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Author for correspondence:
Andri Nirwana An
andri.nirwana@ums.ac.id
Universitas Muhammadiyah Surakarta, Indonesia

Understanding the Integration of Deep Learning and Artificial Intelligence in Quranic Education and Research through Bibliometric Analysis

Andri Nirwana An, Fauziyah Qurrota A'yun Tamami, Zainora Daud, Norsaleha Mohd Salleh, Mohamad Haeqal bin Ishak, Muthoifin Muthoifin

Abstract

Background/purpose. Recent developments in information and communication technology have opened up many new opportunities in various research fields, including religious studies (Burton, 2020). One of the most notable innovations was integrating artificial intelligence and deep learning in religious studies, including Quranic education and research. This study conducted a bibliometric analysis of Quranic education and research integrating deep learning and artificial intelligence. The study evaluated five key indicators in bibliometrics: scientific production, authors, country level, affiliations, and sources or journals.

Materials/methods. Data were collected from the Scopus database using Boolean search, and the final data set included 244 studies published between 1966 and 2024. Data were analyzed using R/R-Studio, VOSViewer, and Microsoft Excel software.

Results. The results showed that most publications were from the United States, the United Kingdom, and China, with the University of Michigan and Ann Arbor as the most productive institutions. The analysis also revealed that publications integrating DL and AI in Quranic research peaked in 2023. Network visualization identified three main clusters that illustrate the relationship between terms and concepts, with keywords such as "religion" and "Artificial Intelligence" being the most frequently discussed topics.

Conclusion. The study provides significant methodological insights for researchers interested in integrating AI and DL in religious research and encourages further research.

1. Introduction

Recent developments in information and communication technology have opened up many new opportunities in various research fields, including religious studies (Burton, 2020). One of the most notable innovations was the integration of artificial intelligence (AI) and deep learning (DL) into religious research, which has the potential to revolutionize the way we understand, analyze, and interpret religious data (Giannopoulou, 2020).

AI and DL are incrementally used to analyze sacred texts, religious traditions, and spiritual phenomena more deeply and comprehensively with unprecedented accuracy and speed. AI is designed with a classification focus on religious texts, thus providing theoretical implications for this approach (Reed, 2021) and methodological insights for analysis in religious contexts (Yazdi et al., 2024). The use of AI in religious studies through bibliometric analysis is used to identify the latest research trends that are directed toward the future (Tamami et al., 2023, 2024). Buckley (2020) used bibliometric methodology to identify key trends and themes in the use of AI in customer relationship management, which can be applied to understand the use of AI in the realm of religion (Ledro et al., 2022).

Previous research discussed bibliometric analysis of the use of AI and DL separately, but no research has been found that conducts bibliometric analysis of studies integrating AI and DL in religious studies. Therefore, this study aims to conduct a bibliometric analysis of literature integrating DL and AI in religious research, particularly Quranic research, to get a deeper understanding of the extent to which AI and DL have been adopted in religious studies, as well as the impact and contribution of these technologies to the progress of such research.

2. Literature Review

Integrating DL and AI into Quranic research is a burgeoning field combining technological advancements with religious studies. This literature review synthesizes recent scholarly contributions to this interdisciplinary area, focusing on how these technologies enhance the understanding and analysis of the Quran.

2.1. The Role of DL and AI in Quranic Education and Research

DL has been applied to various aspects of Quranic research, demonstrating its potential to bridge ancient texts with modern analytical techniques. One notable study explores the concept of deep learning within the Holy Quran, particularly in Chapter 2, Verses 30-33 (Abu-Naser & Abunasser, 2023; Nigar et al., 2023). This research highlights metaphorical aspects and textual clues that align with contemporary deep learning principles, suggesting a parallel between the wisdom in the scripture and modern scientific advancements (Mohd et al., 2021; Osman et al., 2024). The authors propose developing a deep learning model based on these insights to validate their findings through rigorous testing and evaluation metrics (Alashqar, 2024; Qayyum et al., 2018). The findings emphasize that while AI can significantly enrich Quranic studies, ethical considerations regarding interpretation accuracy and religious sensitivity must be addressed (Al-Ayyoub et al., 2018).

AI technologies are increasingly recognized for their capacity to enhance Quranic education. A literature review identifies several opportunities where AI can facilitate deeper understanding and interaction with the Quran (Abu-Naser & Abunasser, 2023). These include personalized learning experiences, interactive educational tools, and improved access to information. Moreover, the integration of AI is seen as a means to overcome traditional learning challenges, thus improving efficiency in religious education.

Recent advancements have led to the development of intelligent frameworks utilizing deep learning for Quran recitation training (An et al., 2024a; An et al., 2024b). One study presents a system

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that employs Long and Short-Term Memory (LSTM) networks to assist users in accurately reciting verses from the Quran (Sholeh et al., 2024). This system not only helps learners improve their recitation skills but also adapts by incorporating user data to enhance its effectiveness over time (Muthoifin et al., 2024). The results indicate high accuracy rates, showcasing the potential for deep learning applications in educational contexts during challenging times, such as the COVID-19 pandemic (Muthoifin et al., 2024).

3. Methodology

This study adopts a comprehensive bibliometric analysis approach, including document and network analysis. Data were collected using a Boolean search on the Scopus database from 966 to 2024. The search was conducted on May 22, 2024, at 8:00 AM. R/R-Studio, VOSViewer, and Microsoft Excel software are used for document, citation, and network analysis.

The researchers first reviewed related literature to ensure the relevance of the research and identify gaps in bibliometric topics. This review also helped determine the right keywords for research coverage. Next, a data search was performed using Boolean operators in Scopus, which yielded 2,534 documents. The steps for the data search and analysis procedure are presented in Figure 1.

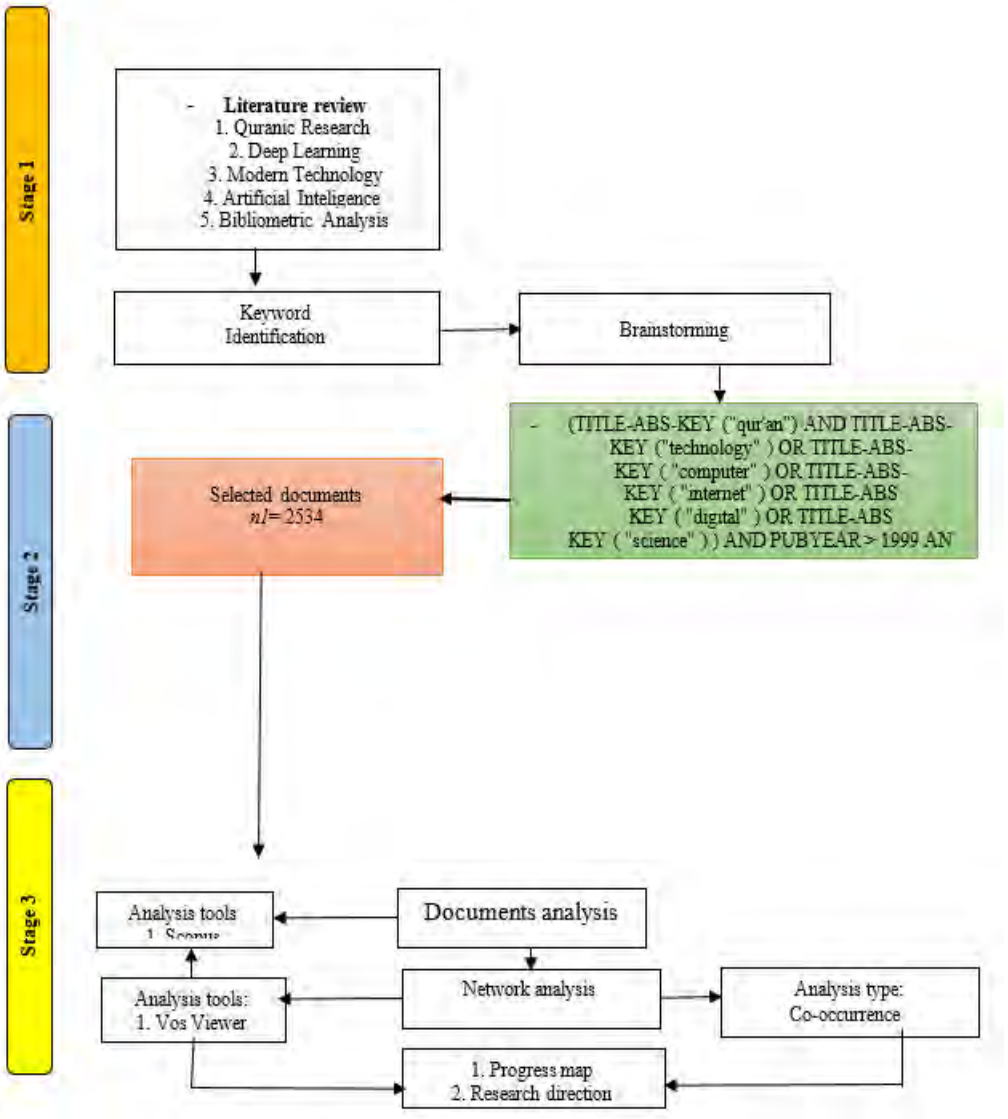

Figure 1. Research Flowchart

Bibliometric analysis was performed using Scopus analyzer and R/R-Studio to identify the number of documents per year by journal, author, affiliation, country, and field of study. The network

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visualization of documents was performed using VOSViewer, and data processing was performed using Microsoft Excel.

4. Results

4.1. Document Analysis

The overall analysis of documents included in the bibliometric analysis showed that 11,926 authors contributed to this line of research, with 237 authors being single authors while the others conducting cooperative work. The average number of authors per document was 5.69, which indicates a high level of collaboration, and 31.25% of authors were involved in international collaboration.

The results of the analysis by year are presented in Figure 2. As can be seen, 90% of documents were published in recent decades, and the number of articles published in various journals peaked in 2023, which probably relates to the increased research interest in this line of research in the last decade. The increase in the number of documents in 2023 and beyond suggests a trend due to various factors such as technological developments, increased access to research resources, and more intensive international collaboration (Sulaiman et al., 2024). The analysis also revealed an acceleration in the production of religious research, including DL and AI.

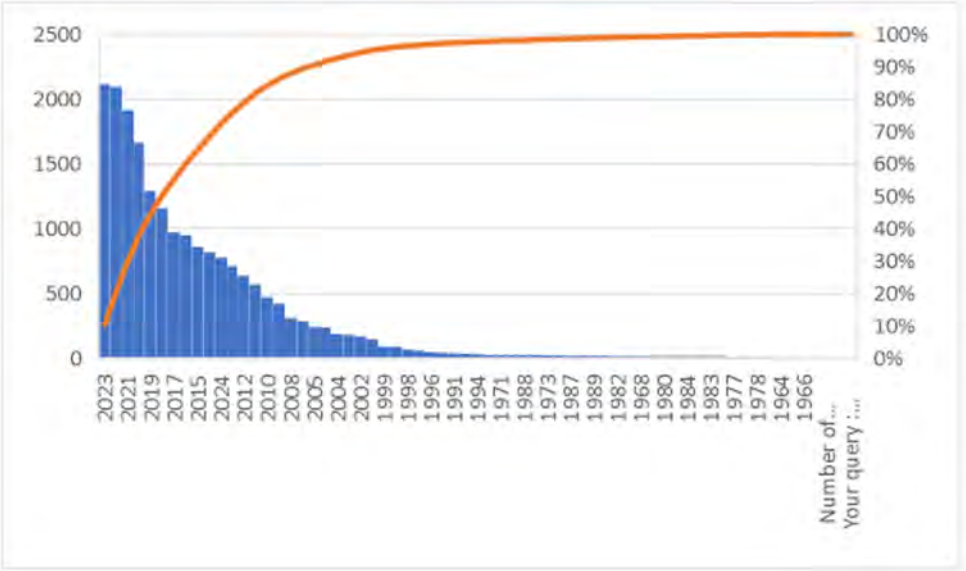

Figure 2. Results of Analysis by Year

Figure 3 shows the results of the analysis by authors, which can be an important indicator in identifying key figures and measuring the authors' contribution to religious research integrating AI and DL. As shown in Figure 3, the most prolific author in the field was Koening, H.G, with 74

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publications, followed by Francis, L. J, with 57 publications. The result indicates that Koening, H.G. has had a significant impact on this field of research (Koenig & de Guchteneire, 2017).

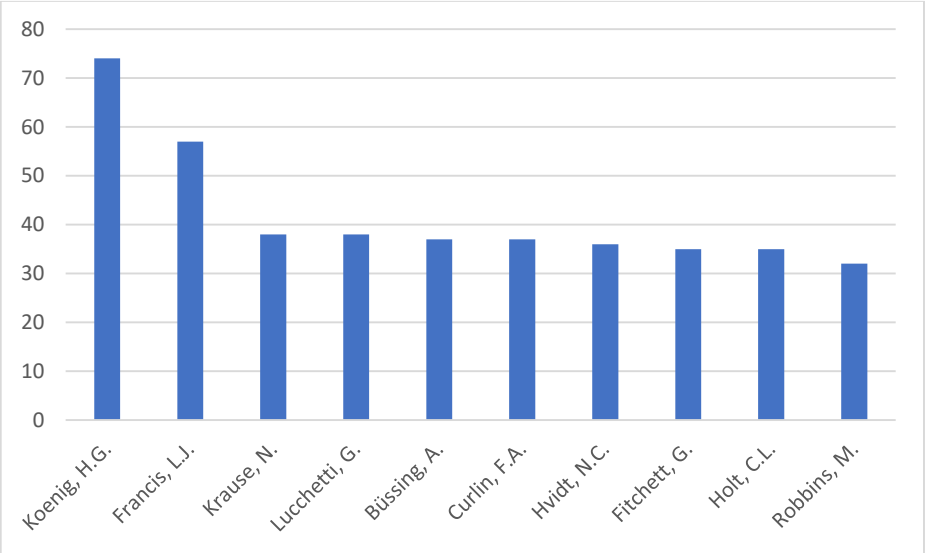

Figure 3. Results of Analysis by Authors

The horizontal bar chart in Figure 4 illustrates the distribution of publications from various leading universities. Our analysis showed that the University of Michigan, Ann Arbor, was the most widely listed in publications included in our analysis (288 documents). Harvard Medical School (239 documents) and University College London (233) followed it. The University of Oxford was listed in 233. Notably, these universities are all reputable, demonstrating high performance in many academic fields (Castles, 2001; Pascual-Leone & Bartres-Faz, 2021; Spring, 2012).

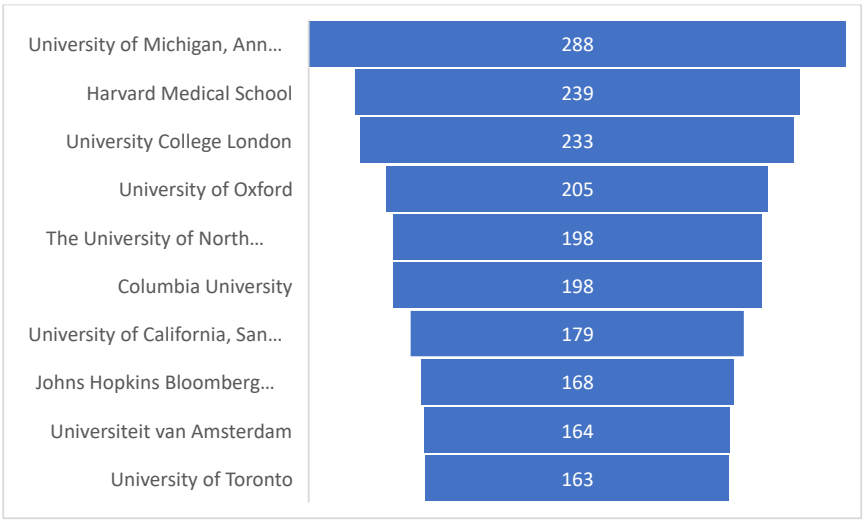

Figure 4. Affiliation Charts

Figure 5 displays the results of the analysis by country. As can be seen, the United States dominates the contribution to this line of research with the largest share of 43%, indicating a considerable influence on the development of this knowledge base. The United Kingdom followed the USA, representing 20% of the documents included in the analysis. Countries such as Australia,

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Canada, the Netherlands, and India also contributed significantly, albeit with fewer documents than the USA and the UK.

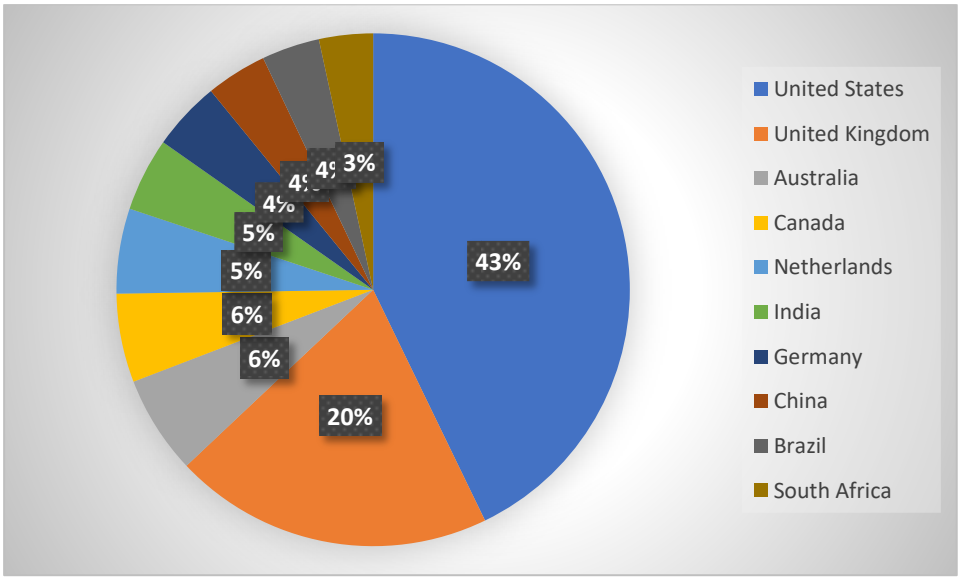

Figure 5. Country Chart

Figure 6 displays the number of articles or publications published in different fields of study. Accordingly, the field of Medicine seems to have contributed the most to this research, with the most publications. The fields of social science, arts and humanities, and nursing followed it.

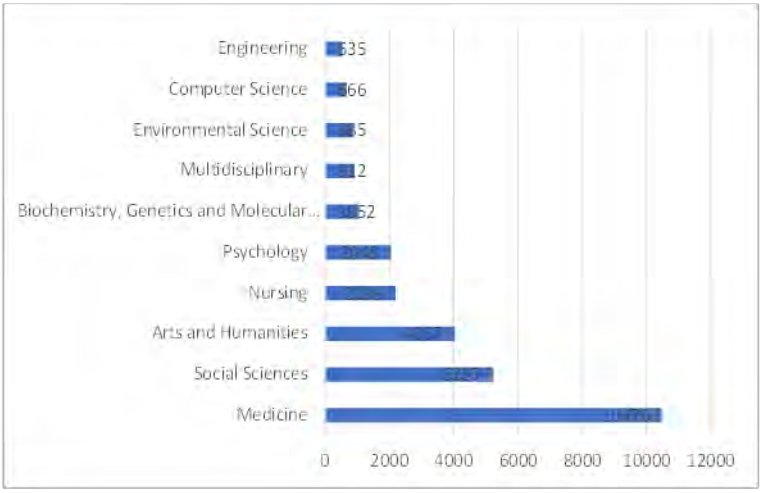

Figure 6. Fields of study

Figure 7 displays the results of analysis by the R/R-Studio tool on a Three Field Plot, representing three elements to be examined, namely the name of the journal, the author names, and the theme or topic investigated (Elbashir et al., 2024).

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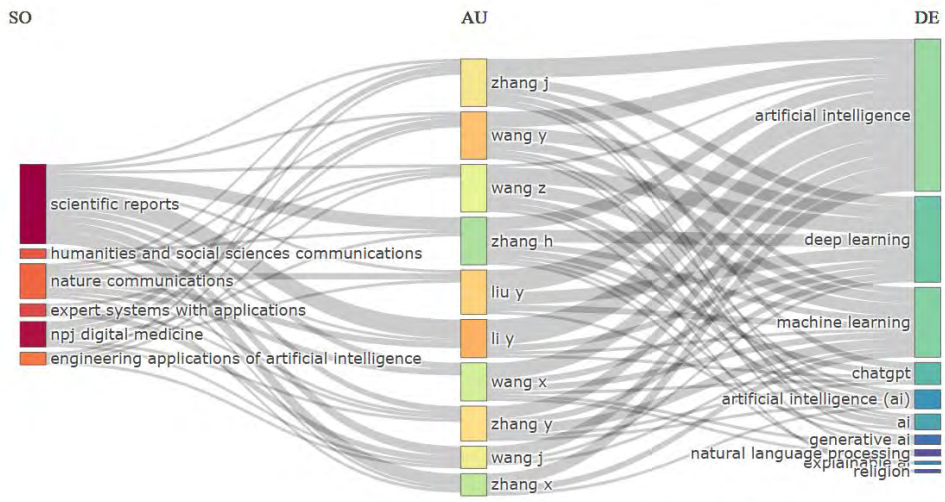

Figure 7. Three Field Plot

The three labels in the Three Field Plot in Figure 6 are interconnected with gray plot lines (Heravi, 2024). The findings show that the Scientific Reports journal, which can be seen in dark red, published the highest number of documents produced by ten leading authors, namely Zhang. J, Wang. Y, Wang. Z, Zhang, H, Liu. Y, Li. Y, Wang. X, Zhang. Y, Wang, J, and Zhang, X. Humanities and Social Sciences Communications and Nature Communications were the second and third journals that published research by these authors on topics of artificial intelligence, deep learning, machine learning, ChatGPT, generative AI, natural language processing and religion. Studies published in these journals seem to have contributed significantly to other relevant studies published in other journals.

The results of analysis by the countries of corresponding authors are shown in Figure 8. The results indicate that many publications were contributed from China, with 331 SCP documents and 108 MCP documents. This shows that much of the research in China was conducted internally and involved collaborators from other countries. However, China also had a smaller proportion compared to internal collaboration (Rizka et al., 2021). The USE contributed with 76 documents and 335 MCP documents. India had 30 SCP documents and 149 MCP documents. The results also indicated that the USA dominated international collaboration networks regarding this line of research.

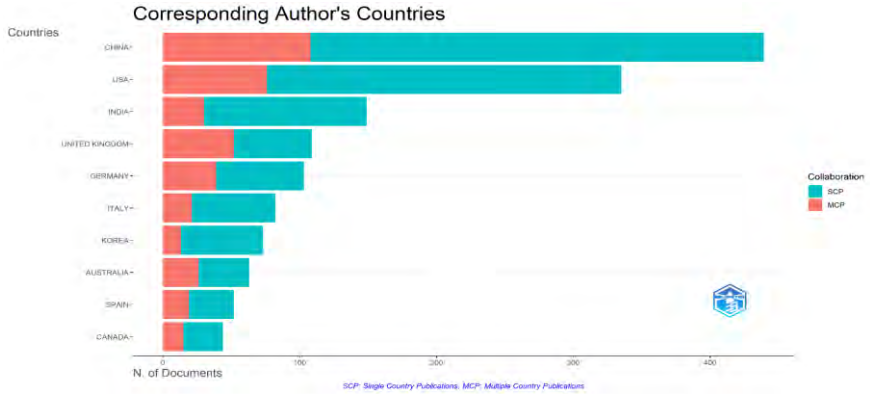

Figure 8. Corresponding Author's Countries

The results of the citation analysis are presented in Table 1. As can be seen, Abbas et al. (2022) achieved the most significant impact with their study published in 'The Journal of Religious Health,' which received 14 citations in one year. The highest number of global citations (n=2) were obtained

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by Stevens et al. (2024) for his publication in the 'Pediatric Critical Care Medicine' journal. Other studies, on the other hand, received seven citations on average, which implies that they had a relatively low level of recognition within the academic community.

Table 1. Globally Most-Cited Documents

Paper	Total Citations	TC per Year
ABBAS A, 2024, J RELIG HEALTH	14	14.00
ALFERTSHOFER M, 2024, ANN BIOMED ENG	11	11.00
SUN T, 2024, NANO-MICRO LETT	10	10.00
MAHESH TR, 2024, INT J COMPUT INTELL SYST	7	7.00
AROWOIYA VA, 2024, ENERGY BUILT ENVIRON	7	7.00
LONGO L, 2024, INF FUSION	7	7.00
CHIU TKF, 2024, COMPUT EDUC-a	7	7.00
VARGHESE J, 2024, J HEPATOL	7	7.00
WELLS A, 2024, J RELIG HEALTH	7	7.00
ABBAS M, 2024, INT J EDUC TECHNOL HIGH EDUC	6	6.00

Table 2 displays the results of the analysis concerning the locally most-cited studies. Accordingly, documents by Allahham M., Koga S., Mikulak-Klucznik B., and Pation G.A. had the same recognition at the local and global levels, each getting one local citation and one global citation.

Table 2. Locally Most-Cited Document

Document	Year	Local Citations	Global Citations
ALLAHHAM M, 2024, UNCERTAIN SUPPLY CHAIN MANAG	2024	1	1
KOGA S, 2024, DIG LIVER DIS	2024	1	1
MIKULAK-KLUCZNIK B, 2024, CHEM	2024	1	1
STEVENS PE, 2024, PEDIATR CRIT CARE MED	2024	1	2
PATINO GA, 2024, ACAD MED	2024	1	1
ALAM AI, 2024, SCI REP	2024	0	0
SANTOS H, 2024, DATA INTELL	2024	0	0
CANTINI R, 2024, J BIG DATA	2024	0	0
DU H, 2024, HUM SOC SCI COMM	2024	0	0
CECIL J, 2024, SCI REP	2024	0	0

4.2. Network Analytics

Figure 9 illustrates the results of the network analysis, which shows the relationship between various terms or concepts grouped in three clusters based on the similarity of context or use in the article/research. The analysis of co-occurrence with a threshold of 15 clusters was performed using

VOSViewer. The entire network involves 97 items grouped under three clusters. The first cluster is red with 49 items; the second cluster is green with 29 items, and the third is blue with 19 items.

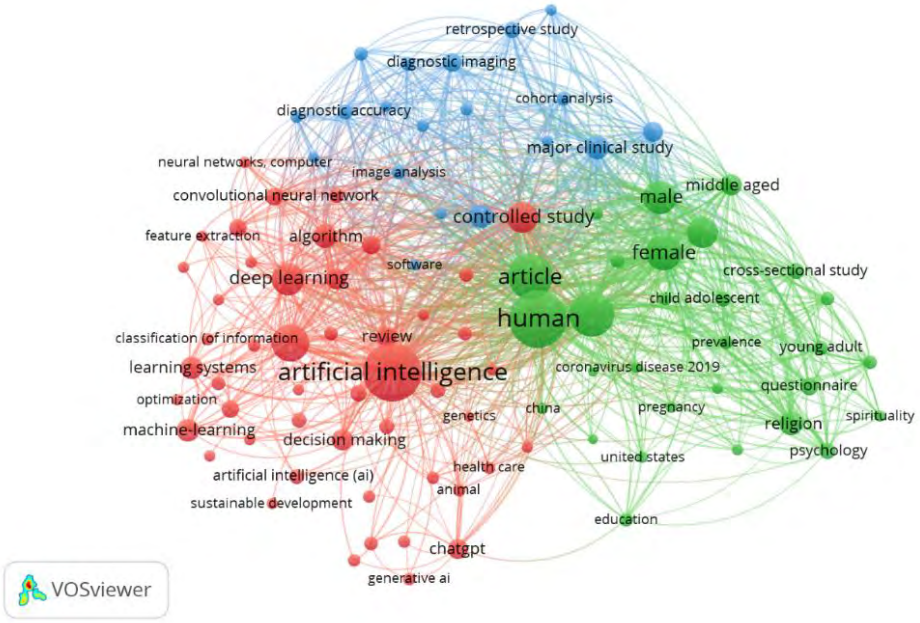

Figure 9. Network Analysis

Figure 10 displays the results of the overlay network analysis. As can be seen in the image shown in bright yellow, the "religion" theme was new and became popular with the latest research published in 2024. The bright yellow color shows warmth of discussion rather than the faded green theme (Hakiman et al., 2021). The theme of "religion" reflects a growing interest in studies that combine aspects of religion with other research areas such as AI and DL. Green to blue color indicates keywords that have the same relevance but reflect topics that have been explored more frequently and are currently less popular and receive less research interest.

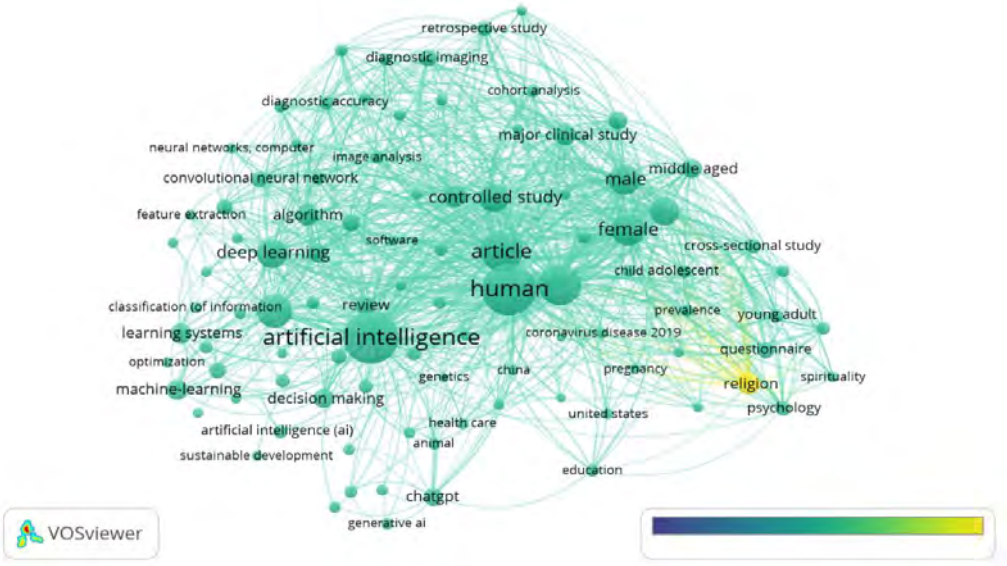

Figure 10. Overlay Network

Figure 11 displays the results of density network analysis, which shows that keywords such as 'Article,' 'Human,' and 'Artificial Intelligence' frequently co-occurred, marked in bright yellow

(Kerwanto et al., 2024). This reflects that many studies have been published that combine the human element with AI technology. Keywords such as 'Learning Systems,' 'Controlled Study,' and 'Deep Learning' are shown in blurred yellow, indicating that these keywords appeared less frequently despite their importance in the field. This could indicate that while relevant, these topics may be more specific or not listed among the keywords of several studies.

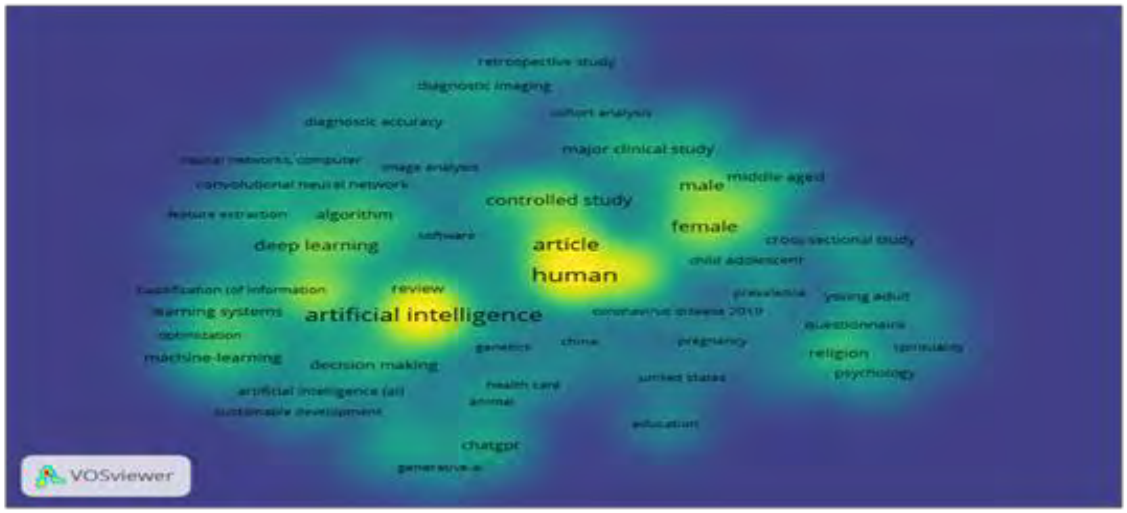

Figure 11. Density Network

5. Discussion

The findings of this study provide a comprehensive understanding of the development and trends in integrating Deep Learning (DL) and Artificial Intelligence (AI) into religious research published between 1966 and 2024. The study analyzed key bibliometric indicators such as the volume of scientific production, prolific authors, country-level contributions, institutional affiliations of contributors, and journals by employing bibliometric methods. This multidimensional approach highlighted the trajectory of this interdisciplinary field and underscored its growing prominence, particularly in recent years (Sulaiman et al., 2024). Such insights are invaluable for researchers exploring the intersection of technology and religious research further.

One notable contribution of this study is its ability to serve as a foundation for researchers interested in bibliometric analyses in this niche area. By clearly depicting the patterns and clusters within the existing literature, the study effectively opens new avenues for prospective researchers (Isaac, 2024). It provides a methodological roadmap for leveraging bibliometric tools such as R/R-Studio, VOSViewer, and Microsoft Excel, which can be used to generate detailed network visualizations and keyword analyses (Hasan et al., 2024). These tools allow researchers to identify trends, gaps, and potential areas for future exploration in the field of religious studies as well.

Additionally, the study identifies the dominance of specific regions—namely the United States, the United Kingdom, and China—in this field of research (Adanu, 2024). Although including publications written only in English in our analysis might have influenced this result, it still raises questions about the potential underrepresentation of contributions from other regions, such as Africa, South America, and Southeast Asia. Future research could delve into the reasons for this geographical disparity and actively seek to include and analyze works from these regions(Ali & Lawal, 2024). Doing so could enrich the field with diverse cultural and contextual insights as well as increase contributions from diverse contexts to the international literature.

Another critical aspect is the growing interest in AI and DL in religious contexts, as evidenced by the peak in publications in 2023. This trend suggests an increasing recognition of the potential of AI

and DL to contribute to religious studies. Future discussions could explore the specific applications driving this interest, such as analyzing religious texts, modeling spiritual behaviors, or addressing ethical and philosophical questions about the role of AI in faith-based practices (Wan Zahari et al., 2022).To further enhance the field, researchers are encouraged to create comprehensive bibliometric studies that integrate data from multiple databases and span various disciplines. This would provide a broader and deeper understanding of how AI and DL intersect with religion and how these technologies influence theological and spiritual discussions (Suud et al., 2024).

Finally, the study underscores the need for open access and increased accessibility of research outputs. By making bibliometric analyses and related findings freely available, scholars from developing regions or institutions with limited resources can engage with the research, contributing to a more inclusive and collaborative academic environment (Arifin et al., 2023). In conclusion, this study serves as a stepping stone for future investigations into integrating AI and DL in religious studies (Hakiman et al., 2021). Future research can build on these findings by addressing its limitations and incorporating a broader scope of data and perspectives to provide even more robust insights and foster interdisciplinary collaboration in this rapidly evolving field.

6. Conclusion and Limitations

The findings of this study determine the development and direction of research on the Integration of DL and AI in Religious Research between 1966 and 2024. The analysis includes many indicators in extensive bibliometrics, i.e., the volume of scientific production, authors, country level, affiliations, and sources/journals. This bibliometric study provides many advantages for analysts who want to deepen their insight into bibliometric analysis in the religious research field, opening new horizons for prospective researchers interested in bibliometric analysis.

Despite its significant contributions, the study's reliance on articles indexed only in Google Scholar and Scopus presents a limitation that future research should address. While these databases are significant and widely used, they do not encompass the full spectrum of global research (Enceng et al., 2024). For a more holistic understanding, it is essential to incorporate other major databases, such as Web of Science (WoS), PubMed, and IEEE Xplore (Abubakar, 2024). These platforms can provide additional perspectives and uncover literature that may be underrepresented in the current analysis (Al-Kausar, 2024).

7. Implications for Future Research

The results of the current study suggest several significant implications for future studies focusing on the integration of technology in religious research, as elaborated below.

Expand Database Coverage: To overcome the limitation of relying solely on Google Scholar and Scopus, future research should incorporate additional databases such as Web of Science, PubMed, IEEE Xplore, and specialized repositories. These databases offer a broader range of resources and may reveal insights not captured in the current analysis. By diversifying bibliometric data sources, researchers can better track the development of AI and DL applications in religious studies, providing a more holistic view of this emerging field.

Investigate Contributions from Underrepresented Regions: The dominance of publications from the United States, United Kingdom, and China highlights a geographical concentration in the research output. Future studies should make a concerted effort to include contributions from underrepresented regions, such as Africa, South America, and Southeast Asia. Exploring how cultural and regional perspectives influence the integration of AI and DL in religious contexts would provide a richer and more inclusive understanding of the field.

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Analyze Emerging Trends Post-2023: The significant increase in publications in 2023 underscores the growing interest in the subject. Researchers should investigate the factors contributing to this surge and analyze whether this trend persists in subsequent years. Identifying key events, technological advancements, or societal shifts that drove this growth will help contextualize the evolution of AI and DL in religious studies.

Encourage Cross-disciplinary Collaboration: Integrating AI and DL in religious studies benefits greatly from interdisciplinary approaches. Future research should foster collaborations between theology, computer science, sociology, and ethics to develop a nuanced understanding of how these technologies intersect with religious practices, beliefs, and communities. Such collaborations can lead to innovative frameworks and methodologies that enhance the depth and relevance of research findings.

Adopt Advanced Bibliometric Tools: While the study effectively utilized R/R-Studio, VOSViewer, and Microsoft Excel, incorporating more advanced bibliometric tools can deepen insights. For example, machine learning-driven text mining and semantic analysis could be used to uncover latent patterns and connections within the dataset. These methods would allow for a more detailed exploration of keyword relationships, thematic clusters, and trends in the literature.

Focus on Ethical and Philosophical Dimensions: AI and DL's integration into religious studies raises profound ethical and philosophical questions. Future research should delve into the implications of these technologies, particularly their influence on spiritual practices, moral decision-making, and the human understanding of divinity. Investigating how AI systems interpret or interact with religious texts and contexts could spark critical discussions about the role of technology in shaping faith and spirituality.

Conduct Regular Bibliometric Reviews: Given the rapid pace of technological advancement, periodic bibliometric reviews are essential to stay updated on trends and developments in this field. Researchers should aim to revisit and update analyses every 3–5 years to capture changes in publication patterns, emerging themes, and evolving research priorities. This iterative approach ensures that studies remain relevant and reflect the dynamic nature of AI and DL research in religious contexts. In addition, the intersection of AI, DL, and Quranic studies is an evolving field that invites further exploration. Future research should focus on expanding bibliometric analyses to map out existing literature comprehensively and identify gaps where further investigation is needed (Ardiansyah et al., 2024). Additionally, interdisciplinary collaborations between technologists and religious scholars could foster innovative applications that respect both scientific inquiry and spiritual integrity (Nirwana et al., 2024a, 2024b).

Integrating DL and AI into Quranic research represents a significant advancement in both technological application and religious scholarship. As this field continues to grow, it is essential to navigate the ethical implications carefully while maximizing the benefits these technologies offer for understanding sacred texts (Mahmudulhassan et al., 2024). Continued exploration will not only enhance educational methodologies but also deepen our comprehension of the Quran's profound insights (Nofrizal et al., 2024).

Declarations

Author Contributions. All authors have read and approved the published version of the article.
Conflicts of Interest. The authors declared no conflict of interest.
Funding. The authors received no financial support for this article.
Data Availability Statement. All data supporting the results reported in this study are retrieved from the Scopus database.

Ethical Approval. This study received ethical approval from the Ethics Committee of Universitas Muhammadiyah Surakarta.

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About the Contributor(s)

Andri Nirwana AN, PhD, is an academic associated with Universitas Muhammadiyah Surakarta (UMS). His work primarily focuses on Islamic studies, including Islamic education, Quranic studies, and fostering multicultural harmony. He has contributed to academic journals and research focusing on topics such as Islamic moderation (wasatiyah), tolerance among religious communities, and educational leadership models linked to the Sustainable Development Goals (SDGs); for example, his research has examined themes such as the media for promoting Islamic moderation through Quranic exegesis and strategies for enhancing moral transformation in youth through mosque-based programs. Additionally, he has published on broader societal issues, such as post-traumatic stress in adolescents and sustainable development.
Email: andri.nirwana@ums.ac.id
ORCID: https://orcid.org/0000-0002-5793-7203

Fauziyah Qurrota A'yun Tamami is an academic associated with Universitas Muhammadiyah Surakarta (UMS). She has contributed to research on Muhammadiyah education systems, particularly regarding the role of the Pondok Hajjah Nuriyah Shabran, a Muhammadiyah boarding school in Surakarta. This institution focuses on developing qualified Muhammadiyah cadres through programs such as Quran memorization and Islamic leadership training. Her research examines the institution's efforts to maintain high standards in character-building and international outreach as it evolves over time.
Email: o100230073@student.ums.ac.id
ORCID: https://orcid.org/0009-0006-7761-7158

Zainora Daud is an academic associated with the Faculty of Quranic and Sunnah Studies at Universiti Sains Islam Malaysia (USIM). She holds the lecturer position (DS51) and has contributed to research in areas such as gamification in Islamic education. For example, she has co-authored studies on the effectiveness of innovative teaching methods like the "Global Tahfiz Game" in enhancing teaching and learning experiences in Malaysia. Her work highlights her focus on integrating modern educational tools with traditional Islamic studies to improve learning outcomes.
Email: zainora@usim.edu.my
ORCID: https://orcid.org/0000-0002-1252-2645

Norsaleha Mohd Salleh is an academic and researcher affiliated with Malaysia's International Islamic University College Selangor (KUIS). She specializes in Islamic studies, focusing on Usuluddin (Islamic theology) and contemporary issues related to Islamic belief systems. Her research includes analyzing challenges such as secularism, liberalism, and humanism among Muslim youth in Malaysia. She has contributed to various publications, including books, journal articles, and collaborative research projects. One of her notable studies, conducted alongside other researchers, explored the level of "unbelief thinking" (influences of secularism and liberalism) among Muslim youth in Malaysian higher learning institutions. The findings indicated a generally high level of Islamic knowledge and understanding among students, with a relatively low prevalence of secular or liberal tendencies.
Email: norsaleha@uis.edu.my
ORCID ID: https://orcid.org/0000-0003-0338-3054

Dr. Mohamad Haeqal bin Ishak, M.A, is a lecturer at the AbdulHamid AbuSulayman Kulliyyah of Islamic Revealed Knowledge and Human Sciences (KIRKHS), International Islamic University Malaysia (IIUM), Gombak Campus. He specializes in Qur'an and Sunnah Studies, holding advanced degrees in this field, including a Master's degree from IIUM and a Bachelor's degree from Université Hassan II in Casablanca. His academic contributions include teaching subjects like Fiqh al-Sirah, Introduction to Qur'an, and Memorization of Selected Surahs and Hadiths, as well as supervising final-year projects.

His research focuses on Islamic thought and its relevance to modern society, including studies on the Tijaniyya order and the contributions of Islamic scholars like Shaykh Ismail Shihabuddin.
Email: haeqalishak@iium.edu.my

Dr Muthoifin Muthoifin, is an academic and scholar affiliated with Universitas Muhammadiyah Surakarta (UMS). His research and publications focus on Islamic studies, particularly in Islamic law, Islamic education, and Islamic finance. Some notable contributions include studies on managing productive waqf, developing Islamic economic law, and the interplay between religiosity and societal development. He has also published extensively on topics such as the impact of Sharia-compliant practices in various sectors and broader Islamic perspectives on education and social welfare.
Email: mut122@ums.ac.id
ORCID ID: https://orcid.org/0000-0001-7216-3966