Sinergi International Journal of Education
E-ISSN: 2988-4926
Volume. 1, Issue 2, August 2023
Page No: 75-83

Integration of Artificial Intelligence in Geography Learning: Challenges and Opportunities

Heinrich Rakuasa
Universitas Pattimura, Indonesia
Correspondent: heinrichrakuasa01@gmail.com

Received : May 8, 2023
Accepted : August 20, 2023
Published : August 31, 2023

Citation: Rakuasa, H. (2023). Integration of Artificial Intelligence in Geography Learning: Challenges and Opportunities. Sinergi International Journal of Education, 1(2), 75-83.

ABSTRACT: This research discusses the potential and challenges of integrating Artificial Intelligence (AI) in geography learning. By considering the fundamentals of AI and the role of geography in the era of globalization, this research outlines the benefits of AI in geography learning through interactive visualization and personalization of learning. However, challenges such as equitable access to technology and teacher training are major concerns in the application of AI. The research uses descriptive method with literature review which involves collecting, analyzing, and explaining the information in the literature relevant to the integration of artificial intelligence (AI) in Geography learning. In addition, this study highlights the opportunities of AI in geographic data analysis and addressing global challenges such as climate change. The profound implications of AI integration in geography learning are also discussed, given its impact on education and society. This research provides a holistic picture of the intersection of AI and geography, encouraging a better understanding of its potential and limitations. It is hoped that this research will provide guidance for educational practitioners and researchers to optimize the potential of AI in geography teaching, taking into account the challenges to be overcome and the opportunities to be exploited.

Keywords: Artificial Intelligence, Geography Learning, Geography Education

INTRODUCTION

Education is an important foundation in the formation of a competent generation that is ready to face the challenges of the modern world. In this context, Geography learning has a central role in helping students understand the complexity of interactions between humans and the environment. Along with technological advancements, especially in the field of Artificial Intelligence (AI), opportunities arise to integrate this technology in the Geography learning process (Chang & Kidman, 2023). However, amidst the promising opportunities, there are a number of challenges that need to be addressed. One of the main opportunities of integrating Artificial Intelligence in Geography learning is to provide a more interactive and personalized learning experience. By

utilizing AI technology, educators can design learning materials that suit students' individual needs and interests (Simon, 2019). For example, intelligent systems can analyze each student's learning progress and adapt learning content to suit their individual level of understanding.

However, behind these opportunities, there are significant challenges. First, limited access to technology is a concern (Huang et al., 2021). Not all schools or regions have adequate infrastructure to integrate Artificial Intelligence in Geography learning (Zawacki-Richter et al., 2019). This inequality of access can deepen the educational gap between different groups of students (Huang et al., 2021). The next challenge is concerns related to privacy and security of student data (Knox, 2020). The use of AI technology in monitoring student learning progress may involve the collection of sensitive personal data (Zawacki-Richter et al., 2019). Strict regulations and policies are needed to ensure that student data is not misused and their privacy is maintained (Alam, 2022). In addition, there are challenges related to curriculum and the development of learning materials that are compatible with AI technologies (Huang et al., 2021). Educators need to be trained and empowered to utilize these technologies effectively. Developing engaging and relevant learning content also requires sufficient time and resources (Zhai et al., 2021).

In the context of Geography learning, AI technology can enable faster and more accurate analysis of complex spatial data (Knox, 2020). However, this also brings up the challenge of ensuring that students not only rely on the technology, but also understand the fundamentals of Geography concepts (Guan et al., 2020). To overcome these challenges, collaboration between the government, educational institutions, the technology industry, and the education community is necessary. Investment in technology infrastructure, training for educators, and regulations that protect student privacy are needed. Overall, the integration of Artificial Intelligence in Geography learning offers exciting opportunities to improve the quality of education and prepare students for an increasingly complex world (Cope et al., 2021). However, the challenges must be overcome with concrete steps so that this integration can provide the maximum possible benefit to the world of education. Based on the above description, this study aims to determine the integration of artificial intelligence in geography learning: challenges and opportunities.

METHOD

This research uses a descriptive method with a literature study approach to describe in detail about how the integration of artificial intelligence (AI) is done in the context of Geography learning. The main emphasis of this method is to understand the challenges and opportunities that arise when artificial intelligence technology is applied in the teaching and learning of Geography subjects. This literature study approach allows the researcher to summarize, analyze, and comprehensively explain the information in the relevant literature.

RESULT AND DISCUSSION

1. Fundamentals of Artificial Intelligence and Geography

a. Introduction to Artificial Intelligence

Artificial Intelligence (AI) is a computer science discipline that focuses on developing computer systems that can perform tasks that require human intelligence (Huang et al., 2021). This includes the ability to learn from data, recognize patterns, make decisions, and complete complex tasks (Simon, 2019). One of the main approaches in AI is machine learning, which involves using algorithms to teach a computer how to process data and take action based on discovered patterns (Zawacki-Richter et al., 2019). This allows AI systems to continuously improve their performance over time.

b. Geography in the Modern Context

Geography is the study of the interaction between humans and the physical environment (Chorley, 2019). In the era of globalization, an understanding of geography has growing relevance. It helps us understand how human interaction with the environment affects global phenomena such as climate change, urbanization, migration, and international trade. In the modern context, geography is not only concerned with the physical mapping of the world, but also includes the study of people and culture (Radcliffe, 2017). This includes maps of population distribution, research into land use, analysis of environmental change, as well as an understanding of geopolitical relations between countries (Susan et al., 2023). Geography is also concerned with technology, such as geographic information systems (GIS) that enable spatial analysis and data visualization (Rakuasa & Latue, 2023).

With these technologies, we can more effectively map environmental changes, population distribution, and inter-regional relationships (Manakane et al., 2023). All in all, an introduction to Artificial Intelligence and an understanding of geography in a modern context has a significant impact in an increasingly complex and connected world (Huang et al., 2021). The combination of AI's ability to analyze data and understand patterns with an understanding of geography helps us make informed decisions.

2. Benefits of Artificial Intelligence Integration in Geography Learning

a. Interactive Visualization and Realistic Simulation

The integration of Artificial Intelligence (AI) in geography learning brings significant benefits in the form of interactive visualizations and highly realistic simulations of geographical environments (Lavallin & Downs, 2021). Technologies such as Augmented Reality (AR) and Virtual Reality (VR) allow students to "explore" maps, geographic locations, and natural phenomena in an immersive and realistic visual form (Albahbah et al., 2021). This creates an immersive learning experience, allowing students to interact directly with geographic content virtually (Papanastasiou et al., 2019). With this visualization, geography concepts become easier to understand and apply in a real-world context.

b. Personalization of Learning

Another benefit of AI integration in geography learning is the ability to personalize learning. AI can analyze student behavior and learning patterns through data, which allows for adaptation of learning according to individual needs and preferences (Zawacki-Richter et al., 2019). Learning materials, teaching methods, and task difficulty levels can be tailored to each student's characteristics. This helps students who take longer to understand concepts get additional support,

while faster students can be given more challenging assignments (Cope et al., 2021). This personalization improves learning efficiency and effectiveness, and motivates students to actively participate in the learning process.

In all, the integration of Artificial Intelligence brings significant benefits in geography learning. From more immersive visualization to personalization of learning, AI provides a new approach to teaching and understanding geography concepts, helping students develop a better understanding of the world around them.

3. Challenges in Integrating Artificial Intelligence in Geography Learning

a. Infrastructure and Access to Technology

One of the main challenges in the integration of Artificial Intelligence (AI) in geography learning is the availability of infrastructure and equitable access to technology (Huang et al., 2021). Not all schools or regions have adequate access to advanced technology such as smart devices, stable internet connection, or AI software (Chen et al., 2023). This inequality in technology access can result in disparities in the educational opportunities generated by AI integration. Students in less developed regions or impacted by the digital divide may not be able to access the full learning benefits of AI, which could deepen the education gap (Cope et al., 2021).

b. Teacher Training and Trust

AI integration in geography learning requires deep technical and pedagogical understanding from teachers. Challenges arise in providing teachers with the necessary training to effectively utilize these technologies in teaching (Li & Hsu, 2022). Many teachers may not have sufficient knowledge or experience in the use of AI in educational contexts. In addition, there is the issue of trust in AI technologies. Teachers may feel that the use of AI in geography learning may replace their role or raise ethical issues (Janowicz et al., 2020). Efforts are needed to ensure that teachers have the necessary knowledge, support and trust to adopt AI technologies confidently and effectively in their teaching (Chang & Kidman, 2023).

These challenges point to the need for a cautious approach to integrating AI in geography learning. Efforts should be focused on improving technology infrastructure and access, providing appropriate training to teachers, and ensuring that these technologies are used with trust and ethics in mind (Toom et al., 2019). By addressing these challenges, AI integration in geography learning can be a powerful tool for advancing education, although a comprehensive collaborative effort from governments, educational institutions, and the technology industry may be required to effectively address these challenges (Çifçi & Dikmenli, 2019).

4. Future Opportunities and Profound Implications in Integrating Artificial Intelligence in Geography Learning

a. Geographic Data Analysis

The integration of Artificial Intelligence in geography learning opens up great opportunities in in-depth geographic data analysis (Huang et al., 2021). AI has the ability to analyze large volumes of geographic data, identify patterns, and draw deep insights into environmental changes, population movements, and other geographic phenomena (Muin & Rakuasa, 2023). This can help in

understanding the impact of climate change, anticipating natural disasters, and forecasting changes in human migration patterns (Rakuasa, 2022). AI-enhanced geographic data analysis provides more accurate and rapid insights, which enables better decision-making in a variety of areas, including the environment and public welfare (Hehanussa et al., 2023; Muin & Rakuasa, 2023).

b. Addressing Global Challenges

The integration of Artificial Intelligence in geography learning has the potential to help address complex global challenges (Latue et al., 2023). For example, AI can be used to map the spread of diseases, forecast sea level rise due to climate change, and analyze the impact of urbanization on the environment (Latue & Rakuasa, 2023). With a better understanding of these global challenges, public policies and mitigation measures can be designed more effectively. The integration of AI in geography learning also prepares the younger generation to contribute to solving global problems by applying geographic technology and knowledge (Huang et al., 2021).

The implications of these opportunities include a profound impact on the way we understand and address global and local challenges. AI opens up new opportunities in analyzing data, forecasting trends and designing more effective solutions in various aspects of life. In the context of geography learning, these opportunities are resulting in a generation of students who have a deeper understanding of how humans interact with the environment and how technology can help solve complex problems (Zawacki-Richter et al., 2019). However, these implications also coexist with the responsibility of managing data with proper ethics and privacy, as well as considering the long-term impact of AI technologies on the environment and society as a whole.

The opportunities offered by the integration of Artificial Intelligence in geography learning have the potential to bring significant positive changes in understanding and addressing global challenges (Lambert et al., 2015). However, the success of these applications requires collaborative efforts from various sectors, including education, technology industries, and governments, to ensure that these benefits can be realized in a thoughtful and responsible manner.

5. Towards a Future of Geography Learning with Artificial Intelligence

a. Effective Integration Strategy:

To steer geography learning into the future with artificial intelligence (AI), effective integration strategies are required. Some important steps that can be taken include:

1) Teacher Training: Provide comprehensive training to teachers on the use of AI technologies in geography learning. Teachers need to understand the potential and limitations of these technologies and how to integrate them into teaching effectively.
2) Learning Material Development: Design learning materials that are responsive to AI technologies. Materials should be adaptable by AI to personalize learning according to individual student needs
3) Technology Infrastructure: Ensuring equitable access to AI technologies across schools and regions. This involves investing in technology infrastructure, such as adequate hardware and internet connectivity.
4) Evaluation and Feedback: Using AI data and analytics to monitor student learning progress. The resulting feedback can help teachers design appropriate interventions for students who need additional support.

b. Future Vision:
The future vision of geography learning with artificial intelligence is to create a holistic, personalized, and interactive learning experience. Students will be able to explore geographic environments through realistic simulations, design research based on in-depth geographic data analysis, and solve real problems with AI-generated solutions. Teachers will serve as learning facilitators, helping students articulate questions, explain concepts, and direct their exploration in the increasingly complex world of geography.

This vision also includes global collaboration, where students from different parts of the world can interact and collaborate on solving complex geographic problems (DeMers, 2016). AI technology will become a partner in the learning process, helping to understand geographic patterns and forecast future trends. More than that, students will receive an in-depth education on the impact of human interaction with the environment and how technology can help address global challenges such as climate change, inequality and urbanization (Lambert et al., 2015). The future of geography learning with artificial intelligence represents a significant shift in learning approaches. With effective integration strategies and a progressive vision, geography learning will be more dynamic, relevant and interactive. However, the development and implementation of this vision requires cross-sector collaboration as well as a commitment to utilize the potential of AI technology wisely and responsibly (Radcliffe, 2017).

The integration of Artificial Intelligence (AI) in geography learning carries great potential to change the way we teach and understand geography. With the combination of AI technologies and geography knowledge, there are opportunities to enhance learning, provide deep insights, and address complex challenges (Guan et al., 2020). However, challenges also arise along with these opportunities, and successful implementation depends on a deep understanding of both fields. Infrastructure and technology access challenges are important barriers to realizing the potential of this integration (Zawacki-Richter et al., 2019). Unequal access to advanced technology can deepen the education gap. Teacher training and building trust in AI are also determining factors. Teachers play a central role in teaching, and efforts to ensure that they are comfortable and competent in integrating AI are crucial.

Despite the challenges, the opportunities that arise are exciting. Interactive visualizations and realistic simulations possible with AI can bring a deeper understanding of geographical phenomena (Simon, 2019). Personalization of learning optimizes students' learning experience. AI-enhanced geographic data analysis can help understand and address global challenges such as climate change and urbanization . The integration of Artificial Intelligence in geography learning opens the door to a smarter and more informed future. However, success requires an effective integration strategy, as well as collaboration between education, technology and government. By addressing challenges and capitalizing on opportunities, we can shape a generation that not only understands the world around them, but is also able to face global challenges with innovative and responsible solutions.

CONCLUSION

The integration of Artificial Intelligence (AI) in geography learning is a blend of advanced technology and an understanding of the physical environment and human interaction. While it

brings great opportunities in interactive visualization, personalization of learning, and in-depth geographic data analysis, challenges such as equitable access to technology, teacher training, and trust in technology also arise. Successful integration requires effective strategies and cross-sector collaboration. By overcoming challenges and capitalizing on opportunities, the integration of AI in geography learning can bring about a more dynamic and relevant education, preparing a generation ready to face global challenges with deep understanding and innovative solutions.

REFERENCE

Abdul Muin, & H. R. (2023). Pemetaan Kerentanan Kebakaran Hutan di Pulau Buru, Provinsi Maluku Berdasarkan Fire Hotspot. *INSOLOGI: Jurnal Sains Dan Teknologi*, *2*(4), 675–683. https://doi.org/https://doi.org/10.55123/insologi.v2i4.2256

Alam, A. (2022). *Employing Adaptive Learning and Intelligent Tutoring Robots for Virtual Classrooms and Smart Campuses: Reforming Education in the Age of Artificial Intelligence* (pp. 395–406). https://doi.org/10.1007/978-981-19-2980-9_32

Albahbah, M., Kıvrak, S., & Arslan, G. (2021). Application areas of augmented reality and virtual reality in construction project management: A scoping review. *Journal of Construction Engineering, Management & Innovation*, *4*(3). https://doi.org/10.31462/jcemi.2021.03151172

Chang, C.-H., & Kidman, G. (2023). The rise of generative artificial intelligence (AI) language models - challenges and opportunities for geographical and environmental education. *International Research in Geographical and Environmental Education*, *32*(2), 85–89. https://doi.org/10.1080/10382046.2023.2194036

Chen, M., Claramunt, C., Çöltekin, A., Liu, X., Peng, P., Robinson, A. C., Wang, D., Strobl, J., Wilson, J. P., Batty, M., Kwan, M.-P., Lotfian, M., Golay, F., Joost, S., Ingensand, J., Senousi, A. M., Cheng, T., Bandrova, T., Konecny, M., … Lü, G. (2023). Artificial intelligence and visual analytics in geographical space and cyberspace: Research opportunities and challenges. *Earth-Science Reviews*, *241*, 104438. https://doi.org/10.1016/j.earscirev.2023.104438

Chorley, R. J. (Ed.). (2019). *Directions in Geography*. Routledge. https://doi.org/10.4324/9780429273292

Çifçi, T., & Dikmenli, Y. (2019). Why Geography Learning: Candidate Teachers' Views for Geography. *Review of International Geographical Education Online*. https://doi.org/10.33403/rigeo.672979

Cope, B., Kalantzis, M., & Searsmith, D. (2021). Artificial intelligence for education: Knowledge and its assessment in AI-enabled learning ecologies. *Educational Philosophy and Theory*, *53*(12), 1229–1245. https://doi.org/10.1080/00131857.2020.1728732

DeMers, M. N. (2016). Geospatial Technology in Geography Education. *The Geography Teacher*, *13*(1), 23–25. https://doi.org/10.1080/19338341.2016.1151722

Guan, C., Mou, J., & Jiang, Z. (2020). Artificial intelligence innovation in education: A twenty-year data-driven historical analysis. *International Journal of Innovation Studies*, *4*(4), 134–147. https://doi.org/10.1016/j.ijis.2020.09.001

Hehanussa, F. S., Sumunar, D. R. S., & Rakuasa, H. (2023). Pemanfaatan Geogle Earth Engine Untuk Identifikasi Perubahan Suhu Permukaan Daratan Kabupaten Buru Selatan Berbasis Cloud Computing. *Gudang Jurnal Multidisiplin Ilmu*, *1*(1), 37–45.

Heinrich Rakuasa, & P. C. L. (2023). Monitoring Urban Sprawl in Ambon City Using Google

Earth Engine. *MULTIPLE: Journal of Global and Multidisciplinary*, *1*(2), 88–100.

Huang, J., Saleh, S., & Liu, Y. (2021). A Review on Artificial Intelligence in Education. *Academic Journal of Interdisciplinary Studies*, *10*(3), 206. https://doi.org/10.36941/ajis-2021-0077

Janowicz, K., Gao, S., McKenzie, G., Hu, Y., & Bhaduri, B. (2020). GeoAI: spatially explicit artificial intelligence techniques for geographic knowledge discovery and beyond. *International Journal of Geographical Information Science*, *34*(4), 625–636. https://doi.org/10.1080/13658816.2019.1684500

Knox, J. (2020). Artificial intelligence and education in China. *Learning, Media and Technology*, *45*(3), 298–311. https://doi.org/10.1080/17439884.2020.1754236

Lambert, D., Solem, M., & Tani, S. (2015). Achieving Human Potential Through Geography Education: A Capabilities Approach to Curriculum Making in Schools. *Annals of the Association of American Geographers*, *105*(4), 723–735. https://doi.org/10.1080/00045608.2015.1022128

Latue, P. C., Rakuasa, H., Somae, G., & Muin, A. (2023). Analisis Perubahan Suhu Permukaan Daratan di Kabupaten Seram Bagian Barat Menggunakan Platform Berbasis Cloud Google Earth Engine. *Sudo Jurnal Teknik Informatika*, *2*(2), 45–51. https://doi.org/https://doi.org/10.56211/sudo.v2i2.261

Lavallin, A., & Downs, J. A. (2021). Machine learning in geography–Past, present, and future. *Geography Compass*, *15*(5). https://doi.org/10.1111/gec3.12563

Li, W., & Hsu, C.-Y. (2022). GeoAI for Large-Scale Image Analysis and Machine Vision: Recent Progress of Artificial Intelligence in Geography. *ISPRS International Journal of Geo-Information*, *11*(7), 385. https://doi.org/10.3390/ijgi11070385

Manakane, S. E., Latue, P. C., Somae, G., & Rakuasa, H. (2023). Flood Risk Modeling in Buru Island, Maluku Province, Indonesia using Google Earth Engine: Pemodelan Risiko Banjir di Pulau Buru, Provinsi Maluku, Indonesia dengan menggunakan Mesin Google Earth. *MULTIPLE: Journal of Global and Multidisciplinary*, *1*(2), 80–87.

Muin, A., & Rakuasa, H. (2023). Pemanfaat Geographic Artificial Intelligence (Geo-AI) Untuk Identifikasi Daerah Rawan Banjir Di Kota Ambon. *Gudang Jurnal Multidisiplin Ilmu*, *1*(2), 58-63. https://doi.org/https://doi.org/10.59435/gjmi.v1i2.24

Papanastasiou, G., Drigas, A., Skianis, C., Lytras, M., & Papanastasiou, E. (2019). Virtual and augmented reality effects on K-12, higher and tertiary education students' twenty-first century skills. *Virtual Reality*, *23*(4), 425–436. https://doi.org/10.1007/s10055-018-0363-2

Philia Christi Latue, H. R. (2023). Analisis Perubahan Suhu Permukaan Daratan di Kecamatan Ternate Tengah Menggunakan Google Earth Engine Berbasis Cloud Computing. *E- JOINT (Electronica and Electrical Journal of Innovation Technology)*, *4*(1), 16–20. https://doi.org/https://doi.org/10.35970/e-joint.v4i1.1901

Radcliffe, S. A. (2017). Decolonising geographical knowledges. *Transactions of the Institute of British Geographers*, *42*(3), 329–333. https://doi.org/10.1111/tran.12195

Rakuasa, H. (2022). ANALISIS SPASIAL TEMPORAL SUHU PERMUKAAN DARATAN/ LAND SURFACE TEMPERATURE (LST) KOTA AMBON BERBASIS CLOUD COMPUTING: GOOGLE EARTH ENGINE. *Jurnal Ilmiah Informatika Komputer*, *27*(3), 194–205. https://doi.org/10.35760/ik.2022.v27i3.7101

Simon, J. P. (2019). Artificial intelligence: scope, players, markets and geography. *Digital Policy, Regulation and Governance*, *21*(3), 208–237. https://doi.org/10.1108/DPRG-08-2018-0039

Susan E Manakane, Philia Christi Latue, Glendy Somae, H. R. (2023). The Role of Geography

Research in Supporting Sustainable Development in Ambon City, Indonesia: A Review. *Sinergi International Journal of Economics*, *1*(2), 64–75. https://doi.org/https://doi.org/10.61194/economics.v1i2.67

Toom, A., Tiilikainen, M., Heikonen, L., Leijen, Ä., Mena, J., & Husu, J. (2019). Teacher candidate learning of action-oriented knowledge from triggering incidents in teaching practice. *Teachers and Teaching*, *25*(5), 536–552. https://doi.org/10.1080/13540602.2019.1652162

Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators? *International Journal of Educational Technology in Higher Education*, *16*(1), 39. https://doi.org/10.1186/s41239-019-0171-0

Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., Liu, J.-B., Yuan, J., & Li, Y. (2021). A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. *Complexity*, *2021*, 8812542. https://doi.org/10.1155/2021/8812542