

Assessing the Potential of Artificial Intelligence (AI) in Education

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Proceedings of the Kalijaga International Conference on Education 2026

Abstract. Education currently plays an important role in the progress of a country. The lack of innovation in the world of education today, if it is not balanced with existing technological developments, will make education not developed properly. Many people currently believe that AI is a key component of the fourth industrial revolution and that it will eventually lead to the fourth revolution in education. Artificial intelligence (AI) is the advancement of computer systems' or other information-based technologies' capacity to carry out tasks that ordinarily demand for human intelligence and logical reasoning. Even if AI has the capacity to change the world, there are some issues with it. These issues include the readiness of teachers, the availability of technological infrastructure, and the need to ensure that AI is implemented appropriately to support the learning process. Therefore, understanding the potential benefits and challenges of AI in education is important for developing effective and meaningful learning practices. The purpose of this study is to look at the potential of AI in education using scoping review method. Using this method, 16 articles were obtained from the results of a quasi-experiment study. The results showed that AI can improve performance, achievement, motivation, and attitude of students. These findings indicate that AI has significant potential to support the improvement of the quality and effectiveness of the educational process. The suggestion for future research is development of AI so the teachers can have many choices when using in education. Future research should also consider developing AI tools that are accessible, practical, and suitable for teachers' and students' needs.

Keywords: *Artificial Intelligence (AI), Potential, Scoping Review.*

INTRODUCTION

Education currently plays an important role in the progress of a country. The lack of innovation in the world of education today, if it is not balanced with existing technological developments, will not enable education to develop properly. Information and communication technology (ICT) has substantially aided the development of learning pedagogy during the past several years [1], [2]. Modern society and people are significantly impacted by technologies. In the meantime, technological breakthroughs are drastically and quickly altering how we teach and learn. As a result, the educational landscape is slowly evolving. With the development and widespread use of interactive technologies, particularly in recent years, their applications inside and outside of classrooms are steadily rising in popularity. These tools are designed to adapt to the various demands and circumstances of learners while also boosting competition in the global education industry. Instead of using copybooks, students use tablets, while teachers make use of a variety of teaching resources and software, including Moodle and Google Classroom [3]. Technology has had a significant impact on people's learning experiences by creating an enhanced environment. Through the use of technology, students are able to learn both inside and outside of the classroom. The development of learning and teaching strategies is important to enhance students' levels of thinking and stay up to date with scientific and technical advancements in a variety of disciplines of knowledge that has a significant impact on contemporary social changes. Globally, new teaching and learning solutions are being developed and tested using intelligent tutoring systems, technical architecture, and artificial intelligence (AI) capabilities [4], [5], [6]. In our daily lives, artificial intelligence (AI) is becoming more and more significant. People employ a variety of artificial intelligence (AI)-based tools, programs, and services. Examples include smart home equipment like self-driving vacuums or lawn mowers, as well as online and mobile services like Google (Maps, Now,...), Cortana, or Siri. Contrarily, very few people are aware of the theories and methods that underlie those services and programs. Additionally, there are currently very few programs that teach the fundamentals of AI and computer science at the elementary school or preschool level [7]. Many people currently believe that AI is a key component of the fourth industrial revolution and that it will eventually lead to the fourth revolution in education. Additionally, the inclusion of AI education in school curricula has started [8], [9]. Based on research conducted by Guntur [10] he suggested that technology can improve education and are more effective than conventional learning [11].

Artificial intelligence (AI) is the advancement of computer systems' or other information-based technologies' capacity to carry out tasks that ordinarily demand for human intelligence and logical

reasoning. Even if AI has the capacity to change the world, there are some issues with it [12]. Despite having few practical applications at the moment, advocates of AI and machine learning believe that these technologies have enormous promise to advance education. The classification and decision-making processes are at the heart of AI technology use. A system must be dynamic and able to continuously update itself through interactions with learners and dynamic resources in its surroundings in order to be truly artificially intelligent [13], [6]. The use of artificial intelligence (AI) in education is widespread and growing. One noteworthy example is the use of individualized teaching methods, which is already widely used and is showing increasing signs of being more effective at enhancing learning [14], [15], [16], [17], [18], [19]. AI has been marketed more and more as having strategic benefits for education [20]. According to Loeckx [21], AI may be an effective educational tool that lightens the strain on teachers and students while still giving them stimulating learning possibilities. With contemporary educational changes including the digitalization of educational resources, gamification, and personalized learning experiences, there are many opportunities for the development of AI applications in education.

This study aims to inform the potential of artificial intelligence in education in detail. There has been a lot of research done on artificial intelligence which is linked to the world of education, but here researchers are trying to look at it from the potential side. With the research being conducted now, it is hoped that it can open minds even more in the world of education to be able to use artificial intelligence in its implementation.

METHODS

The research method used is scoping review. The five-stage framework developed by Arksey and O'Malley [22] is applied in this scoping review study. The five stages of Arksey and O'Malley's framework "first identifying research questions, second identifying relevant studies, third study selection, fourth charting the data, and fifth summarizing and reporting the results were utilized in this review of the use of artificial intelligence in education". A scoping review is a knowledge synthesis that methodically searches, selects, and synthesizes knowledge to meet an exploratory research question with the goal of mapping key concepts, types of evidence, and research gaps connected to a specific subject or field [23].

Data was obtained through a search on Google Scholar using the keywords artificial intelligence in education. To get a fairly diversified study, the search term "artificial intelligence in education" was chosen without using any other filtering choices. Google Scholar's search results revealed 4 million articles, which were then condensed to 16 articles. The criteria for selecting the data used are as follows.

Table 1. Criteria for inclusion and exclusion

Criteria	Inclusion	Exclusion
Time Period	The last 5 years (2017-2022)	Studies conducted outside of these dates or times
Focus of Study	Education	There is no use of research outside of the field of education
Research method	Quasi-experiment, Quantitative, Experiment, Mix-method	Qualitative, RnD, Development, Survey
Sample	Student	The populace that have completed their education
Language	English	Excluding English

RESULTS AND DISCUSSION

Each article's summary is created taking into consideration a variety of factors, including the author, year, subject, method, instrument, country, dependent variable, results, and suggestions. Table 2 provides a thorough review of the factors that were identified from the included research.

Table 2. Research included in the Scoping Review

Researcher	Monica Ciolacu, et al.	Patrick G. Galleto & America M. Ponggan	Shien-Ping Huang	Hernando Barrios Tao, et al.
Year	2018	2018	2018	2019
Title	"Education 4.0 – Artificial Intelligence assisted Higher Education: Early recognition System with Machine Learning to support Students' Success" [24]	"Bagatrix: An Artificial Intelligence Application in Teaching Normal Distribution" [25]	"Effects of Using Artificial Intelligence Teaching System for Environmental Education on Environmental Knowledge and Attitude" [26]	"Artificial Intelligence and Education Challenges and disadvantages for the teacher" [27]
Subject	Students from Business Administration and Business Informatics	123 students grade 11	186 college students	140 teachers
Country	Germany	Philippines	Taiwan	Colombia
Method	Experiment	Quasi-Experiment	Quasi-experiment	Mix method
Instrument	Questionnaire	Pre-test and Post-test	Computer Statistics Software and Test	Questionnaire and literature
Dependent variable	Students' Success	Students' Performance	Environmental Knowledge and Attitude	Teaching learning process
Result	"Nearly half of the exam failure percentage was supplied. The concept	"According to the study, Bagatrix was a useful tool for teaching Grade 11	"According to the results of a study, there are strong relationships between	"This study describes the difficulties and drawbacks teachers faced while

	significantly affects students' academic performance and does give them a clear perspective." [24]	pupils about normal distribution. The use of the math program led to a significant improvement in the pupils' performance on the pretest and posttest." [25]	environmental education and attitude toward the environment, environmental knowledge and attitude toward the environment, and environmental education and attitude toward the environment." [26]	considering the potential use and generalization of robot behaviors, as well as the use of artificial intelligence more generally, in the classroom." [27]
Suggestions	"In our upcoming work, we'll take into account more environmental elements that affect kids, like biological signals, to address explanatory and real-time information." [24]	"Additionally, students should use the Bagatrix mathematical program as a supplement to improve and guarantee superior success in all mathematics courses, not just in problem solving for Normal Distribution." [25]	"The results have led to recommendations that are intended to improve environmental education teaching practices, cultivate college students' environmental awareness, advance environmental protection knowledge, attitudes, and action intentions, as well as advance the ability to employ environmental action strategies." [26]	"Being vigilant and taking the required safety measures is essential to ensuring that robots and artificial intelligence never rule over situations without human supervision, especially when it comes to education." [27]
Researcher	Mutlu Cukurova, et al.	Randi Williams, et al.	Mohammed A. Alomari & Manar Omar Jabr	Sheshadri Chatterjee & Kalyan Kumar Bhattacharjee
Year	2019	2019	2020	2020
Title	"Impact of an Artificial Intelligence Research Frame on the Perceived Credibility of Educational Research Evidence" [28]	"PopBots: Designing an Artificial Intelligence Curriculum for Early Childhood Education" [29]	"The effect of the use of an educational software based on the strategy of artificial intelligence on students' achievement and their attitudes towards it" [30]	"Adoption of artificial intelligence in higher education: a quantitative analysis using structural equation modelling" [31]
Subject	605 participants	80 Pre-K and Kindergarten children	34 students	329 respondents
Country	London	America	Jordan	India
Method	Experiment	Quantitative	Quasi-Experiment	Quantitative
Instrument	Questionnaire	Curriculum assessments	Post Test	Questionnaire
Dependent variable	Perceived Credibility of Educational Research Evidence	Student's learning	Students' Attitude	Opportunities of AI
Result	"The results indicate that educational research evidence is viewed as less trustworthy when it is positioned inside AI research than when it is framed within neuroscience or educational psychology. Even after taking into account the subjects' knowledge with the framing discipline, the effect is still noticeable." [28]	"We discovered that using a social robot as a teaching tool and programmable artifact was successful in aiding young children in understanding AI principles. Additionally, we determined which teaching methods had the biggest effects on students' learning." [29]	"The study's results indicated that there were statistically significant differences in the mean scores of the experimental group's students and those of the control group on the post test, favoring the experimental group's pupils." [30]	"If such learned information is utilized in practice strategically, applying AI in higher education system would readily benefit the stakeholders of higher educational institutes as they would increase the intellectual health of higher education system." [31]
Suggestions	"The article's conclusion makes the suggestion that, in order to assist offset these effects, the AI in Education community should try to be more actively engaged with important stakeholders in AI and Education." [28]	"We offer suggestions for next PopBots platform modules and iterations." [29]	"Encourage teachers to employ AI-based software and AI-based teaching methods due to their good effects on fostering a positive attitude toward these subjects." [30]	"Furthermore, it is anticipated that this proposed model will be relied upon by the authorities and policy makers to guarantee the adoption of AI in India's higher education system." [31]
Researcher	Suping Qian & Qiming Feng	Reham El Shazly	Song Pu, et al.	Si Wu & Fei Wang
Year	2020	2020	2021	2021
Title	"Research on the Integration of Artificial Intelligence and Education" [32]	"Effects of artificial intelligence on English speaking anxiety and speaking performance: A case study" [33]	"Improvement of Pre-Service Teachers' Practical Knowledge and Motivation about Artificial Intelligence through a Service-learning-based Module in Guizhou, China: A Quasi-Experimental Study" [34]	"Artificial Intelligence-Based Simulation Research on the Flipped Classroom Mode of Listening and Speaking Teaching for English Majors" [35]
Subject	72 students from two classes in grade one	48 undergraduate participants in an EFL class	60 PSTs and 107 primary school students	31 English majors
Country	China	Saudi Arabia	China	China
Method	Quasi-experiment	Quasi-experiment	Quasi-experiment	Experiment
Instrument	Pre-test and Post-test	Pre-test and post-test	Pre-test and post-test	Questionnaire, Pre-test and Post-test
Dependent variable	Students' creativity	Speaking anxiety and speaking performance	Pre-Service Teachers' Practical Knowledge and Motivation	Listening and Speaking Teaching
Result	"The study showed that understanding-based instruction in a network setting can foster the growth of students' creativity more so than conventional	"The results showed that FL learners had FLA both before and after the intervention. The detected anxiety levels aided FL learning, leading to a	"The study's results showed that SLBM-TAIS was successful in preparing PSTs to instruct AI topics to elementary school students. The SLBM-TAIS that	"The results show that by implementing flipped classrooms, students have enhanced their capacity to create learning plans, carry them out, and evaluate the

	instruction.” [32]	number of benefits.” [33]	improve PSTs' practical knowledge and motivation as well as primary school students' attitudes regarding AI.” [34]	success of their learning. Students have also exercised their capacity to self-manage their learning.” [35]
Suggestions	“The derivative thesis and creativity measurement should be acknowledged as two significant elements that influence the experimental findings and should be further investigated in the future.” [32]	“Future studies should look for longitudinal large-scale investigations that are informed by pedagogy to look into further AI-driven applications in various linguistic and cultural contexts.” [33]	“The next phase of AI teaching can be the subject of future research. In addition to PSTs and sixth-graders, researchers can also look at the impact of SLBM-TAIS on the three psychological variables at various educational levels.” [34]	“We will support the better development of numerous technologies in future research.” [35]
Researcher	Xiaodong Huang	Dr. Mohammed Khalaf Ismail Makhoulouf	Hala Khairy Abdelghany Elgohary & Hla Khalaf Al-Dossary	Hosah Almelweth
Year	2021	2021	2022	2022
Title	“Aims for cultivating students' key competencies based on artificial intelligence education in China” [36]	“Effect of Artificial Intelligence-Based Application on Saudi Preparatory - Year Students' EFL Speaking Skills at Albaha University” [37]	“The Effectiveness of an Educational Environment Based on Artificial Intelligence Techniques Using Virtual Classrooms on Training Development” [38]	“The Effectiveness of a Proposed Strategy for Teaching Geography through Artificial Intelligence Applications in Developing Secondary School Students' Higher-Order Thinking Skills and Achievement” [39]
Subject	978 students from five middle schools in Beijing	20 engineering students	15 students	60 female students from the second year of secondary school
Country	China	Saudi Arabia	Saudi Arabia	Saudi Arabia
Method	Quantitative (Experiment)	Quasi-experiment	Quasi-experiment	Quasi-experiment
Instrument	Questionnaire	Pre-test and Post-test	Pre-test and post-test	Pre-test and Post-test
Dependent variable	Students' key competencies	Students' EFL Speaking Skills	Field training and teaching skills	Students' Higher Order Thinking Skills and Achievement
Result	“The key competencies that students develop in AI courses are described quantitatively in this research. demonstrates how modern artificial intelligence courses support the development of skills competence, cognitive competence, and self-learning competence.” [36]	“The study's findings showed a substantial difference between the treatment group's mean speaking pretest and posttest scores, favoring the posttest. The findings indicated that AI improved the pupils' speaking abilities.” [37]	“The researcher came to the conclusion that the use of artificial intelligence technology in virtual classrooms by female teachers contributed to the development of field training and teaching skills to a semi-high degree (84.40%), and this result suggests a high level of development of field training skills.” [38]	“The posttest results of the study revealed significant differences at (0.05) between the mean achievement test scores of the students in the experimental and control groups, favoring the experimental group. On the higher-order thinking abilities evaluation card, changes were also seen in favor of the experimental group between the assessment means of the students in the control and experimental groups.” [39]
Suggestions	“A list of issues with the existing artificial intelligence curriculum is provided, along with recommendations for change.” [36]	“The study's conclusions made recommendations that are important to employing AI to educate speaking skills.” [37]	“The study suggested that virtual classrooms be used to teach practical education courses, and that student instructors be trained in the use of technology and kept up to date with new advancements.” [38]	“According to the study, there is a need to stress the increased usage of artificial intelligence tools in geography classes.” [39]

Artificial Intelligence (AI) is currently developing very rapidly, where AI is widely used in any field, especially education. Lai [40] defined artificial intelligence as a computer system with human knowledge and behaviors and the ability to solve problems, memorize information, and comprehend human natural language. Ng [41] defined the development of artificial intelligence (AI) as the decomposition of human stimuli and responses to problems and affairs, as well as the reasoning, problem-solving, learning, judging, and thinking of decisions into fundamental steps, and the modularization or formulation of problem-solving processes through programming so that a computer could be designed with structural methods or handle more challenging problems.

Based on research conducted by Ciolacu, et al. [24] they took the first step in developing an early identification system and used it to identify students who were at risk using intelligent sensors on Android-based devices. Supporting students' performance actively is becoming more and more crucial. In this context, we identified 21 at-risk students in the mathematics course during the winter term of 2017–18 using the early recognition system. For the second time in Knowledge Management's summer 2018 term, our early recognition system with machine learning finds in the course's Business Administration and Business Informatics sections 38 and 20 at-risk students, respectively. The concept really helps students perform better and does provide them a transparent perspective. As well as students in senior high school grade 11 can learn probability and statistics, specifically the normal distribution, with the help of the Bagatrix Mathematical Software. Its implementation has shown a significant improvement in the student's

performance from the pretest to the posttest [25]. Additionally, the current artificial intelligence courses, according to research by Huang [36], support the development of skills competence, cognition competence, and self-learning competence. As a result, it is important to take into account enhancing team member cooperation in the curriculum setting of artificial intelligence courses.

Based on research conducted by Hernando Tao, et al. [27], extreme applications of artificial intelligence and robots pose risks and difficulties that must be taken into account in all spheres of their use, especially in education. A robot could never make the individualized efforts that human teachers do for each of their students to succeed in the learning processes. To the best of our knowledge, this is the first study to demonstrate how the trustworthiness of reported conclusions is influenced by an AI framing of educational research evidence [28]. AI solutions have opened a new horizon of teaching opportunities, and learning as well as for administrative works in institutes of higher education, in India [31].

According to research on the integration of artificial intelligence and education by Qian [32], the experimental class has more solutions to problems than the comparison class. The students in the experimental class also appear to have a greater understanding of learning and life. The relationship between teachers and students is improved by this innovative approach, which can help to spread and transform knowledge. Based the research by Wu [35], research on artificial intelligence-based simulation research, by using flipped classrooms, students have enhanced their capacity for self-managing their learning and practiced creating, implementing, and reflecting on learning strategies. Therefore, by implementing flipped classrooms, students have exercised their capacity to manage their own learning and have developed their capacity to create learning plans, carry them out, and evaluate the success of their learning.

According to the study's findings, using artificial intelligence (AI) encouraged students to communicate by having them complete real-world tasks. Artificial intelligence (AI) has given low and middle achievers fantastic opportunity to interact with and learn from high achievers. Low achievers and shy students were therefore more eager to participate and engage. Additionally, as artificial intelligence (AI) assisted participants in developing a sense of leadership and ownership over their learning, learning also became more learner-centered [37]. Based on the study, applications of artificial intelligence help analyze students' circumstances, identify their educational needs, and provide the aid they require to pursue their goals and learn concepts. Additionally, the applications support students in overcoming their anxiety and nervousness when learning challenging subjects like geography. Additionally, they aid in raising awareness, motivating students to learn, igniting their excitement, developing greater responsibility in them, and boosting their self-assurance [39].

AI can enhance speaking ability in the classroom and offer flexible, interactive, and learner-centered learning, according to study from Shazly [33]. The Service-learning-based Module is an efficient way to prepare pre-service teachers to teach AI courses to students in primary schools according to the study by Pu, et al. [34]. In teaching skills (planning, implementation, and evaluation), a large number of academics unanimously agreed that the application of the artificial intelligence strategy would revolutionize the educational path and break with it the traditional templates that depend on indoctrination, change, and development from the role of the teacher. This result indicates a high level of developing field training skills through the use of classroom-based virtual artificial intelligence technology [38].

According to the research mentioned above, it is also possible to draw the conclusion that the usage of AI has increased in a number of nations, including China, Saudi Arabia, London, America, Jordan, India, Germany, Philippines, Taiwan, and Colombia. AI can also improve education seen from motivation, performance, and achievement of the students [39], [30], [31], [24], [28], [25], [26], [36], [34], [27], [29]. Based on existing research, Artificial Intelligence is important to apply in the world of education, because it improves student learning outcomes.

CONCLUSION

The results of the study chosen for this article look at how artificial intelligence (AI) is used in education. The educational levels of the studied disciplines ranged from kindergarten to college. Quantitative, experiment, and quasi-experiment research techniques are used. A questionnaire, curriculum assessments, pre- and post-test interviews, and a questionnaire were all components of the studies' instrument. Improvements in student performance, achievement, motivation, and attitude are reported in every study.

Based on the results of the study above, research aimed at looking at student learning outcomes as measured by pre-test and post-test scores reported improvement compared to the control group, where the AI application was not used. The questions in the open interview revealed the students' perspectives

regarding the use of the AI application in education, the results of the interview showed the students were more motivated and enthusiastic about in participating in-class learning.

Most of the research results in this study reveal the fact that, although the use of AI in education has the potential to improve performance, achievement, motivation, and attitude of students, there are still many other potentials that can be searched to developed. Like the use of AI in other subjects and methods.

What needs to be done in future research is the development of AI so the teachers can have many choices when using in education. Finally, there is a need for research aimed to develop and use AI in developing countries, including Indonesia.

ACKNOWLEDGMENTS

The researchers would like to express their sincere gratitude to Bumi Aswaja Foundation Yogyakarta, as the foundation that oversees Bumi Cendekia Senior High School Yogyakarta, for its support and encouragement throughout the completion of this study. The researchers also extend their sincere appreciation to Bumi Cendekia Senior High School Yogyakarta for providing institutional support, facilities, and an academic environment that contributed to the completion of this research. Thank you to my parents for always supporting and encouraging me. And lastly thanks to my students and brothers for all their prayers.

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