



Exploring Research Trends Between Artificial Intelligence and Technological Innovation: A Bibliometrics Perspective

Sufandi Mohd Johan^{1*}, Lim Tian Pau¹, Hairul Azam Mohd Mokhtar¹, Mohd Shahrir Abd Rahim¹, Ramli Ngatniman²

¹Department of Mechanical Engineering, Politeknik Port Dickson, KM 14, Jalan Pantai, Si Rusa, 71050 Port Dickson, Negeri Sembilan, Malaysia

²Department of Mechanical Engineering, Politeknik Muadzam Shah, Lebuhraya Tun Razak, 26700 Muadzam Shah, Pahang, Malaysia

*Corresponding author: sufandi@polipd.edu.my

Please provide an **official organisation email** of the corresponding author

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Abstract

Future civilizations are increasingly challenged by the impact of modern technological change. The various influences of artificial intelligence technology provide benefits and prospects to human life, products and the environment. This study aims to investigate the research trends through bibliometric analysis can determine the mapping of data from the Scopus database with the keywords “artificial intelligence” and “innovation”. A total of 175 documents were obtained after screening from 2015 to 2025; the data were analyzed and visualized using vosviewer and bibliometrix R-package to generate the thematic maps and collaboration networks. The largest number of publications are from technological forecasting and social change on the topic of artificial intelligence and innovation with quartile 1 (Q1). Based on the results and discussion, the findings of the article data on the keyword artificial intelligence work on 5 large clusters, namely responsible innovation, sustainability, green innovation, business model innovation and machine learning. The visualization of keyword co-occurrence found that the specific keywords innovation is still less related to digital transformation, implementation, business model innovation, journalism, medical imaging, learning, sustainable development, and green technology innovation. From this data it can also be observed that green innovation, digital innovation, computer science, product innovation, ecosystem innovation, ethics, responsible innovation have a long distance with the theme of AI and innovation research. This provides opportunities for future research on this topic by researchers. This fact shows that AI has a great impact on the environment of technological revolution and innovation without marginalizing the well-being of human life through the quality and challenges of education.

Keywords: - Artificial intelligence, innovation, vosviewer, bibliometrix R-package, visualization

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1. Introduction

The future of human civilization is increasingly challenged by the increasing reliance on technology and artificial intelligence (AI) (Belhadi et al., 2024) which are now pervasive and shaping various replacements of human life (Haefner et al., 2021). The key to the industrial revolution and artificial intelligence has changed social policies, economic sectors, investment firms, jobs and the valuation of existing markets in evolving in line with

product innovation towards modernization (Babina et al., 2024). The main emphasis of artificial intelligence is its performance ability to process advanced information (Belhadi et al., 2024) and even provide the expected level of accuracy and potentially explore the development of advanced AI, deep learning algorithms (Pinto-Coelho, 2023). Interestingly, attention is now increasingly focused on the theoretical implications of design and innovation that algorithms are significantly performing (Verganti et al., 2020). Algorithms recognize complex patterns and can be developed in networks to handle other tasks with ease

without being seen by the human eye (Pinto-Coelho, 2023). Importantly, the development of research and development knowledge will reduce costs, save time, strengthen the market and help the sustainability of green development with high-tech innovation (Mariani et al., 2023). This is in line with the United Nations and other organizations supporting the concept of sustainable development as a framework for achieving economic, environmental and social balance (Mhlanga, 2021).

AI-based innovation will influence sustainable development more competitively by making quality education to meet adaptive learning, personalized in science and technology (Nahar, 2024). Through integrating AI innovations in medicine, especially radiology imaging, tomography, diagnostic communication, is becoming an important role in human healthcare (Pesapane et al., 2018). Thus, integrating AI in management will also help manage organizations while solving problems by rationalizing the creativity of the innovation process as a uniform decision-making method (Pietronudo et al., 2022). In context organization, firms are investing in new innovations in the field of artificial intelligence in recent times (Babina et al., 2024). The concern is that firms are realigning their organizations by replacing employees with immediate management innovation to the adoption of artificial intelligence technologies (Haefner et al., 2021).

Developments have occurred indicating that Artificial Intelligence is expected to have a major impact on the adoption of technology in various applications of systematic identification, detection, inspection and predictability of its results (Pinto-Coelho, 2023). Given the aforementioned, there is still much exploration of the theme of artificial intelligence and innovation that will emerge from researchers from the perspective of studies across various new fields soon (Guan et al., 2020). In addition to comprehensively investigating the AI theme, it is important to know the patterns research trends, development directions and novelty values of new fields that have the potential to develop in line with the evolution of knowledge (Islam & Guangwei, 2025). The analysis of this study will have basis for planning curriculum development, knowledge dissemination, expertise, competency (Dehen et al., 2026). For that reason, AI practitioners and education practitioners need to be prepared from a new strategic perspective to provide AI to the public through education so that they are prepared for the increasingly rapid and critical socio-technical future of human job automation (Hautala & Ahlqvist, 2024 & Glushkova et al., 2025).

Therefore, this study aim is to address a clear research direction, insufficient critical consideration of risk, challenges and shorter period reviews about this topic artificial intelligence and innovation through bibliometric analysis. Among the reputable database sources are Scopus

and web of science which are often used in bibliometric analysis by researchers (Zahra & Ramadhani, 2025 & Jiang et al., 2024). Scopus is the most comprehensive academic database and is recognized as having a competitive number of scholarly articles and research papers (Akhmad et al., 2025).

To answer the bibliometric research question is to use the biblioshiny R package which can extract data on co-words, keywords, and thematic evolution mapping (Monadi & Lakrarsi, 2026). Meanwhile Vosviewer software is used to see the visualization cluster, visualization overlay, publication trends, keyword co-occurrence analysis and collaboration networks of the metadata (Afzaal et al., 2024). There are six research questions for this study; 1) what is the trend in the number of publications from 2015-2025? 2) Which are most sources published about this topic? 3) Who are the most influential authors in this topic? 4) How are the co-occurrence keyword analysis visualization and networks for this topic? 5) How does visualization overlay for this topic? and 6) What is the development of thematic map author's keywords direction?

2. Methodology

This research is based on bibliometric analysis of bibliographic material as quantitative data methodology this study (Zupic & Čater, 2015 & Misbah et al., 2025). A metadata search was conducted using the Scopus database with the keywords “artificial intelligence” and “innovation” on 30 January 2026, produced 200 documents. Data extracted from Scopus will be filtered and aligned to ensure metadata consistency. Document are reduced through filtering limitations based on open access, data year: 2015-2025, document type: articles and conference papers, publication stage: final, and language: English. From the filtering, a total of 175 were found, 96% of which were articles and 4% were conference papers. The following documents were analysed using vosviewer and bibliometrix R-package software. The procedure of the data collection methodology flowchart as shown in Fig. 1.

3. Result and Discussion

The number of publications article research on artificial intelligence and innovation from years 2015 to 2025 is shown in Fig. 2. The data demonstrates a steady trajectory in publications, culminating in a dramatic peak in 2024. This signifies a maturing interest in the AI-Innovation nexus and reflects the rapid global adoption of generative technologies as a primary research focus (Afzaal et al., 2024).

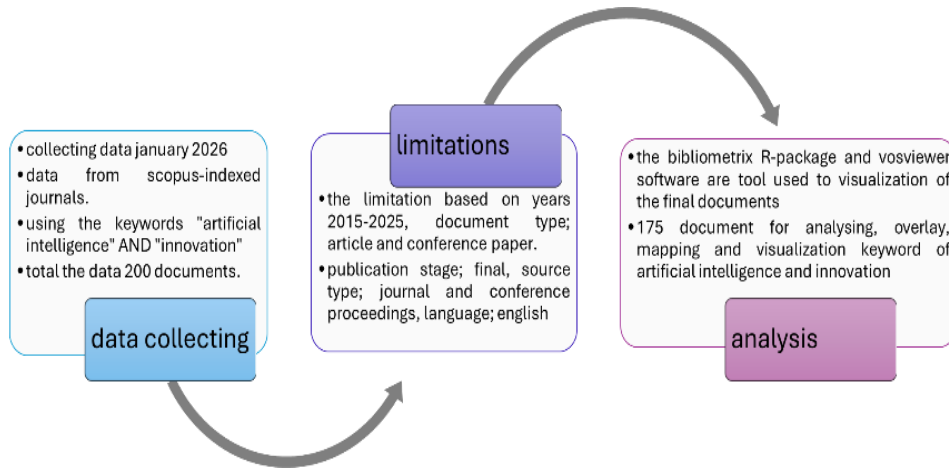


Fig. 1: Flowchart of data collection on the topic artificial intelligence and innovation

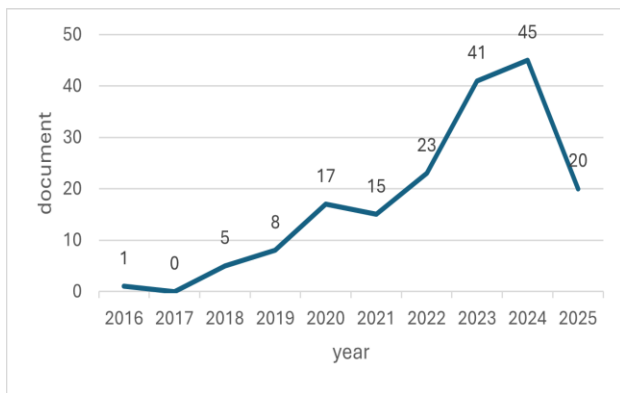


Fig. 2: Number of publication articles on the topic artificial intelligence and innovation

Fig. 3 shows that the largest number of publications is from technological forecasting and social change on the topic of artificial intelligence and innovation with quartile 1 (Q1), while most publishers are Elsevier, springer nature link and Wiley online library. This publisher was established in 1969 and 2019 marks its 50th anniversary as an international journal in the field of technology and futures studies (Mas-Tur et al., 2021). Among the researchers in the topic of artificial intelligence and innovation have been published in technological forecasting and social change such as (Haefner et al., 2021), stated that firm management explores the organizational implications of firms that have been innovating based on AI due to the rapid development of machine learning-based systems technology. Then (Liu et al., 2020), concluded that the findings of the data analysis of the AI model mechanism will influence technological innovation by accelerating knowledge, talent investment and learning capability spillovers in the manufacturing sector. Whereas currently, much of the research and development on artificial intelligence focuses on new

markets and new operations that are unrelated to existing product activities (Johnson et al., 2022). Technology-related firms and corporate management are rapidly redesigning their innovation processes due to the rapid development of information systems and AI technology (Bahoo et al., 2023). AI has the potential and capability to drive business model innovation for manufacturing industries by empowering digital transformation processes (Sjodin et al., 2023).

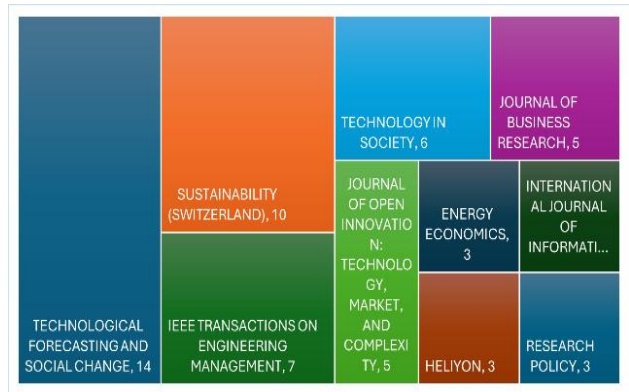


Fig. 3: Top 10 resources article publishing regarding artificial intelligence and innovation

Nearly of the articles published by the publisher technological Forecasting and Social Change are Scopus indexed articles (Savin, 2023) and the following are the top ten authors with the most cited articles with Q1 quartile in Table 1. The data from Table 1 shows the top ten authors who have been cited as reference sources for international articles with quartile 1 (Q1), along with their research findings in the field of artificial intelligence and innovation research trend. Fig. 4 is a list of visualization colour shapes and their illustrating networks relationship between keywords on the topic artificial intelligence and innovation using vosviewer software.

Table 1: Top 10 author researchers from topic artificial intelligence and innovation

Authors	Cited/Quartile/SJR	Findings
(Haefner et al., 2021)	708/Q1	Produce a framework for how AI will replace humans at work and explain the key issues for a fully implemented digital transformation of firms through innovation
(Verganti et al., 2020)	611/Q1	AI innovative technologies can solve problems because they use human-centered solutions and focus on design for each person in more detail
(Liu et al., 2020)	513/Q1	The results of the study show that R&D investment intensity, FDI, firm ownership, product imitation, AI innovation will promote technological change
(Belhadi et al., 2024)	467/Q1	Empirical evidence is generated for sustainable Supply Chain performance from the benefits of using AI innovations across multiple aspects of the investigation
(Babina et al., 2024)	439/Q1	The study found that the use of AI and information technology from 1980 to 1990 increased economic productivity, especially in the marketing sector.
(Mariani et al., 2023)	382/Q1	This study identifies economic, technological, social, and AI adoption factors in firms that provide competitive advantage to organizational structures
(Bouschery et al., 2023)	326/Q1	This study identifies the technological limitations and the impact of AI on New Product Development practices during the process of using language models in the innovation field
(Sjödin et al., 2023)	236/Q1	AI has the potential and capability to drive business model innovation for manufacturing industries by empowering digital transformation processes
(Bahoo et al., 2023)	234/Q1	Technology-related firms and corporate management are rapidly redesigning their innovation processes due to the rapid development of information systems and AI technology
(Johnson et al., 2022)	222/Q1	The results of this study show that the development of AI technology is focused on research and development of new areas, especially the operational areas of firms and new markets.

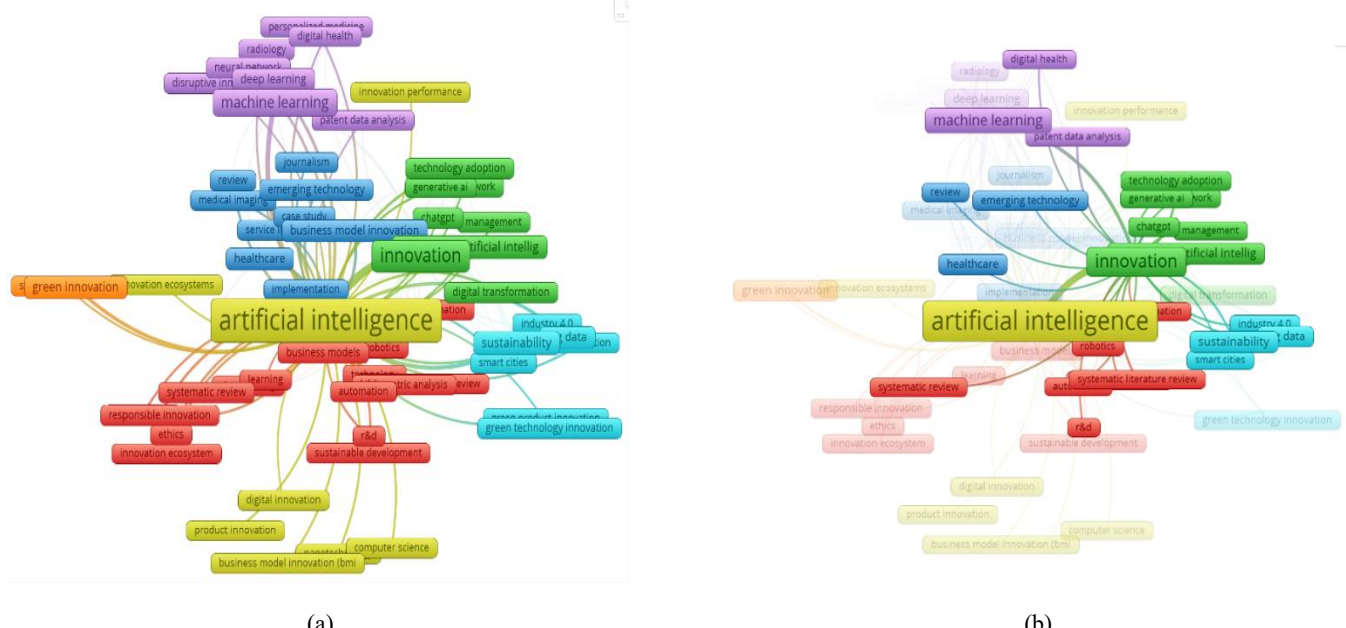


Fig. 4: Co-occurrence analysis keyword visualization and networks on artificial intelligence and innovation specific to (a) artificial intelligence and (b) innovation

Using co-occurrence networks relationship between keywords analysis, research trend development (Jiang et al., 2024) and the number of publications of 60 keywords that reached the threshold. Fig. 4(a) shows five clusters visualization and networks formed by red, green, blue, yellow and purple. Fig. 4(b) shows that the specific keywords innovation is still less related to digital transformation, implementation, business model innovation, journalism, medical imaging, learning, sustainable development, and green technology innovation. From this data it can also be observed that green innovation, digital innovation, computer science, product innovation, ecosystem innovation, ethics, responsible innovation have a long distance (weak relationship) with the theme of AI and innovation research. This means that the topic is under-discussed or under-

researched and it provides opportunities for future research on this topic by researchers.

Each colour cluster shows with the top ten keywords items listed in Table 2. In cluster one discusses, the findings that AI-based Innovation Ecosystem can continuously improve sustainable development, knowledge, accelerate the innovation process (Rammer et al., 2022 & Nahar, 2024) and strengthen the elements of value creation in the long term (Liu et al., 2020; Barile et al., 2025). In terms of responsible innovation, it must be built as a framework that integrates ethical considerations into the innovation process. The framework aligns as a normative governance mechanism and risk mitigation for managers, ensuring that the use of AI is in line with regulatory requirements and stakeholders (Buhmann &

Fieseler, 2021). However, in terms of ethics, the use of AI technology must be responsible and not misuse AI technology for personal gain and to cause problems for society (González-Esteban & Calvo, 2022). In addition, digital transformation through online retail and consumer services has created ethical anxiety for digital workers, which in turn impacts societal values on organizational operations (Wang & Zhang, 2025a).

Another important is the social transformation from the source of information technology innovation in the form of digital news is a new challenge (Savin, 2023). There is therefore an urgent need to systematically apply the principles of filtering through an AI-adapted digital framework so that the AI community remains moral integrity, ethically especially regarding its societal impact (Mura & Stehliková, 2025). In cluster two discusses, sustainability research aims to improve efficiency and

support Environmental, Social, and Governance objectives that contribute to environmental and social performance (Wang & Zhang, 2025a). Industry 4.0 is now a reality, driving towards integrating modern technology and innovation (Mhlanga, 2021). Starting in 2023, the use of artificial intelligence (genAI) ChatGPT will increase significantly, this development is important for users to have competent literacy in education and professions (Dehen et al., 2026). Artificial intelligence is an important component in the transformation of industrial management that enables autonomous self-monitoring, interpretation, diagnosis (Ahmed et al., 2022) and analysis using smart machines in performing these tasks (Haefner et al., 2021). Interestingly in terms of organizational management, individual creativity is now increasing with the use of ChatGPT for decision making (Emett et al., 2026) and problem solving (Cimino et al., 2025).

Table 2: Analysis of keywords for topic artificial intelligence and innovation

No	Cluster	Number of items	Keywords
1	Red	17	Responsible innovation, Automation, Innovation ecosystem, Sustainable development, Ethics, Ai governance, social transformation, Virtual reality, Learning, bibliometric analysis, rri, learning, r&d, robotic, technology,
2	Green	16	Ai Innovation, Sustainability, Technology adoption, Industry 4.0, Management, Manufacturing firm, Generative AI, Chatgpt, Digital transformation, big data, Smart cities, green product innovation, toe framework,
3	Blue	10	Artificial intelligence, green innovation, Spatial spillover effect, Computer science, Nano technology, Digital innovation, Innovation performance, product innovation, business model innovation, ecosystem,
4	Yellow	9	Business model innovation, Emerging technology, Healthcare, Review, Case study, journalism, Implementation, Service innovation, medical imaging,
5	Purple	8	Machine learning, Deep learning, Neural network, Personalized medicine, Digital health, Radiology, Disruptive innovation, Patent analysis data, disruptive innovation,

In cluster three discusses, green innovation is directly proportional to technology and AI performance. This green innovation emphasizes the potential of AI to benefit design, environmentally friendly processes and reflects a firm's ability to adapt to environmental challenges and market demands (Mariani et al., 2023). Among the important thrusts of Artificial Intelligence in digital innovation management is the need to apply critical existing products and services to better structure the product market environment (Johnson et al., 2022). Furthermore, green knowledge is a link between marketing efforts, sustainable development and products under development processes (Babina et al., 2024 & Rahman et al. 2025). The relationship between artificial intelligence and BMI results in the creation and capture of value revenue streams, reallocate resources, operational processes and build new capabilities in organizational strategy (Zare & Persaud, 2025).

In cluster four discusses, firms need to re-engineer new models of management processes so that AI technology can shape the business model initiated by emerging technologies to transform the global competitive landscape (Mhlanga, 2021). It also needs to align AI across business models' innovation to potentially succeed with organization challenges (Babina et al., 2024 & Lee et al., 2019). In the medical field, AI can provide optimal advantages such as high efficiency in oncology therapy and

improved image quality. In addition, it can reduce medical costs through reduced radiation doses due to the use of scanners that are utilization (Pesapane et al., 2018).

In cluster five discusses, AI relies on machine learning because the system's ability to generate analytical models to solve specific tasks depends on the data it is given (Zupic & Čater, 2015). However, for the application of deep learning models with data analysis, it can outperform machine learning if the task is complex and unstructured data (Verganti et al., 2020). From a management perspective, machine learning will provide the ability to advance basic analytics to advanced models, but there are concerns about managing large data and infrastructure that require efficient technical solutions (Paramesha et al., 2024).

Fig. 5(a) shows that research on artificial intelligence innovation in the previous two years is linked to green innovation, generative ai, digital transformation, business model innovation, personalized medicine, and ChatGPT. However, Fig. 5(b) shows many circles or keywords are still not directly related to artificial intelligence, such as radiology, deep learning, innovation performance, nano technology, bibliometric analysis, ai innovation, green product innovation, personalized medicine, innovation ecosystem, responsible innovation, ethics and green technology innovation in this research trend. Therefore, this study provides a bright opportunity for future

researchers to carry out further studies. This finding is also important to maximizing the potential of generative AI in innovation management as integration strategies will lead

to better decision-making (Cimino et al., 2025) and this is also an opportunity for future researchers (Emett et al., 2026).

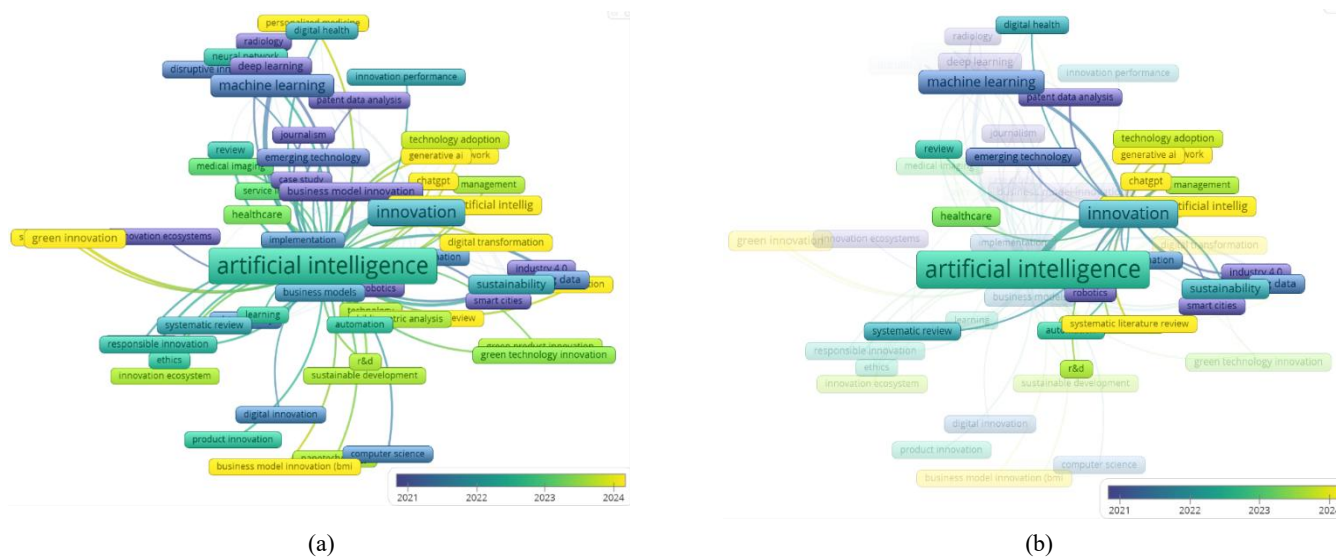


Fig. 5: Visualization overlay on the topic artificial intelligence and innovation specific to a) artificial intelligence and b) innovation

Several studies have looked at AI mechanisms that should influence innovation from four angles: creation, knowledge, learning, AI promotion (Liu et al., 2020). In general outline Innovation approaches in learning sector emphasize the need to train educators to implement effective moving to achieve AI technology understanding (Belhadi et al., 2024). Following this, innovation requires educators to use interdisciplinary learning styles while promoting skills to address new knowledge (Guan et al., 2020) and intersection of education with technology (Afzaal et al., 2024). Besides, flexible configuration is necessary to reproduce human behavior with cognitive, social and emotional intelligence (Johnson et al., 2022). Recent research has shown that green innovation is increasingly recognized as a critical strategy for playing a role in sustainable performance in AI-based businesses (Rahman et al., 2025).

Initially, environmentally based, digital-based and green approaches are relevant to the real world to achieve AI (Mhlanga, 2021). Significantly green environmental provides opportunities for governance to develop emerging technology, industry 4.0 (Wu et al., 2025) and governance performance in analytical skills (Emett et al., 2026). A digital fluency approach can also realize the SDGs in utilizing free digital platforms (Nahar, 2024). Many researchers have suggested that green and digital approaches involve integrating different subjects and encourage technological adoption (Hashim et al., 2022). At the same time, no organization is exempt from the impact of digital transformation, which will change the business structure in terms of the external environment, internal environment, implementation strategy, control, evaluation, feedback systems and learning environment (Rêgo et al., 2022). With recommendation from all the above researchers to applying this approach can create a learning

environment that produces a better understanding of the future life world. Seeing the direction of development based on the author’s keywords (Akhmad et al., 2025) as thematic map shown in Fig. 6.

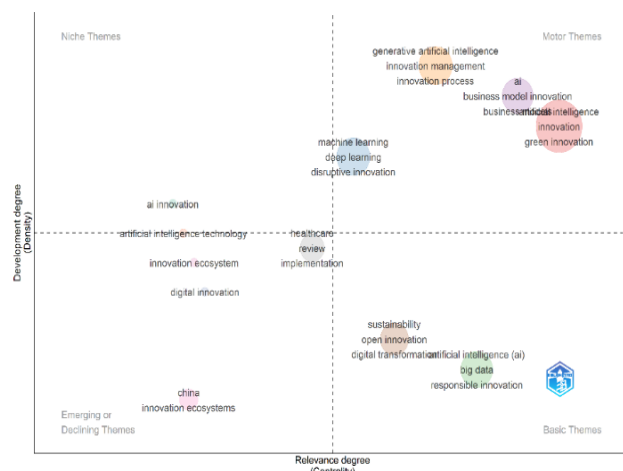


Fig. 6: Thematic map author’s keywords on the topic artificial intelligence and innovation

This is the last point of discussion, based on the development thematic map author’s keywords in Fig. 6, the mapping from artificial intelligence, innovation, green innovation, business model innovation, innovation process, innovation management and generative artificial intelligence is on the motor themes, showing that these topics are of high interest, importance in research trend (Wu et al., 2025) and are growing rapidly (Emett et al., 2026). Artificial intelligence innovation management explores the effects on users in terms of behavior to increase interactivity with AI (Glushkova et al., 2025). Many researchers are now focused on exploring variables

to improve generative artificial intelligence skills literacy and integration in education (Dehen et al., 2026). Currently, research in generative AI integration has highlighted the potential impact of human-AI collaboration to reduce bias issues and integration challenges towards complementing high-performing and innovative AI capabilities with human judgment (Zhang et al., 2025).

The theme explains artificial intelligence and green innovation as an indication that the topic is progressing and provides opportunities for researchers to expand their studies (Wang & Zhang, 2025b). Meanwhile, the topics of big data, digital transformation, sustainability, responsible innovation must be studied extensively, especially in the framework of organizational (Hashim et al., 2022) and compulsory in strategy management (Rêgo et al., 2022). Meanwhile, for the keyword healthcare, review, implementation is at the crossroads of axes as a transition towards innovations into more integrated systems, such as AI healthcare technology to improve health systems (Apell & Eriksson, 2023).

4. Conclusion

This paper aims to explore the development of artificial intelligence technology approaches in line with the increasingly urgent technological landscape that requires evidence and empirical data. The results of this research show that the publisher of technological forecasting and social change is the largest in terms of article publication. The visualization of keyword co-occurrence found that the specific keywords innovation is still less related to digital transformation, implementation, business model innovation, journalism, medical imaging, learning, sustainable development, and green technology innovation. From this data it can also be observed that green innovation, digital innovation, computer science, product innovation, ecosystem innovation, ethics, responsible innovation have a long distance with the theme of AI and innovation research. This means that the topic is under-discussed or under-researched and it provides opportunities for future research on this topic by researchers. Meanwhile, result from visualization overlay shows many circles or keywords are still not directly related to artificial intelligence, such as radiology, deep learning, innovation performance, nano technology, bibliometric analysis, ai innovation, green product innovation, personalized medicine, innovation ecosystem, responsible innovation, ethics and green technology innovation show the direction of the study. This fact shows that artificial intelligence has a great impact on the environment of technological revolution and innovation without marginalizing the well-being of human life through the quality and challenges of education.

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Conflicts of Interest: The authors declare no conflict of interest.

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