelligence (AI) in the 21st century education curriculum is becoming increasingly important along with the rapid development of this technology in various sectors of life. AI is no longer just a specialised topic in computer science, but has developed into an integral component in various disciplines (Voogt & Roblin, 2023). In the context of education, AI integration aims to prepare students for a world increasingly dominated by smart technologies. An AI-integrated curriculum includes a basic understanding of how AI works, the ethical use of AI, as well as its practical applications in various fields such as healthcare, business, and the arts (Harris & Goosen, 2021).

One important aspect of AI integration in the curriculum is the development of relevant skills. These include basic programming, data analysis, and understanding of algorithms (Iksal et al., 2024); (Irwan et al., 2024). However, more than just technical skills, students also need to be equipped with critical thinking abilities to evaluate AI outputs, understand potential biases in AI systems, and use AI as a tool to enhance creativity and problem solving. AI education should also include discussions on the social and ethical implications of this technology, including issues of privacy, data security, and the impact of AI on future employment (Zhang et al., 2021).

The integration of AI in the curriculum also opens up opportunities for more personalised and adaptive learning methods. AI-based learning systems can customise content and learning pace according to students' individual needs. In addition, AI can be used to analyse students' learning patterns and provide more targeted feedback to teachers and students (Rijal, 2020). In a broader context, an understanding of AI prepares students to actively participate in shaping the future of this technology. Thus, the integration of AI in the curriculum is not only about teaching the technology, but also about empowering future generations to become critical thinkers, innovators, and responsible digital citizens in the AI era (Bhandari & Mathew, 2023).

Ethics and Safety in the Use of AI in Education

Artificial Intelligence (AI) assumes a significant role in the global education system of the twenty first century as this technology is rapidly evolving in every other aspect of life. Education can be practice oriented to accomplish practical skill acquisition of practices relating to artificial intelligence and preparing students for the changing world dominated by intelligent systems. In this regard, AI is concerned about changing this by integrating advanced technologies into the education. There is also an understanding of how AI can be ethically utilized and AI applications in business, healthcare, and the arts (Neylon & Le, 2021).

The importance of developing necessary skills is one of the aspects to bear in mind while integrating AI in the curriculum. Particular skills focus on ken programming basic elements, analysis of analytical data, and knowledge of algorithms. However, it is not just the technical skills that are needed, students need to be able to think critically about the given AI-given output, the presence of hidden biases in AI, and apply AI for improving creative and knowledge-driven processes (Das et al. 2023). This education should have a focus on social issues associated with AI such as privacy concerns, data security, and the future of jobs with the advent of AI (Pedersen, 2024).

Integrating artificial intelligence into the school syllabus makes it also possible to implement more individualised and adaptive learning techniques. With AI technologies, learning content and the rate of learning can be adjusted to each student’s needs. Also, AI may be used in effficiently understanding the study patterns of the students and help in addressing feedback to the teachers and the students more effectively. Moreover, this aspect links to the importance of AI in students as it arms them to be useful in communities that seek the enhancement of this contemporary technology. In this way, the focus on the preparation of the students contains not only the teaching of the AI curriculum, but also the formation of critical, creative and active citizens of new technological age in respect to the AI systems.

Conclusion

Integrating artificial intelligence (AI) into the education system is one of the most important measures that must be taken in the 21st century in order to prepare the younger generation in the coming digital age. This doesn't just give students working knowledge of AI hardware or software systems but trains their thinking, imaginative and design skills necessary for effective management and application of AI systems. Such AI-enhanced program curricula instill in students the sense of how such technology affects the lives of others thereby ensuring that they are not just able to use these tools.

Moreover, the introduction of AI technology in education offers more significant and flexible customization of learning experiences, whereby every individual gets an opportunity to learn in a way that suits them best. AI is introduced as a tool in teaching in such a way that, it helps to equip the students with the skills for the technology dominated organisations of the future and also gives power to the students to become creators of the technology in the near future. In other words, any efforts toward the introduction of AI technologies in the education system are quite relevant nowadays – they strengthen the workforce that is prepared to cope with the threats and possibilities of the digital world in the age of 21st century.

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