Legal Aspects of The Use of Artificial Intelligence (AI) in Health Students: Bibliometrics Analysis

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Abstract: The opportunities perceived by healthcare students for AI include increased efficiency and reduced workload. The challenges perceived by healthcare students for AI include its impact on concerns about technology dependency.The purpose of this study is to determine the trend of the number of publications on the legal aspects of the use of artificial intelligence in health students, the number of citations, and the direction of future research topics. The research method applied in this study is the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) which uses 26,881 scientific articles or proceedings sourced from the Dimensions database. Article review uses the VOSviewer application. The results of the study revealed that the number of publications on the topic of the legal aspects of the use of artificial intelligence (AI) in health students has an upward trend, the number of citations on the topic of the legal aspects of the use of artificial intelligence (AI) in health students has increased, network visualization on the topic of the legal aspects of the use of artificial intelligence (AI) in health students provides information to find novelty on topics that are not yet connected, there are 5 clusters reviewed from co-occurrence, overlay visualization on the topic of labor pain intervention provides a trend in the direction of future research topics, density visualization on topics that are still rare. The results of this study contribute to the development of a research roadmap on the legal aspects of the use of artificial intelligence (AI) in health students.

Keywords: artificial intelligence (AI), bibliometrics analysis, legal aspects

Introduction

Artificial intelligence (AI) is considered the most transformative technology of the 21st century. The use of AI is deeply embedded in all aspects of our daily lives, promoting efficiency and security in routine tasks at home and at work.(Rincón et al., 2025). Similarly, the healthcare world is rapidly exploring new uses of AI for image analysis, electronic health records, and clinical decision-making (Kim et al., 2023). Healthcare has been identified as an early candidate to be revolutionized by AI technology. Artificial intelligence (AI) has taken over various functions in the medical field, and research has shown that AI can address complex problems in a wide range of applications (Daher et al., 2024). In healthcare, artificial intelligence (AI) is poised to catalyze transformative changes in healthcare delivery, the devices used by healthcare professionals, and the traditional roles of patients and healthcare professionals. Given the importance and potential impact of this technology, there is growing interest in using AI among healthcare students to facilitate various tasks and problems.(Lee et al., 2024).AI opportunities perceived by healthcare students, including aspects of increased efficiency and reduced workload. AI challenges are perceived in healthcare, such as its impact on concerns about technology dependency (Moldt et al., 2025).

Interest over time in the topic of legal aspects of the use of artificial intelligence among health students around the world, such as in(Akhmad Fauzy & Supandi, 2022) And(Prabowo et al., 2023)Searched

through Google Trends. Searches over the past five years, using web searches and all categories, yielded the data presented in Figure 1. This data was collected on September 22, 2025.
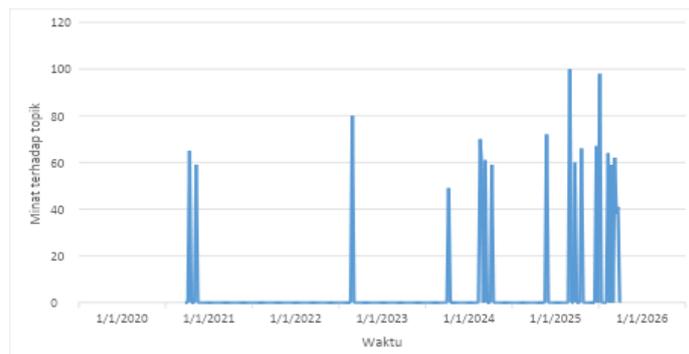

Figure 1. Interest over time in the topic of legal aspects of the use of artificial intelligence among health students (Data source: Google Trends)

Besides time, Interest in the topic of the legal aspects of using artificial intelligence among health students can also be reviewed by country. Interest in the legal aspects of using artificial intelligence among health students by country is presented in Figure 2. According to Figure 2, the Philippines is the country with the highest interest in the topic of the legal aspects of using artificial intelligence among health students.
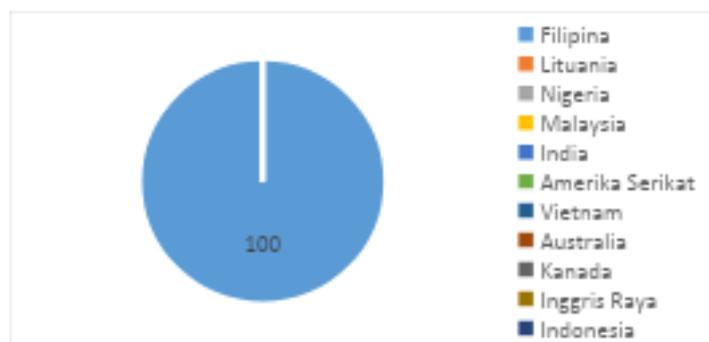

Figure 2. Histogram of interest by country on the topic of legal aspects of the use of artificial intelligence in health students (Data Source: Google Trends)

The data illustrate the general interest in the legal aspects of using artificial intelligence among health students. On the other hand, researchers who want to research the topic of legal aspects of the use of artificial intelligence in health students need more information specifically, for example, scientific publications in the form of scientific articles and scientific seminar proceedings on the topic of legal aspects of the use of artificial intelligence in health students. Therefore, information on the topic of legal aspects of the use of artificial intelligence in health students in the form of scientific articles is very necessary.

In research, researchers need information on trends and novelties for the future legal aspects of artificial intelligence use in healthcare students. This is a growing issue among researchers. However, there is no bibliometric analysis of publications addressing the legal aspects of artificial intelligence use in healthcare students to identify trends and novelties. The questions that will be answered in this research are (1) how is the development number of publications on the topic, legal aspects of the use of artificial intelligence in health students, (2) how is the development of the number of citations on the topic? legal aspects of the use of artificial intelligence in health students, (6) how to network visualization on the

topiclegal aspects of the use of artificial intelligence in health students, (7) how the publication clusters on the topiclegal aspects of the use of artificial intelligence in health students reviewed from the co-occurrence, (8) how the visualization overlays the topiclegal aspects of the use of artificial intelligence in health students, (9) how to density visualization onlegal aspects of the use of artificial intelligence in health students.

Bibliometric analysis is a statistically based approach to research that visualizes the contributions of academic institutions and changes in research hotspots.(Fu et al., 2023). Bibliometric analysis helps researchers to identify emerging areas and future directions of a research domain with the help of visualization tools (Lam et al., 2022). Bibliometric analysis has been used by various authors to evaluate information theories listed in the Scopus database (Lam et al., 2022), to evaluate immigration and environmental degradation (Anuar et al., 2022), and to investigate trends in research into the legal aspects of the use of artificial intelligence in health students.(Zhang et al., 2022).Thus, bibliometric analysis is a scientific and quantitative method for assessing published articles, which can help researchers to find development trends, updates and hotspots of certain research, providing development in future research for researchers (Soytas, 2021).

The purpose of this study was to determine the trend in the number of publications on the legal aspects of artificial intelligence use in healthcare students, the number of citations, and the direction of future research topics. Topics related to the legal aspects of artificial intelligence use in healthcare students are still rare, so it is necessary to explore novelty in the legal aspects of artificial intelligence use in healthcare students through bibliometric analysis.

Method

Bibliometric analysis is a research method used in library and information science to evaluate research performance.(Syros et al., 2022)Bibliometric analysis is very important in assessing the impact of research, where studies are ranked based on the citations they receive.(Pahwa et al., 2022).

Data extracted from https://app.dimensions.ai/ on September 22, 2025. Preferred Reporting Items for Systematic Reviews and Meta-Analyses(Page et al., 2021), abbreviated as PRISMA, is used to extract articles from databases https://app.dimensions.ai/. The PRISMA flowchart is presented in Figure 3.
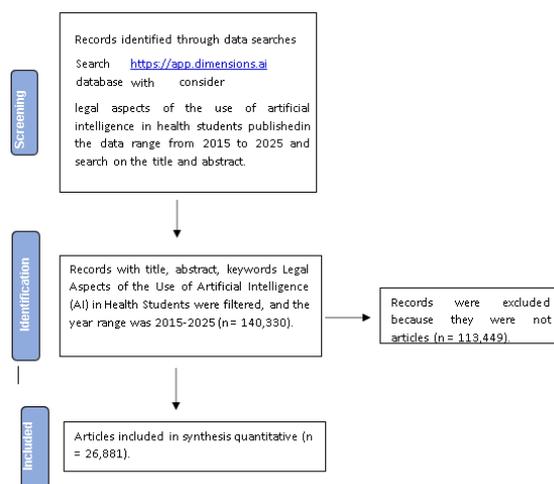

Figure 3. PRISMA flowchart (Page et al., 2021)

The PRISMA method consists of three stages: identification, filtering, and inclusion. Stage 1 (identification) detected 140,330 records from https://app.dimensions.ai/, considering the legal aspects of the use of artificial intelligence in health students published in the data range from 2015 to 2025, and

searching the title and abstract. Stage 2 (filtering), generated 26,881 records by selecting the publication type "article", resulting in 113,449 records being excluded. Stage 3 (inclusion), the final sample yielded 26,881 articles. Data were analyzed using VOSviewer. VOSviewer is a computer program for creating and viewing bibliometric maps.(Van Eck & Waltman, 2010). In this study, the analysis is reviewed from the perspective of co-occurrence.

The procedure for co-occurrence analysis is as follows. (1) The type of data is selected as the option to create a map based on text data. This option is selected to create a co-occurrence map based on text data. (2) The data source is selected as the option to read data from reference manager files. Supported file types are RIS, EndNote, and RefWorks. (3) The file type is selected as RIS. (4) The fields from which terms will be extracted are selected as the title and abstract fields, ignoring the structured abstract label and copyright statement. (5) The calculation method is selected as the full counting option. (6) The threshold is selected as the minimum number of occurrences of a term is 10. Of the 8897 terms, 297 meet the threshold. (7) The number of terms is calculated as follows. For each of the 297 terms, a relevance score is calculated. Based on this score, the most relevant terms are selected. The default is to select 60% of relevant terms. The number of terms to be selected is 178 terms.

Results and Discussion

The search from 2015 to 2025 yielded 26,881 scientific article publications. The number of publications legal aspects of the use of artificial intelligence in health students per year are presented in Figure 4.
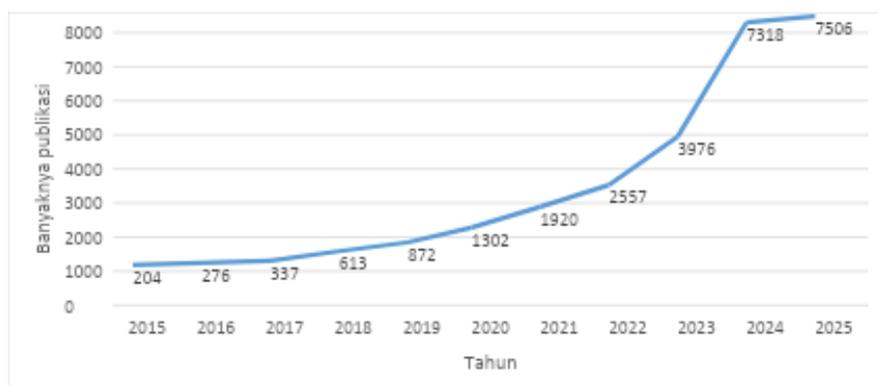

Figure 4. Number of publications on the legal aspects of the use of artificial intelligence in health students from 2015 to 2025 (source: https://app.dimensions.ai/)

Number of The legal aspects of the use of artificial intelligence in health students from 2015 to 2025 amounted to 629,493. The number of citations per year is presented in Figure 5.
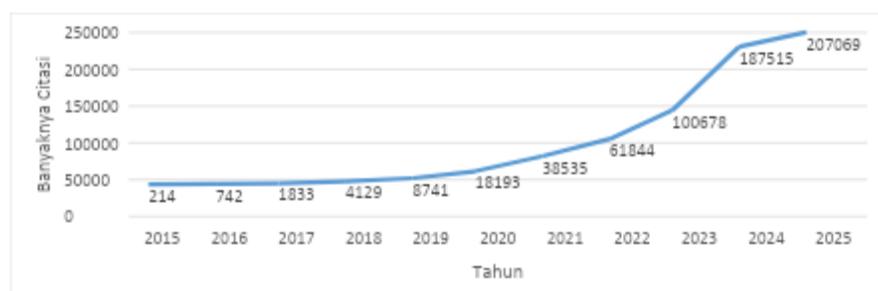

Figure 5. Number of citations for the topic of legal aspects of the use of artificial intelligence in health students from 2015 to 2025 (source: https://app.dimensions.ai/)

Network visualizationof these 178 terms are presented in Figure 6.
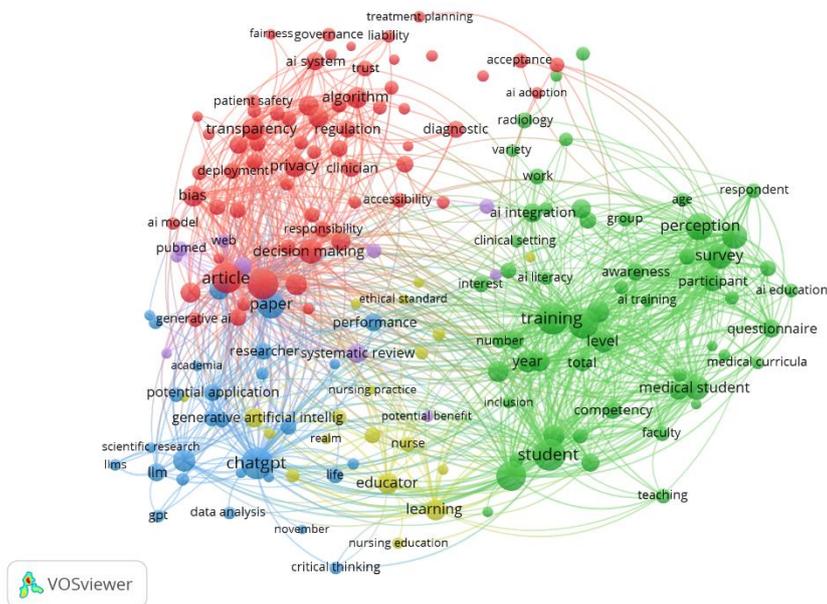
Figure 6. Network visualization (source: VOSviewer and https://app.dimensions.ai/)

VOSviewer also provides map overlay visualization.Overlay visualizationof these 178 terms are presented in Figure 7.

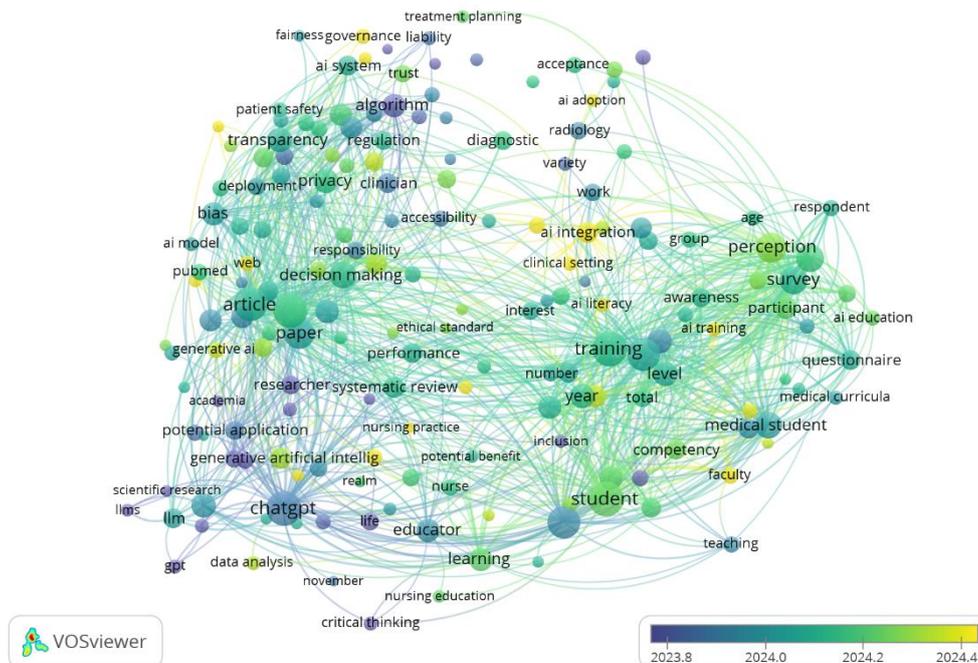Figure 7. Overlay visualization (source: VOSviewer and https://app.dimensions.ai/)

Density visualization of these 178 terms is presented in Figure 8.
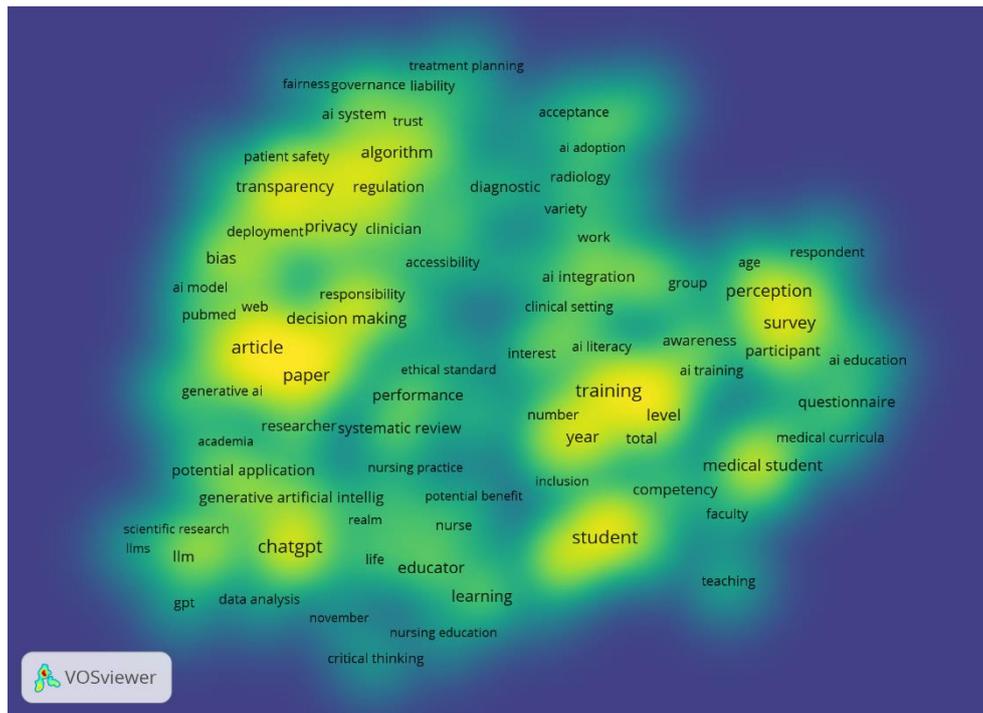
Figure 8. Density visualization (source: VOSviewer and https://app.dimensions.ai/)

Figure 4. shows that number of publicationsThe number of publications has increased exponentially year by year. The smallest number of publications occurred in 2015, with 204 publications. Meanwhile, the largest number of publications occurred in 2025 with 7,506 publications. The average number of publications was 2,443. These statistics are presented in Figure 9. Of the 26,881 publications, the publication entitled "When Technology Meets Anxiety: The Moderating Role of AI Usage in the Relationship Between Social Anxiety, Learning Adaptability, and Behavioral Problems Among Chinese Primary School Students"(Ma et al., 2025) is the most relevant. Research suggests that AI improves diagnostic accuracy and improves healthcare systems. However, they are concerned about legal consequences and demand legal protection, while opinions on ethical issues are divided. Positive future expectations are significantly correlated with the perceived need for legal protection and belief in ethical AI standards. Furthermore, there is a weak correlation between viewing AI in healthcare as ethical and supporting legal protection for healthcare professionals. Studies show that healthcare students recognize the potential of AI and emphasize the need to integrate legal and ethics education into medical curricula to prepare future healthcare professionals for the evolving role of AI in healthcare (Solic et al., 2025). Therefore, there is a need for the latest publications related to the topic. Legal aspects of the use of artificial intelligence in health students.
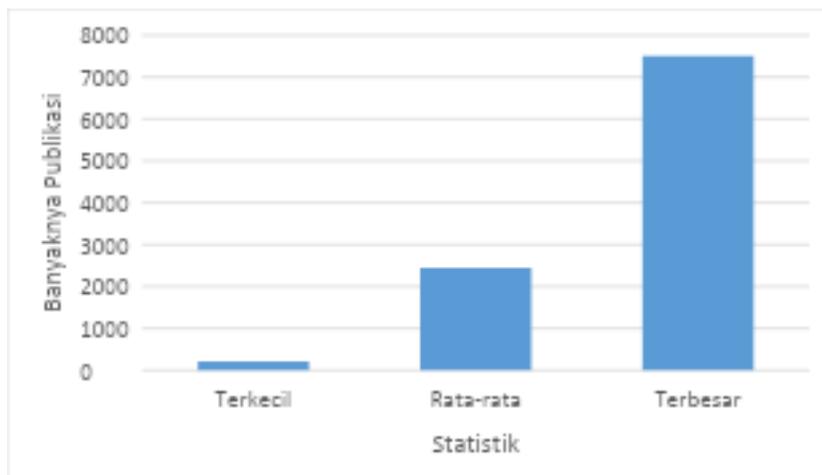
Figure 9. Histogram of the number of smallest, average, and largest publications
for the topic of legal aspects of the use of artificial intelligence in health students.

Figure 5 shows that number of the number of citations has increased exponentially from year to year. The smallest number of citations occurred in 2015, with 214. Meanwhile, the largest number of citations occurred in 2025, with 207,069. The average number of citations was 57,226. These statistics are depicted in Figure 10. Research data reveals that, of the 158,201 publications, the publication entitled "A survey on deep learning in medical image analysis"(Litjens et al., 2017) is the most cited publication. Journals indexed by reputable indexers will be highly cited by other authors. Therefore, this article can be used as a reference in research that explains the topic. Legal aspects of the use of artificial intelligence in health students.
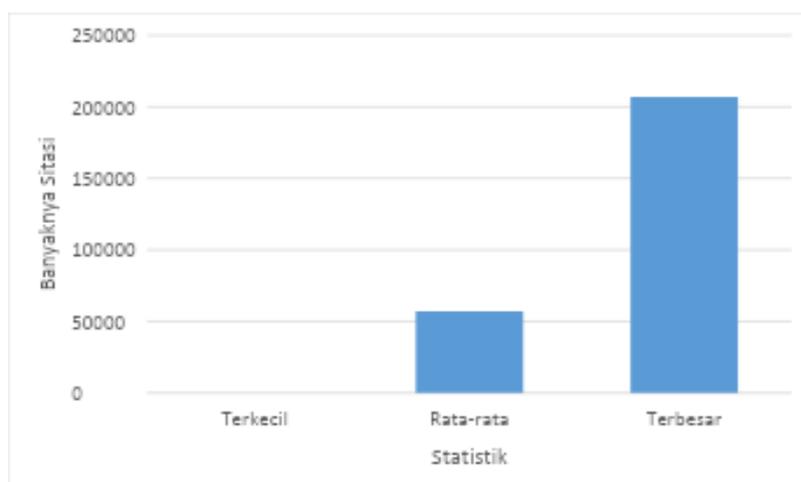

Figure 10. Histogram of the increase in the number of smallest, average, and highest citations for the topic of legal aspects of the use of artificial intelligence in health students.

In-network visualization (Figure 6.), two terms connected by a line indicate that the two terms appear together in a title and abstract. Conversely, two terms not connected by a line indicate that the two terms do not appear together in a title and abstract. The research data revealed that there are 102 terms, 4 clusters, 3302 links, and a link strength of 7945. In the era of total digitalization, the educational process has also begun to use modern communication technologies regularly. Artificial intelligence is widely used by students and greatly facilitates the learning process, as well as completing various tasks. As a result, the following advantages of using artificial intelligence in the educational process have been

identified: automation of the educational process; creation of personalized educational materials; adaptation of educational materials to specific students; 24-hour interaction; interactive content; accessibility; analytics (Cupples, 2023)Among the disadvantages are the following: imperfect technology; breach of personal data security; responsibility and rights of artificial intelligence. Scientific novelty: Based on the analysis, the main areas of use of artificial intelligence in the educational process have been identified and supplemented: adaptive learning; gamification; robot creation; nanolearning; creation of educational materials; online MOOC platforms with educational content; tutoring; introduction of information and consulting systems; automated knowledge assessment; customization of educational materials based on individual characteristics; application of pre-trained artificial intelligence systems.(Kirillova et al., 2025). Therefore, the novelty for researchers on the topic of legal aspects of the use of artificial intelligence in health studentsfurther information can be obtained through research on terms that are not directly connected, for example, medical curriculum and regulation.

Of the 178 terms, they are grouped into 5 clusters consisting of cluster 1 (64 terms), cluster 2 (57 terms), cluster 3 (28 terms), cluster 4 (19 terms), and cluster 5 (10). In more detail, these clusters are presented in Table 1.

Table 1. Cluster for the topic of legal aspects of the use of artificial intelligence in health students
(Source: VOSviewer and https://app.dimensions.ai/)

Cluster	The number of term	Cluster member terms
1	64	Acceptance, accessibility, accountability, advance, advent, ai adoption, ai development, ai implementation, ai model, ai system, algorithm, algorithmic bias, article, autonomy, bias, bias, capability, case, clinical decision support, clinical workflow, clinician, complexity, data privacy, decision making, deep learning, dentistry, deployment, diagnostic, ethical challenge, ethical concern, evolution, example, fairness, future direction, generative ai, governance, healthcare delivery, innovation, liability, machine, machine learning, narrative review, overview, patient outcome, patient safety, policy, policymaker, privacy, promise, regulation, relevance, responsibility, review, safety, security, standard, telemedicine, transparency, treatment, treatment planning, trust, trustworthiness, utility, world.
2	57	Age, ai education, ai integration, ai literacy, ai training, ai use, attitude, awareness, clinical setting, competency, cross sectional study, curricula, curriculum, doctor, expectation, faculty, future healthcare professional, gap, group, inclusion, interest, knowledge, level, majority, medical curricula, medical education, medical field, medical practice, medical school, medical student, number, part, participant, perception, physician, practical application, qualitative study, questionnaire, radiologist, radiology, readiness, respondent, response, self, skill, student, survey, teaching, term, topic, total, training, university, variety, view, work, year.
3	28	Acamedia, author, capacity, chatgpt, content, critical thinking, data analysis, emergence, empathy, gpt, large language model, life, literature review, llm, llms, natural language processing, nlp, november, openai, paper, performance, potential application, researcher, responsible use, scientific research, strength, task, text.
4	19	Academic integrity, educator, effectiveness, ethical aspect, ethical implication, ethical standard, ethical use, genealogy, generative artificial intelligence, learning, nurse, nursing, nursing education, nursing practice, nursing student, rapid advancement, realm, simulation, technological advancement.
5	10	Error, google scholar, potential benefit, pubmed, scoping review, scopus, search, successful implementation, systematic review, web.

Overlay visualization(Figure 7.) provides an analysis based on the keyword legal aspects of the use of artificial intelligence in health students from 2015 to 2025 to observe the trend of research titles related to the legal aspects of the use of artificial intelligence in health students. Based on the overlay visualization map in Figure 7., the yellow terms imply that the keyword is of current research interest (Lam et al., 2022). AI in healthcare offers many potential benefits. Appropriate regulation is needed to maximize these benefits while minimizing their risks. Regulatory reform is more likely to maintain the necessary balance if it is based on an understanding of how experts prioritize the problems and potential solutions they have identified (Chikhaoui et al., 2022). A comprehensive mapping of how different disciplines frame, prioritize, and analyze legal issues in health-related AI, and how they propose to address these issues, will support a cross-disciplinary understanding of perceived legal barriers or gaps. It will also aid policymaking through a holistic view of legal issues in health-related AI and diverse perspectives on their solutions. This will provide a foundation for developing better domestic and international responses to the legal challenges posed by health-related AI (Da Silva et al., 2022). Therefore, the research trend on legal aspects of the use of artificial intelligence in health students is currently focusing on terms in yellow, such as AI integration, nursing practice, and clinical setting.

Density visualization(Figure 8) shows a visualization of the term density level indicated by color. Blue indicates high density, while yellow indicates low density. High density means that the topic has been widely used in previous research, while low density means that the topic has not been used much in previous research. Legal and ethical issues facing society due to Artificial Intelligence (AI) include privacy and surveillance, bias or discrimination, and perhaps the philosophical challenge of the role of human judgment. Concerns about newer digital technologies are the source of the European Parliament Resolution based on research commissioned, supervised, and published by the policy department for "Citizens' Rights and Constitutional Affairs" in response to a request from the European Parliament's Legal Affairs Committee. The report emphasizes the critical nature of the resolution, which calls for the immediate creation of a legislative instrument regulating robots and AI, capable of anticipating and adapting to any scientific breakthroughs anticipated in the medium term (Naik et al., 2022). Therefore, the research topic is related to legal aspects of the use of artificial intelligence in health. The recommended topics are those that have low visualization density, for example, training year, ChatGPT, article, and student.

Conclusion

This study conducted a bibliometric analysis of publications on the legal aspects of the use of artificial intelligence in health students through https://app.dimensions.ai/ from 2015 to 2025. This study shows several results. Among the many publications on the topic of legal aspects of the use of artificial intelligence in health students have an upward trend, the number of citations on the topic of legal aspects of the use of artificial intelligence in health students has increased, network visualization on the topic of legal aspects of the use of artificial intelligence in health students provides information to find novelty on topics that are not yet connected, there are 5 clusters reviewed from co-occurrence, overlay visualization on the topic of legal aspects of the use of artificial intelligence in health students provides a trend in the direction of future research topics, density visualization on the topic of legal aspects of the use of artificial intelligence in health students is still rare. The conclusion of the results of this study is the development of a research roadmap on the legal aspects of the use of artificial intelligence in health students.

Although this research has contributed to providing an understanding of the state of the art regarding the development of publications on the legal aspects of the use of artificial intelligence in health students from 2015 to 2025 through https://app.dimensions.ai/, this study has limitations. The database https://app.dimensions.ai/_We continually update new publications from time to time. Therefore, a bibliometric analysis of the legal aspects of using artificial intelligence for health students can be reviewed

in the next few years. Furthermore, this bibliometric analysis only extracts scientific article data from the database https://app.dimensions.ai/. Further research is needed to expand other databases for a broader and more comprehensive understanding of the legal aspects of using artificial intelligence for healthcare students.

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