**Evolution And Contribution Of Artificial Intelligencess In Indonesian Education**

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| **Informasi Artikel** | **Abstract** |
| E-ISSN : 3026-6874  Vol: 3 No: 3 March 2025  Halaman : 19-26  **Keywords:**  *Evolution*  *Contribution*  *Artificial Intelligences*  *Education*  *Indonesia* | *The aim of this research is to analyze the evolution and contribution of artificial intelligence (AI) in the Indonesian education system. This research aims to understand how AI technology has developed and been applied in various aspects of education, from administration, personalized learning, to evaluating learning outcomes. The research methods used are literature studies and secondary data analysis from various sources, including academic journals, government reports, and case studies of AI implementation in a number of educational institutions in Indonesia. The research results show that AI has made a significant contribution to improving administrative efficiency, facilitating more adaptive learning, and providing in-depth data analysis for educational decision making. However, challenges such as the digital divide, limited infrastructure, and the need to increase teacher competency in using AI technology still need to be overcome. This research concludes that with the right policy support and investment in infrastructure and training, AI has great potential to transform Indonesian education in a more inclusive and quality direction.* |

***Abstrak***

Tujuan penelitian ini adalah untuk menganalisis evolusi dan kontribusi kecerdasan buatan (AI) dalam sistem pendidikan Indonesia. Penelitian ini bertujuan untuk memahami bagaimana teknologi AI telah berkembang dan diterapkan dalam berbagai aspek pendidikan, mulai dari administrasi, pembelajaran personalisasi, hingga evaluasi hasil belajar. Metode penelitian yang digunakan adalah studi literatur dan analisis data sekunder dari berbagai sumber, termasuk jurnal akademis, laporan pemerintah, dan studi kasus implementasi AI di sejumlah institusi pendidikan di Indonesia. Hasil penelitian menunjukkan bahwa AI telah memberikan kontribusi signifikan dalam meningkatkan efisiensi administrasi, memfasilitasi pembelajaran yang lebih adaptif, dan memberikan analisis data yang mendalam untuk pengambilan keputusan pendidikan. Namun, tantangan seperti kesenjangan digital, keterbatasan infrastruktur, dan kebutuhan peningkatan kompetensi guru dalam menggunakan teknologi AI masih perlu diatasi. Penelitian ini menyimpulkan bahwa dengan dukungan kebijakan yang tepat dan investasi dalam infrastruktur serta pelatihan, AI memiliki potensi besar untuk mentransformasi pendidikan Indonesia ke arah yang lebih inklusif dan berkualitas.

**Kata Kunci :** Evolusi, Kontribusi, Artificial Intelligences, Pendidikan, Indonesia

**INTRODUCTION**

The role of Artificial Intelligence (AI) in education in Indonesia is increasingly prominent along with rapid technological developments (Marlin *et al.*, 2023). AI has brought significant changes in various aspects of education, from the learning process, administration, to evaluating learning outcomes. One of the main contributions of AI is its ability to personalize learning. Using sophisticated algorithms, AI can analyze students' learning styles, speed of comprehension, and individual needs. This allows educators to provide learning materials tailored to each student's abilities, so that the learning process becomes more effective and efficient. In addition, AI can also help identify student learning difficulties early, so that intervention can be carried out before the problem becomes more serious.

In Indonesia, the application of AI in education is starting to be seen in several institutions, especially in big cities (Syafe'i, 2017). Several schools and universities have used AI-based platforms to support online learning, especially during the COVID-19 pandemic. These platforms not only provide learning materials, but are also equipped with features such as chatbots that can answer student questions instantly, automatic grading systems, and recommendations for additional materials based on student performance. This makes it easier for students to learn independently while reducing the burden on teachers in preparing and evaluating assignments. However, the application of AI in Indonesia still faces challenges, especially in terms of the digital divide between urban and rural areas. One of the main challenges in implementing AI in Indonesian education is the uneven infrastructure. Stable internet access and adequate technological devices are still obstacles in many areas, especially in remote areas. Without adequate infrastructure, the potential of AI cannot be utilized optimally. Apart from that, there are still many teachers and educational staff who are not yet familiar with AI technology. Training and increasing teacher competency in using this technology is very important to ensure that AI can be properly integrated into the education system. Nevertheless, AI has great potential to improve the quality of education in Indonesia. One example is the use of AI in learning management systems (LMS). An AI-based LMS can help schools and universities manage student data, monitor learning progress, and provide recommendations to teachers on more effective learning strategies. Apart from that, AI can also be used to automate administrative tasks, such as processing grades and attendance, so that teachers can focus more on the teaching process.

AI can also play a role in increasing access to education for students in remote areas (Rifky, 2024). With the help of technology such as AI-based distance learning, students in remote areas can access the same quality learning materials as students in big cities. Additionally, AI can be used to develop learning content in regional languages, making it easier for students who are more comfortable learning in their mother tongue. This can help reduce the education gap between urban and rural areas. Apart from the learning process, AI can also be used to improve educational evaluation systems. By using AI, the assessment process can be carried out automatically and objectively. For example, AI can be used to grade essay assignments or exam answers by analyzing sentence structure, vocabulary, and relevance of answers. This not only reduces teacher workload, but also ensures that assessments are carried out fairly and consistently. Additionally, AI can provide detailed feedback to students about their weaknesses and strengths, so they can improve their learning performance.

At the policy level, AI can also help the government in designing and evaluating educational programs (Taali, Darmawan and Maduwinarti, 2024). By analyzing data from various sources, AI can provide recommendations on more effective and inclusive education policies. For example, AI can help identify areas that need greater assistance in terms of educational infrastructure or teaching staff. In addition, AI can also be used to predict future education trends, so that governments can design better long-term strategies. However, the application of AI in education also raises several concerns, especially related to privacy and ethics.

The collection and analysis of student data carried out by AI systems can pose a risk of data misuse if not managed properly (Cahyanto, 2023). Therefore, strict regulations are needed to ensure that student data is protected and used only for educational purposes. In addition, there needs to be transparency in the use of AI so that all parties, including parents and students, understand how this technology works and what its benefits are. AI has great potential to transform education in Indonesia to be more inclusive, efficient and high quality. However, to achieve this, cooperation between the government, educational institutions and the private sector is needed to overcome existing challenges. Investment in infrastructure, teacher training, and the development of regulations that support the use of AI in education are key to ensuring that this technology can be utilized optimally. With the right support, AI can become a powerful tool to improve the quality of education in Indonesia. However, it is important to remember that AI is not a magic solution that can replace the role of teachers and human interaction in the learning process. AI should be seen as a tool that can strengthen and complement the learning process, not replace it. With a balanced approach, AI can help create an education system that is more adaptive, inclusive and ready to face the challenges of the future.

The evolution of artificial intelligence (AI) in Indonesian education has experienced significant developments in recent years (Zein, 2023). Initially, the use of technology in education was more limited to the use of computers and the internet to access information. However, with the advancement of AI, education systems are starting to adopt more advanced technologies, such as adaptive learning platforms, student support chatbots, and AI-based learning management systems. This development was further accelerated by the COVID-19 pandemic, which forced educational institutions to shift to online learning. AI not only facilitates the distance learning process, but also helps in managing student data, monitoring learning progress, and providing personalized learning recommendations. Despite this, AI adoption in Indonesia still faces challenges, such as digital infrastructure gaps between urban and rural areas, as well as teachers' lack of understanding and skills in using this technology.

AI's contribution to Indonesian education has had a positive impact, especially in improving the efficiency and quality of learning (Rifky, 2024). AI enables personalization of learning, where each student can receive material tailored to their pace and learning style. In addition, AI also helps teachers in grading assignments and exams automatically, thereby reducing administrative burden and allowing teachers to focus more on interactions with students. At the policy level, AI can be used to analyze education data to design more effective and inclusive strategies. However, to maximize the potential of AI, investments in digital infrastructure, teacher training and regulations that protect the privacy of student data are required. With these efforts, AI can become a transformative tool that pushes Indonesian education towards a system that is more adaptive, inclusive, and ready to face future challenges.

**METHOD**

The research approach used in this research is a qualitative research method with a focus on analyzing descriptive data from various written texts. A qualitative approach was chosen because this research relies more on literature and library research. Researchers read, understand, and analyze written sources that are relevant to the problem under study. Library research methods or bibliographic approaches are used, such as Rahayu explained by Ulfah, Supriani, and Arifudin in 2022.

Data was collected through searches from various sources such as theses, theses, dissertations, scientific articles and e-books which can be accessed via electronic media and the internet. The search was carried out using keywords relevant to the research variables in Google Scholar. The journals used are selected based on their relevance to the specified keywords. After conducting a search, the researcher identified 20 journals and reference books which were then analyzed, summarized and grouped to produce new ideas or concepts related to the research topic.

In this research, data was analyzed verbally and descriptively without using statistical techniques. The qualitative approach allows researchers to understand and describe the problems being researched through disclosing data in the form of narratives and descriptions. The results of this research provide an in-depth perspective and understanding of the topic being researched based on analysis and synthesis of relevant written texts.

**RESULT AND DISCUSSION**

**Development of Artificial Intelligence in Indonesia**

The history of the development of artificial intelligence (AI) in Indonesia began in the 1980s, when computer technology was introduced in the country (Mahendra *et al.*, 2024). At that time, AI was still in the early stages of global development, and Indonesia began to explore its potential through academic research at several leading universities. The Bandung Institute of Technology (ITB) and the University of Indonesia (UI) are pioneers in adopting and studying this technology, especially in the fields of computer science and engineering. Although at that time AI applications were still limited, interest in this technology began to grow, especially among academics and researchers. However, the development of AI in Indonesia in this era is still hampered by limited infrastructure and access to advanced technology.

Entering the 1990s, the development of AI in Indonesia began to show progress along with the increasing use of computers and the internet (Palinggi and Ridwany, 2020). In this period, several multinational companies began to bring AI-based technology to Indonesia, although still on a limited scale. Industrial sectors, especially banking and telecommunications, are the first to adopt AI-based systems to improve operational efficiency. For example, customer service automation and data analysis systems are starting to be introduced. However, adoption of AI in the education and government sectors is still very minimal, due to lack of awareness and adequate resources.

In the early 2000s, the development of AI in Indonesia began to accelerate along with advances in information and communication technology (ICT) (Palinggi and Ridwany, 2020). The Indonesian government is starting to realize the importance of this technology and is starting to integrate it in several national programs, such as e-government development. In addition, universities in Indonesia are starting to open study programs and research centers that focus on AI and machine learning. This has encouraged the emergence of a new generation of AI researchers and practitioners in Indonesia. However, challenges such as lack of digital infrastructure and limited research budgets are still major obstacles.

The development of AI in Indonesia entered a more significant phase in the 2010s, along with the industrial revolution 4.0 which encouraged the adoption of advanced technology in various sectors. The Indonesian government has begun to actively promote the use of AI through various policies, such as Making Indonesia 4.0, which aims to prepare Indonesia to face the digital era (Annas *et al.*, 2022). In this period, AI-based startups began to emerge, especially in the fields of fintech, e-commerce and health. Examples include companies such as Tokopedia and Gojek, which use AI to improve their services, such as product recommendations and delivery route optimization.

In the education sector, AI is starting to be applied in the form of online learning platforms and school management systems (Pustikayasa *et al.*, 2023). Several universities are also starting to integrate AI in their curriculum, both as a course and as a research support tool. In addition, the government has begun to initiate training and certification programs to improve human resource (HR) skills in the field of AI. However, the digital divide between urban and rural areas remains a major challenge in the spread of this technology. The COVID-19 pandemic in 2020 became an important momentum in accelerating AI adoption in Indonesia. The need for fast and efficient digital solutions is driving many sectors, including education, health and business, to leverage AI. For example, in the health sector, AI is used to predict the spread of viruses and optimize vaccine distribution. In the education sector, AI-based learning platforms such as Ruangguru and Zenius are becoming popular, helping students study independently at home. This pandemic has also increased public and government awareness about the importance of investing in AI technology.

Even though AI development in Indonesia is accelerating, several challenges still need to be overcome. One of them is the lack of regulations governing the use of AI, especially in terms of data privacy and ethics. Apart from that, limited digital infrastructure, especially in remote areas, is still a major obstacle. The government and private sector need to work together to build adequate infrastructure and ensure that the benefits of AI can be felt equally by all of society. At the global level, Indonesia is starting to show its potential as a player in the field of AI. Several Indonesian researchers and startups have received international recognition for their innovations. For example, in global AI competitions, teams from Indonesia often record impressive achievements. This shows that Indonesia has great potential to become a center for AI development in the Southeast Asia region, as long as it is supported by the right policies and investment. In the future, AI development in Indonesia is predicted to accelerate, especially with support from the government and the private sector. The government has launched various programs to encourage AI adoption, such as the creation of AI research centers and increasing the budget for research and development. In addition, collaboration between universities, industry and government is also intensifying, creating an ecosystem that supports AI innovation. Overall, the history of AI development in Indonesia reflects a journey full of challenges but also full of hope. From its humble beginnings in the 1980s to the transformative technology of today's digital era, AI has had a significant impact on various sectors in Indonesia. By continuing to overcome existing challenges and take advantage of available opportunities, Indonesia has great potential to become one of the main players in the development and application of AI at the global level.

**The Contribution of Artificial Intelligence in the World of Education in Indonesia**

The contribution of artificial intelligence (AI) in the world of education in Indonesia has brought significant changes, especially in improving the quality and accessibility of learning (Marlin *et al.*, 2023). One of the main roles of AI is in the personalization of learning, where AI systems can analyze a student's learning style, speed of comprehension, and individual needs. With this data, AI can provide learning materials tailored to each student's abilities, so that the learning process becomes more effective. For example, learning platforms such as Ruangguru and Zenius use AI algorithms to recommend material and practice questions that suit students' level of understanding. This helps students to learn independently and focus on areas that need improvement. Apart from personalizing learning, AI also plays a role in simplifying the education administration process. AI-based school management systems can automate tasks such as processing grades, attendance and lesson schedules. This not only reduces the workload on teachers and administrative staff, but also ensures that data is managed accurately and efficiently. For example, several schools in Indonesia have started using digital attendance systems integrated with AI to monitor student attendance in real-time. In this way, teachers and parents can monitor student progress more easily.

AI also contributes to improving the quality of teaching through advanced tools. Teachers can use AI to analyze student performance data and identify areas that need more attention. For example, AI systems can provide detailed reports on topics that are difficult for most students to understand, so teachers can adjust their teaching methods. Apart from that, AI can also be used to develop interactive learning content, such as animated videos and simulations, which make the learning process more interesting and effective. At the higher education level, AI has been used to support research and development innovation. Several universities in Indonesia have integrated AI into their research laboratories, both for complex data analysis and the development of new technologies. For example, AI is used in health research to analyze medical data and predict diseases. Apart from that, AI also helps students complete academic tasks, such as writing papers and analyzing data, through tools such as chatbots and analytical software.

One of AI's most transformative contributions is in distance learning, especially during the COVID-19 pandemic (Putri, Asbari and Hapizi, 2024). With the help of AI, online learning platforms can provide a learning experience that is almost equivalent to face-to-face learning. Features such as virtual classes, automatic assessments, and AI-based learning material recommendations allow students to continue learning even at home. This is very important in maintaining educational continuity amidst physical limitations. AI also plays a role in reducing the education gap between urban and rural areas. With the help of AI technology, students in remote areas can access the same quality learning materials as students in big cities. For example, AI-based learning platforms can provide content in regional languages, making it easier for students who are more comfortable learning in their mother tongue. In addition, AI can also be used to develop learning programs tailored to local needs, such as practical skills training that is relevant to local conditions.

On the evaluation side, AI has brought major changes in the way assessments are done. AI-based automated grading systems can grade essay assignments, exam answers, and even student projects quickly and objectively (Kobandaha, 2017). This not only reduces teacher workload, but also ensures that assessments are carried out fairly and consistently. Additionally, AI can provide detailed feedback to students about their weaknesses and strengths, so they can improve their learning performance. Despite the enormous contribution of AI in education, challenges remain. One of them is the digital divide, where not all students have the same access to technology and the internet. In addition, many teachers are still not familiar with AI technology, so training and competency improvement are needed. The government and private sector need to work together to overcome this challenge, for example by providing equitable digital infrastructure and training programs for teachers. In the future, the potential for AI in Indonesian education is still very large. With the right policy support and investment in infrastructure and training, AI can help create a more inclusive, adaptive and quality education system. For example, AI can be used to develop curricula that are more relevant to industry needs, so that graduates are ready to face challenges in the world of work. Apart from that, AI can also help identify students' talents and interests from an early age, so that they can be developed optimally. Overall, AI's contribution to the world of education in Indonesia has had a significant positive impact, ranging from personalizing learning to increasing administrative efficiency. Although there are still challenges that need to be overcome, the potential for AI to transform Indonesian education is enormous. By continuing to develop and integrate AI technology, Indonesia can create an education system that is more advanced, inclusive, and ready to face future challenges.

**Analysis of the Evolution and Contribution of Artificial Intelligence in Indonesia**

The evolution of artificial intelligence (AI) in Indonesia has experienced significant development, starting from the 1980s when computer technology was first introduced. At that time, AI was still in the early stages of global development, and Indonesia began to explore its potential through academic research at several leading universities such as the Bandung Institute of Technology (ITB) and the University of Indonesia (UI). Although AI applications are still limited, interest in this technology is starting to grow among academics and researchers. However, the development of AI in this era is still hampered by limited infrastructure and access to advanced technology, which means its adoption is not yet widespread.

Entering the 1990s, the development of AI in Indonesia began to show progress along with the increasing use of computers and the internet. In this period, several multinational companies began to bring AI-based technology to Indonesia, although still on a limited scale. Industrial sectors, especially banking and telecommunications, are the first to adopt AI-based systems to improve operational efficiency. For example, customer service automation and data analysis systems are starting to be introduced. However, adoption of AI in the education and government sectors is still very minimal due to lack of awareness and adequate resources.

In the early 2000s, the development of AI in Indonesia began to accelerate along with advances in information and communication technology (ICT). The Indonesian government is starting to realize the importance of this technology and is starting to integrate it in several national programs, such as e-government development. In addition, universities in Indonesia are starting to open study programs and research centers that focus on AI and machine learning. This has encouraged the emergence of a new generation of AI researchers and practitioners in Indonesia. However, challenges such as lack of digital infrastructure and limited research budgets are still major obstacles.

The development of AI in Indonesia entered a more significant phase in the 2010s, along with the industrial revolution 4.0 which encouraged the adoption of advanced technology in various sectors. The Indonesian government has begun to actively promote the use of AI through various policies, such as Making Indonesia 4.0, which aims to prepare Indonesia to face the digital era. In this period, AI-based startups began to emerge, especially in the fields of fintech, e-commerce and health. Examples include companies such as Tokopedia and Gojek, which use AI to improve their services, such as product recommendations and delivery route optimization.

In the education sector, AI is starting to be applied in the form of online learning platforms and school management systems. Several universities are also starting to integrate AI in their curriculum, both as a course and as a research support tool. In addition, the government has begun to initiate training and certification programs to improve human resource (HR) skills in the field of AI. However, the digital divide between urban and rural areas remains a major challenge in the spread of this technology.

The COVID-19 pandemic in 2020 became an important momentum in accelerating AI adoption in Indonesia. The need for fast and efficient digital solutions is driving many sectors, including education, health and business, to leverage AI. For example, in the health sector, AI is used to predict the spread of viruses and optimize vaccine distribution. In the education sector, AI-based learning platforms such as Ruangguru and Zenius are becoming popular, helping students study independently at home. This pandemic has also increased public and government awareness about the importance of investing in AI technology.

Even though AI development in Indonesia is accelerating, several challenges still need to be overcome. One of them is the lack of regulations governing the use of AI, especially in terms of data privacy and ethics. Apart from that, limited digital infrastructure, especially in remote areas, is still a major obstacle. The government and private sector need to work together to build adequate infrastructure and ensure that the benefits of AI can be felt equally by all of society.

At the global level, Indonesia is starting to show its potential as a player in the field of AI. Several Indonesian researchers and startups have received international recognition for their innovations. For example, in global AI competitions, teams from Indonesia often record impressive achievements. This shows that Indonesia has great potential to become a center for AI development in the Southeast Asia region, as long as it is supported by the right policies and investment. In the future, AI development in Indonesia is predicted to accelerate, especially with support from the government and the private sector. The government has launched various programs to encourage AI adoption, such as the creation of AI research centers and increasing the budget for research and development. In addition, collaboration between universities, industry and government is also intensifying, creating an ecosystem that supports AI innovation. The evolution and contribution of AI in Indonesia reflects a journey full of challenges but also full of hope. From its humble beginnings in the 1980s to the transformative technology of today's digital era, AI has had a significant impact on various sectors in Indonesia. By continuing to overcome existing challenges and take advantage of available opportunities, Indonesia has great potential to become one of the main players in the development and application of AI at the global level.

**CONCLUSION**

The conclusion of this article is that the evolution of artificial intelligence (AI) in Indonesian education has brought about significant transformation, starting from the early stages of technology introduction to the adoption of sophisticated AI-based learning systems. AI has made a major contribution to the personalization of learning, administrative efficiency, and expanding access to education, especially through online platforms. Although challenges such as the digital divide and lack of teacher competency still exist, the potential of AI to create a more inclusive and quality education system is enormous. With policy support, infrastructure investment, and increased human resource capacity, AI can become an important tool in advancing Indonesian education in the future.

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