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A Bibliometric Analysis of Artificial Intelligence in Admissions and Administrative Processes in Higher Education

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Abstract

The growing demand for university placements has led to inefficiencies and lack of transparency in existing methods. The study aims to explore the underutilization of AI in these processes to improve efficiency, transparency, and accessibility. The methodology involves extracting and cleaning publication data from Scopus, preparing it for analysis using Google Colab, and visualizing relationships between keywords with VOS viewer. Key findings reveal significant research areas, keyword co-occurrence, and collaborative authorship trends in AI applications within HE admissions and administrative processes. The study highlights the importance of AI applications in university management, human factors, employment outcomes, big data utilization, decision support systems, and educational computing infrastructure. The study highlights gaps in the current literature and calls for ethical and methodological rigor, interdisciplinary approaches, and robust AI systems for fairness and transparency. Future research should incorporate diverse data sources, qualitative analysis, and extend the timeframe to capture ongoing developments in AI applications.

1. Introduction

The global higher education landscape has undergone a profound transformation, characterized by a significant surge in student admission. This phenomenon is attributable to a confluence of factors, including demographic shifts, economic growth, and technological advancements [1]. With the significant surge in the number of applications, there may exist pressure on institutions governing admissions to manage them efficiently and fairly. These manual and subjective approaches are time-consuming, error-prone, and lack transparency. AI is an ever-evolving domain of computer science that incorporates complex methods such as machine learning, Natural Language Processing (NLP), and Computer Vision (CV). These techniques allow machines to perform tasks that require human intelligence, such as analyzing large amounts of data, recognizing patterns, and making decisions [2]. In education, AI offers the potential for automating administrative tasks, adapting environments to meet individual learning needs, and improving student outcomes overall [3].

Globally, an increasing number of studies are shedding light on the emerging HE context and its AI applications. This has been evidenced by research into its use in intelligent tutoring systems, automated grading, and personalized student support services [4]. However, a critical gap exists regarding the specific application of AI in the admissions processes [5]. AI has the capacity to revamp university admissions and administrative processes in areas such as application screening, document verification, and merit-based selection of qualified candidates through automation [6]. AI can revolutionize admissions in HE institutions by offering optimal solutions that improve efficiency, transparency, and access for prospective students, thereby helping the growing number of potential students and these Higher Educational institutions.

Additionally, bibliometrics is a valuable research technique that allows scholars to measure and analyse the scientific output within a particular field [7]. By examining publications, including articles, authors, keywords, journals, institutions, and countries, bibliometrics helps us understand the intellectual and social structure of a particular field, along with how it evolves over time [8]. Essentially, bibliometrics acts as a mapping tool, revealing the intellectual landscape of a research field [9]. It helps us visualize the relationships between authors, topics, and research papers within a discipline. This is achieved by categorizing various research elements (authors, papers, journals, keywords) and then using visualization techniques to depict the resulting structure and classification [10]. Bibliometric analysis offers a systematic and comprehensive understanding of a field's evolution over time, its structure, and emerging research trends [11]. It allows researchers to identify key concepts within the field and how they interrelate. A well-conducted bibliometric study provides a solid foundation for meaningful and innovative progress within a specific research field or domain [12].

Given the limited research on the use of AI in admissions and administrative processes, more studies are needed. To the best of our knowledge, no prior bibliometric study has been carried out on this research topic. Hence, we seek to bridge that gap by using a bibliometric analysis approach to examine how AI is being applied in HE institutions with regard to their admissions and administrative processes. This analysis focuses on the development of research from 2014 to 2024 - a key timeframe selected for capturing recent completion points in this rapidly changing field [13].

1.1. Related Works

Artificial intelligence (AI) is rapidly transforming numerous fields, and Higher Education is no exception. Several recent bibliometric analyses have explored the overall growth and trajectory of AI research in Higher Education. [14] analyzed publications between 2017 and 2023, identifying a steady rise in AI-related research in Higher Education, with computer science and social sciences as prominent areas of study. Similarly, [15]found a significant increase in AI-HE publications over the past two decades, with 78% published in the last five years. Furthermore, [16], documented a substantial rise in publications on AI in Higher Education, particularly since 2020. These studies collectively suggest AI research in Higher Education is a rapidly growing field.

While the global landscape of AI research in Higher Education is being established, a closer look at research focus reveals interesting patterns. [17] analyzed research trends in Artificial Intelligence in Education (AIED) and found a surge in research, with China, the US, India, Spain, and Germany leading the way. Their work highlights a focus on Higher Education compared to K-

12 education, with machine learning, decision trees, deep learning, and computer vision as the dominant AI technologies employed. [18] also explored AIED research trends, identifying a rise in publications with a focus on student applications, engineering education, teaching methods, and the potential for AI to revolutionize curriculum development, they found a significant increase in AIED research, especially in the last five years; China is leading; focus on student applications and e-learning

[4] conducted a systematic review of 138 articles, examining the state of AI in Higher Education and identified five primary uses: assessment/evaluation, prediction, AI assistants, Intelligent Tutoring Systems (ITS), and managing student learning. Their work highlights a focus on core educational activities alongside administrative tasks.

The geographic distribution of research leadership in AI and Higher Education is also noteworthy. While earlier studies like [15] identified the United States as a leader, a shift is underway. [4] documented a geographic shift in research leadership from the US to China. [19] further confirmed this trend while also highlighting a global increase in publications from developing nations like Saudi Arabia, India, and Malaysia. This suggests AI research in Higher Education is becoming increasingly globalized.

Beyond the core research areas and geographic distribution, it is important to consider the social and academic implications of AI in Higher Education. [20] conducted a semi-systematic review exploring the social perspective of AIED in Higher Education. They identified the need for a socio-technical approach to balance the potential benefits of AI with potential negative social impacts. Their work emphasizes the importance of responsible AI implementation that considers pedagogical, ethical, and social dimensions.

[21] conducted a systematic bibliometric review to explore the intersection of artificial intelligence (AI) and organizational functions like management, development, change, and culture. Despite increased digitization, human involvement remains dominant in these areas. However, AI's application in various aspects of life has garnered growing research interest in recent years, with some companies offering AI-powered organizational development tools. The study aimed to identify research trends in this domain by analyzing 191 publications (1983-2020) and their citations. Their findings provide valuable insights into the current research landscape and lay the groundwork for further exploration.

While the existing research offers a wealth of insights, there are also gaps to be addressed. [5] identified limited exploration of admissions and administrative aspects within AI and Higher Education, suggesting a valuable area for further investigation.

The existing body of research paints a clear picture of a rapidly growing field. AI research in Higher Education is flourishing globally, with a focus on various applications to enhance learning experiences. While developed nations currently lead research efforts, a global rise in publications is underway. However, there is a need for further exploration of the social and educational implications of AI, alongside investigations into its potential applications in under-researched areas like admissions and administrative processes in Higher Education institutions.

2.0. Methods and Material

2.1. Research Design

This study employs bibliometric analysis to examine the application of AI in higher education admissions and administrative processes, utilizing data extracted from the Scopus database, which covers publications from 2014 to 2024. Scopus was chosen due to its extensive coverage across various disciplines and its recognition as the second-largest comprehensive citation database [22]. The data was analyzed using Google Colab and visualized with VOS viewer to identify relationships between keywords and research trends. A systematic search strategy, following the PRISMA framework, ensured transparency and reproducibility in the document search process. The PRISMA flow diagram in Figure 1 visually depicts the stages of article selection, including identification, screening, exclusion, and final inclusion in the analysis.

2.1. Article Selection Process

A systematic search strategy was used following the PRISMA framework, which ensured transparency and reproducibility in the article search process. The process was done in four phases: Identification, Screening, Eligibility and Included. In the first phase, 415 articles were identified from Scopus Database as shown in Figure 1.

The second phase is the screening phase. All studies relating to AI in admissions or other administrative processes in higher education were included, excluding studies focused solely on unrelated HE technologies. The articles were screened by title and abstracts. 20 articles were excluded.

The third phase is the eligibility phase. This was determined using the eligibility criteria. The articles are selected using the following criteria:

Years considered: Only articles published from 2014 to 2024 were reviewed. In order to get current information, only articles within this period were considered and included.

Language used in writing Article: The search was strictly for articles written in English as there are enough significant number of publications in English.

Article Publishing region: Articles from all regions of the world were reviewed.

Publication status: Only articles published by indexed journals were considered.

Articles with DOI: Articles with DOI (Digital Object Identifier) were first considered before those without.

Keywords in Article: Also, in this phase, the documents were sorted by title, method, dataset, parameter measured, and keywords. Specific set of keywords such as ‘Artificial Intelligence,’ ‘Machine Learning’ ‘Student Admissions,’ derived from commonly used terms in AI Higher Education research, ensuring the selected studies were relevant were used. 17 articles were excluded.

2.2. Scopus Search Query

The following search query was used to retrieve relevant articles published on the Scopus database:

TITLE-ABS-KEY ("Computer Vision" OR "Image Processing" OR "Natural Language Processing" OR "Deep Learning" OR "Big Data Analytics" OR "Optimization Methods" OR "Convolutional Neural Networks" OR "Artificial Intelligence" OR "Recurrent Neural Networks" OR "Generative Models" OR "Recommender systems" OR "AI" OR "Data Mining" OR "Data Science" OR "Text Mining" OR "Text Analytics" OR "Data Analytics") AND TITLE-ABS-KEY ("higher education" OR "university" OR "college") AND TITLE- ABS-KEY ("student admissions" OR "student enrolment" OR "student recruitment") AND PUBYEAR > 2014 AND PUBYEAR < 2024 AND (LIMIT-TO (LANGUAGE , "English"))

This query searched for articles containing keywords related to AI, Higher Education, administrative and admission processes, published between 2014 and 2024. The search was limited to authors name, article titles, abstracts, and keywords to ensure relevance. The initial search yielded 415 documents. After removing duplicates and irrelevant articles, the final dataset consisted of 378 articles for bibliometric analysis.

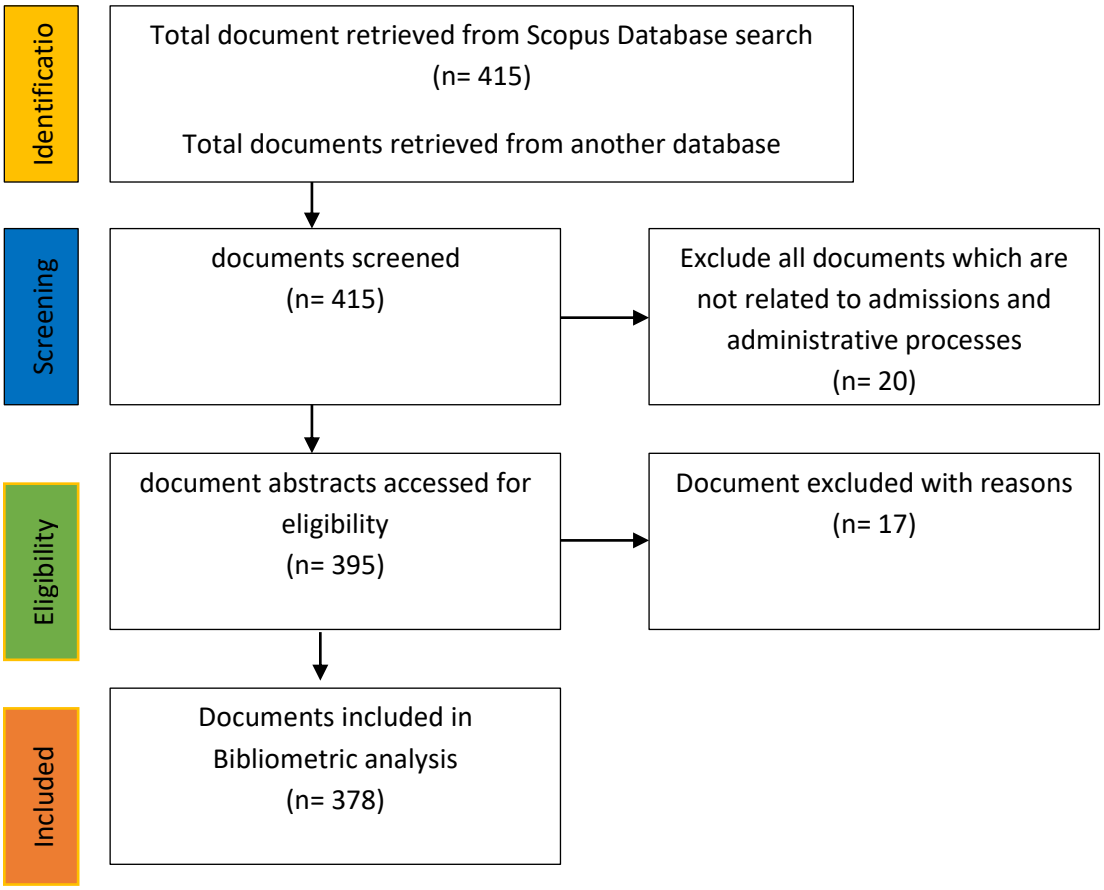

Figure 1: PRISMA flow diagram for the systematic review

3.0.Results and Discussion

3.1. Keyword Co-occurrence Network

A keyword co-occurrence network (KCN) focuses on the links between keywords in the literature to understand the knowledge components and structure of a scientific or technical field [23]. For any given list of terms concerning a collection of texts, co-occurrence networks can be formed.

The minimum number of occurrences of the keyword is 10 out of the 2639 keywords, 131 meet the threshold. For each of the 60 keywords the total strength of the co-occurrent links with the other keyword is calculated. The keywords with the greatest total link strength were selected. The number of keywords selected is 60.

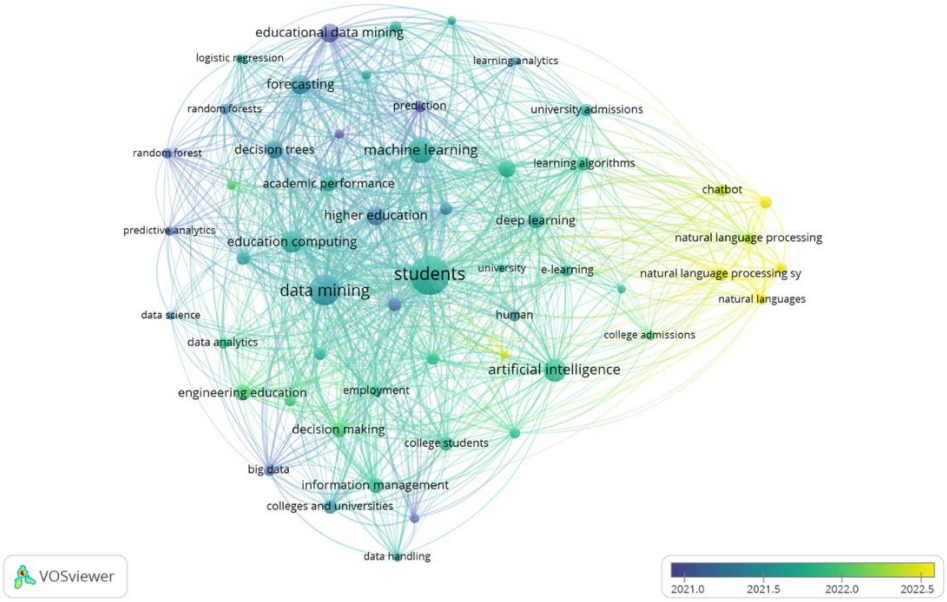

Figure 2. Keyword Co-occurrence Network

Figure 2. shows that "Students" emerges as the most frequently occurring keyword, with 181 occurrences and a total link strength of 919, indicating its central role in the research. "Data mining" follows with 112 occurrences and a link strength of 583, underscoring its importance in handling large datasets. "Machine learning" and "artificial intelligence" also stand out with 75 and 62 occurrences respectively, highlighting their critical role in developing intelligent systems for admissions.

Keywords such as "education computing" (56 occurrences, 334 link strength) and "forecasting" (45 occurrences, 314 link strength) reflect the growing interest in predictive and computational technologies. The term "higher education" appears 44 times, suggesting significant application in academic institutions. "Educational data mining" and "decision trees" are noteworthy with 41 and

40 occurrences respectively, indicating their use in extracting insights and decision-making processes.

Other prominent terms include "learning systems" (36 occurrences, 230 link strength), "high educations" (32 occurrences, 178 link strength), and "deep learning" (31 occurrences, 137 link strength), each reflecting advanced methodologies in AI. The occurrence of terms such as "engineering education," "information management," and "decision making" (all above 20 occurrences) further emphasizes the diverse applications of AI in managing and enhancing educational processes.

3.2. Co-authorship Network

A co-authorship analysis focuses on the relationships between authors in literature to understand the collaboration patterns and the structure of a scientific or technical field. This type of analysis can reveal key researchers, collaboration networks, and the development of research communities. By examining co-authorship networks, insights into the dynamics of research partnerships and the dissemination of knowledge can be gained [24]. The minimum number of countries per document was set to 25, the minimum number of documents of a country was set to 5 and the minimum number of citations of a country was set to 10, out of the 78 countries, 24 met the thresholds. For each of the 24 countries the total strength of the co-authorship links with other countries was calculated. The total number of countries selected is 24. Some of the items in the network are not connected to each other, therefore the largest set of connected items consist of 21 items.

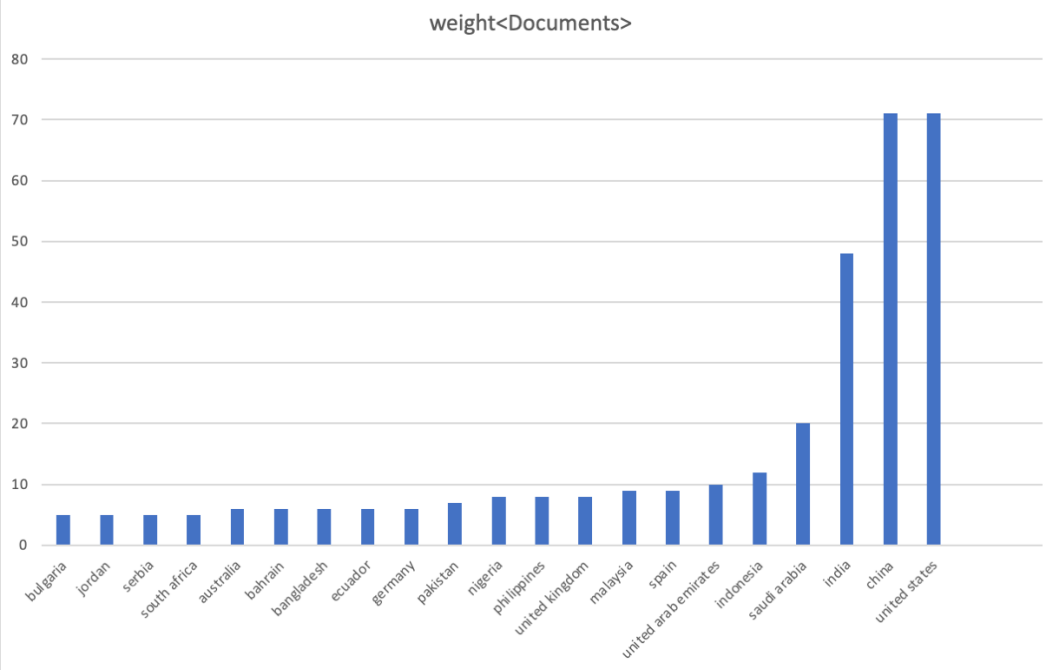

Figure 3. Distribution of Countries against Document Weight

Figure 3**.** depicts the distribution of countries across various weight classifications for documents. The x-axis categorizes the countries based on their labels. The y-axis represents the different weight clusters, and the height of each bar within a cluster indicates the number of countries assigned to that specific cluster.

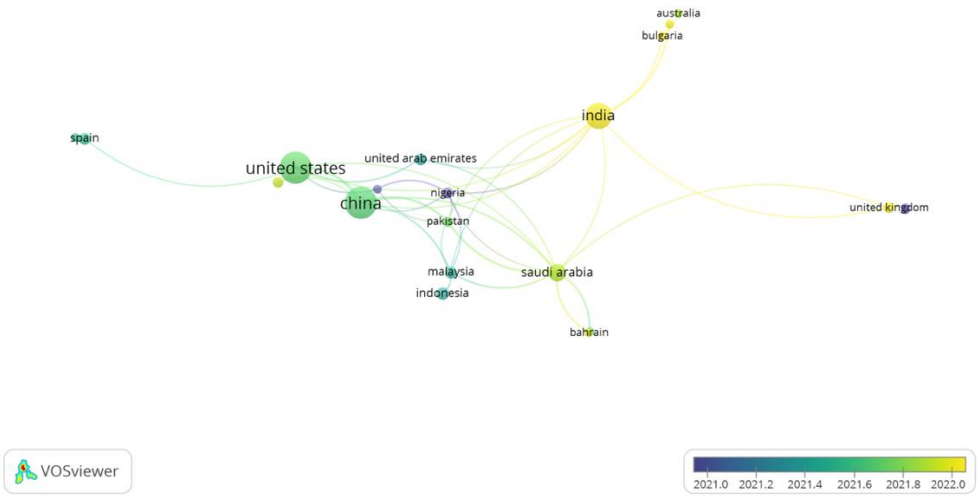

Figure 4. Co-authorship Network

Figure 4. In Cluster 1, we find Australia, Bulgaria, India, and Serbia. Australia contributed six documents with 54 citations, indicating moderate research impact and collaboration (weight of links = 1). Bulgaria, with five documents and 17 citations, shows a similar pattern but with lower impact. India stands out in this cluster with 48 documents and 151 citations, reflecting a significant research output and strong collaborative ties (weight of links = 10). Serbia, contributing five documents and 59 citations, shows moderate influence and collaboration (weight of links = 3).

Cluster 2 includes China, the Philippines, the United Arab Emirates, and the United States. China and the United States are leading contributors, each with 71 documents. China has 260 citations and a weight of links of 8, indicating strong collaborative influence, while the United States dominates with 399 citations and a weight of links of 7, underscoring its pivotal role in research impact. The Philippines, with eight documents and 13 citations, has limited impact and collaboration (weight of links = 2). The United Arab Emirates, with 10 documents and 154 citations, shows strong research influence and moderate collaboration (weight of links = 3).

In Cluster 3, we have Germany, Nigeria, and Pakistan. Germany contributed six documents with 52 citations, demonstrating moderate influence and collaboration (weight of links = 4). Nigeria and Pakistan, with eight and seven documents respectively, have high citation counts (105 for Nigeria and 102 for Pakistan) and strong collaborative ties (weight of links = 6 for both), indicating significant research impact.

Cluster 4 includes Bahrain, Jordan, and Saudi Arabia. Bahrain and Jordan each contributed five and six documents respectively, with moderate citations (20 for Bahrain and 35 for Jordan) and low collaboration (weight of links = 2 for both). Saudi Arabia, however, stands out with 20 documents, 174 citations, and a high weight of links (10), reflecting substantial research output and strong collaborative influence.

In Cluster 5, we find Bangladesh, South Africa, and the United Kingdom. Bangladesh and South Africa each contributed six and five documents respectively, with moderate citations (28 for Bangladesh and 26 for South Africa) and low collaboration (weight of links = 1 for both). The United Kingdom, contributing eight documents with 163 citations and a weight of links of 4, shows significant research influence and moderate collaborative efforts.

Cluster 6 consists of Ecuador and Spain. Ecuador, with six documents and 17 citations, has low research impact and collaboration (weight of links = 1). Spain, contributing nine documents with 101 citations and a weight of links of 2, shows moderate research influence and collaboration.

Finally, in Cluster 7, we have Indonesia and Malaysia. Indonesia contributed 12 documents with 24 citations, showing moderate research output but limited collaboration (weight of links = 1). Malaysia, with nine documents and 80 citations, demonstrates stronger research impact and collaborative ties (weight of links = 6).

3.3. Discussion

The keyword analysis unveils a research emphasis on analyzing student data (181 occurrences of "students") through data mining techniques (112 occurrences of "data mining") and leveraging machine learning algorithms (75 occurrences of "machine learning") to optimize admissions processes. Broader themes emerge with terms like "artificial intelligence" (62 occurrences) and "education computing" (56 occurrences), underlining the extensive application of AI technologies in educational settings, particularly for predicting and managing various facets of student admissions ("forecasting," 45 occurrences). The prevalence of terms like "higher education" (44 occurrences) and "educational data mining" (41 occurrences) further underscores the focus on utilizing AI to improve educational outcomes and administrative efficiency in higher education institutions.

The keyword co-occurrence cluster categorizes these keywords into thematic groupings. Cluster 5, with terms like "universities," "human," "employment," and "recommender systems," centers on AI applications in managing university admissions, considering human factors and employment outcomes. Cluster 4 features terms like "big data," "decision support systems," and "quality control," indicating research on employing big data and decision support systems to enhance the quality and efficiency of admission processes. Cluster 3, which includes "higher education institutions," "student performance," and "education computing," points to a strong interest in applying AI to improve student performance and educational computing infrastructure in higher education.

The co-authorship analysis highlights the collaborative dynamics and research impact of various countries in the domain of AI applications within the admission administrative process. The United States and China emerge as key contributors, each with 71 published documents. The United States stands out with a significant citation count (399) and a strong total link strength (13), signifying its pivotal role in research impact and robust collaborative ties. China, with 260 citations and a

total link strength of 16, also demonstrates substantial research influence and collaboration. Other notable contributors include India (48 documents, 151 citations) and Saudi Arabia (20 documents, 174 citations), both exhibiting considerable research output and collaborative influence.

The co-authorship network (Figure 4) illustrated that the United States and China are predominant contributors to AI research in higher education, exhibiting robust collaborative connections. This can be attributed to several factors. First, both countries have a long history of substantial investment in AI and technology-related research. For instance, China's government, has prioritized AI as part of its national strategic plan, leading to significant academic output [25]. The US, with its leading universities and tech companies, has long been at the forefront of AI research and development [26] The high levels of international collaboration, particularly between China, the US, and European nations, also point to the global nature of AI research, with researchers often engaging in multi-country projects to address complex educational challenges. Additionally, these countries have a higher concentration of infrastructure, institutional support, and research funding, which facilitates large-scale AI projects in education. The moderate influence and collaboration in AI research in countries like Germany (Custer 3) could be attributed to the fact that research in Germany is conducted in German since the official spoken language in Germany is German. Again, the number of documents from countries like Nigeria is eight (8) when compared to the US or china with seventy-one (71) AI documents each. Indicating low influence and collaboration. This could be attributed to the lack of digital infrastructures for the deployment of AI technology [27].

The implications of these collaborations are significant as they foster knowledge sharing, and innovation, driving advancements in the use of AI in HE globally.

Nigeria's contribution to research on AI applications in the admission and administrative process is noteworthy. With eight published documents and 105 citations, Nigeria demonstrates significant research output and impact. The high citation count underscores the recognition and value accorded to Nigerian researchers' work by the academic community, reflecting the quality and relevance of their research.

Nigeria's strong collaborative ties are evidenced by a total link strength of 8, highlighting the country's active engagement in international research collaborations. This collaborative approach fosters the quality and impact of Nigerian research and facilitates the exchange of knowledge and expertise with global researchers. Nigerian research likely focuses on leveraging AI to improve student performance, optimize admission processes, and enhance the overall quality of higher education institutions.

4.0. Conclusion

The bibliometric analysis underscores the significant role of AI in transforming admission and administrative processes in education. Countries like the United States and China are at the forefront due to their endowment with substantial academic resources and technical investments, which are crucial in propelling advancements in the field, although emerging nations like Nigeria are making notable contributions. However, international collaborations as shown by the co-authorship network, are vital for fostering innovation in AI applications in higher education. These collaborations between countries facilitate knowledge transfer and improve the scalability of AI solutions across the educational settings, ultimately leading to more transparent, efficient and accessible admission procedures.

To further enhance AI applications in educational processes, future research should prioritize several key areas. Fostering international collaboration and regional research networks, particularly within Africa, can leverage diverse expertise and address local challenges. Additionally, emphasizing applied research on AI in admissions and administration, including automated application review and personalized student services, will drive practical applications. Integrating AI with disciplines like behavioral science and educational psychology is crucial for developing holistic solutions. Nigerian researchers need to collaborate more with countries like the US and China to increase research impact. Furthermore, addressing ethical and societal implications remains paramount for responsible and inclusive AI use. Finally, increased research funding through government and private support will fuel innovation and drive practical applications of AI, ultimately improving efficiency, accuracy, and student outcomes.

However, it is important to note that this study has certain limitations. Future research should combine data from local journals such as the NIPES - Journal of Science and Technology Research (JSTR) for bibliometric analysis to gain a more comprehensive understanding of Nigeria's focus on AI in admission and administrative processes. This would provide a broader and more accurate perspective on the nation's contributions and challenges in this area

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