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Digital Transformation in Economics Education Through AI: A Bibliometric Approach to Identify Its Impact

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Abstract: The integration of Artificial Intelligence (AI) has brought transformative changes to economics education, reshaping teaching and learning practices to meet the demands of the modern economy. This study uses a bibliometric approach to analyze the impact of AI, highlighting key trends, research collaborations, and advancements in this field. AI enables personalized learning experiences, enhances accessibility for diverse learners, and supports the development of data-driven curricula tailored to evolving market needs. Notably, the highly cited article, "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT" (169 citations), underscores the critical role of digital technologies in addressing global challenges, including those posed by the pandemic. This research highlights the growing importance of interdisciplinary collaboration in leveraging AI to foster innovative and adaptive educational ecosystems. The findings provide valuable insights for educators, researchers, and policymakers seeking to harness AI to create inclusive and sustainable education systems. Future research directions are proposed to explore ethical considerations, scalability, and the long-term implications of AI integration in economics education.

Keywords: Digital transformation, Artificial intelligence, Economics education

Introduction

In present days, AI is a growing force in education as it provides several ways of improving presentation of knowledge and organizing the educational process. In the field of economics education, intelligent tutoring systems, NLP and machine learning have been identified to have high possibilities in altering normal paradigms in learning. Cabic replies to this by focusing on how economics education can benefit from Artificial Intelligence using literature reviewed from Scopus database collected from 2021-2025. It provides an understanding of the primary sources, theories, novel trends and the revolutionary work of AI in this specific area of demand.

The growing differentiation of world economies requires unique pedagogical approaches with technology integration into education for improving students' outcomes in fluctuating economics. AI meets these needs through the different techniques of facilitating adaptive learning, especially the option for formative and summative assessments as well as the provision of feedback using data collected in real-time (Luckin et al., 2016). In economics education AI helps to enhance values like analytical thinking and decisions making skills by offering simulations, prediction models, and learning with scenarios. This integration does not only enhance the learning achievements but also promotes the activities spearheading by institutions to fit the expectations of Industry 4.0 and the digital economy (Holmes et al., 2019).

This research employs bibliometric analysis to identify academic research on AI and its related aspects incorporated into the teaching of economics between 2016 and 2024. Bibliometric methods are more useful when they are applied to clearly track research directions and assess the otherwise blank areas in burgeoning

disciplines. The goal of this study is, therefore, to offer knowledge about the current state of the literature on economics and AI and direct educators, policymakers, and researchers to possible innovation regarding the instruction of this important component in learning and teaching.

Some of the latest research shows that the use of Artificial Intelligence in education is on the rise. In a previously mentioned systematic review by Zawacki-Richter et al. (2019), AI applications in higher education were presented with particular focus on the realisation of personalised learning environments. Similar to this Bond et al. (2020) presented a trend analysis of educational technology research where AI could be used to facilitate student engagement. White and Black (2022) have focused on the learning system in economics and adapted learning systems enable the improvement of the thinking process. Thus, the results emphasize the need to integrate AI proposed solutions in economics curricula for the purpose of further innovations and wealthy future.

This study contributes to the field by utilizing several theoretical frameworks:

1. *Constructivist Learning Theory:* This theory provides an argument to support the thought that learners participate in construction of knowledge through experience. The theory is consistent with the use of AI tools like simulations and interactive platforms active learning (Luckin et al., 2016).
2. *Cognitive Load Theory:* This theory puts a lot of focus and effort on minimizing cognitive load in the learning process. AI systems support the processes of learning by presenting the content according to the learner's tempo and frequency (Sweller, 2017).
3. *Innovation Diffusion Theory:* In this framework, the social diffusion of innovations is defined and discussed. This is because Rogers' (2003) diffusion of innovations theory posits that knowledge of the rate at which individuals adopt AI- related technologies can reveal how they are taken up and implemented in organisations.

This study offers novel contributions to the discourse on AI in economics education:

1. *Comprehensive Bibliometric Analysis:* The present work aims to understand who has been active in the field as well as topical trends and important articles by analyzing the publications from 2016 to 2024, which are available in the Scopus database.
2. *Focus on Recent Advances:* This excludes work published prior to 2016, this helps to capture some of the recent advancements in AI and the teaching of economics.
3. *Theoretical Integration:* Through rigorous theoretical underpinnings, the research improves the comprehension of AI as the agent of change of educational practice in economics.

Therefore, the use of AI in teaching and learning economics remains one of the best ways of exercising great ideas to fit the current learning systems. This study thus fills that gap by presenting a bibliometric analysis of recent published research papers, focusing on trends, contributions, and future directions of the area. It highlights the study and use of further investigations of Artificial intelligence to help the students to be fitted with knowledge and skills that would enable them to compete in a world economy that is headed towards enhanced digital complexity.

Method

In this research, a bibliometric technique is used for systematic review of extant literature on AI in economics education. The bibliometric approach is intended to reveal pattern, trends and remarkable features in the literature (Nederhof, 2019). The following studies' objectives are to provide a literature review on theoretical framework of AI, a review of current states and development of AI in economics education, and the consideration of future opportunities and prospects of AI in the field of economics education.

This research employs the descriptive analytical approach as a research method to describe and analyse the phenomenon of AI in economics education with the use of bibliometric data (Sugiyono, 2019). This paper employed the descriptive method to make a comprehensive analysis of the trends of publications, contributors, and themes of this research field. The research is based on the articles and documents with the source types 'Article', 'Conference Proceedings', 'Review' in the Scopus database, and published between 2016 and 2024. This period was chosen to identify the latest trends in the field, because of the rapidly growing and dynamically developing AI technologies and their applications in educational practices.

The search for information was done under the Search Function of Scopus database. Only those articles with such keywords as “artificial intelligence,” “economics education,” and “AI in education” were considered. This material included publication annual counts, journal names, author roles, institution links, and citation history. The collected data was analyzed using the following bibliometric methods:

1. *Trend Analysis:* Determining the flow of AI-annual publications related to economics education from 2021 to 2025.
2. *Contribution Analysis:* Searching for contributions of authors, institutions, and countries to the field.
3. *Citation Mapping Analysis:* Exploring citation elements concerning author productivity and collaboration.
4. *Thematic Analysis:* Establishing seven major themes that enable categorization of publications to identify major areas of research interest in the specialty.

The first step involves the identification process, where the researcher inputs specific keyword terms into the database Dimensions. The keywords used are ("digital transformation") AND ("AI") AND (“education”). This search yields 468 publication records. The next step is the screening process, where the researcher filters the results based on specific criteria: publications must be in English and must be journal articles. This screening narrows the results to 452 publications, discarding 14 that do not meet the criteria.

Subsequently, the researcher manually reviews the remaining publications to assess their eligibility. This involves examining the abstracts and titles of the 436 publications to determine their relevance to digital transformation in education through AI. By the end of this third phase, publications are deemed suitable for inclusion in the next stage. This data was collected on Januari 6, 2025, during the inclusion stage.
Publication trends related to digital transformation in education through AI are analyzed using descriptive analysis from the Dimensions database with bibliometric techniques. The number of publications and a linear trend line for each year will be displayed in a graph created using Microsoft Excel software.

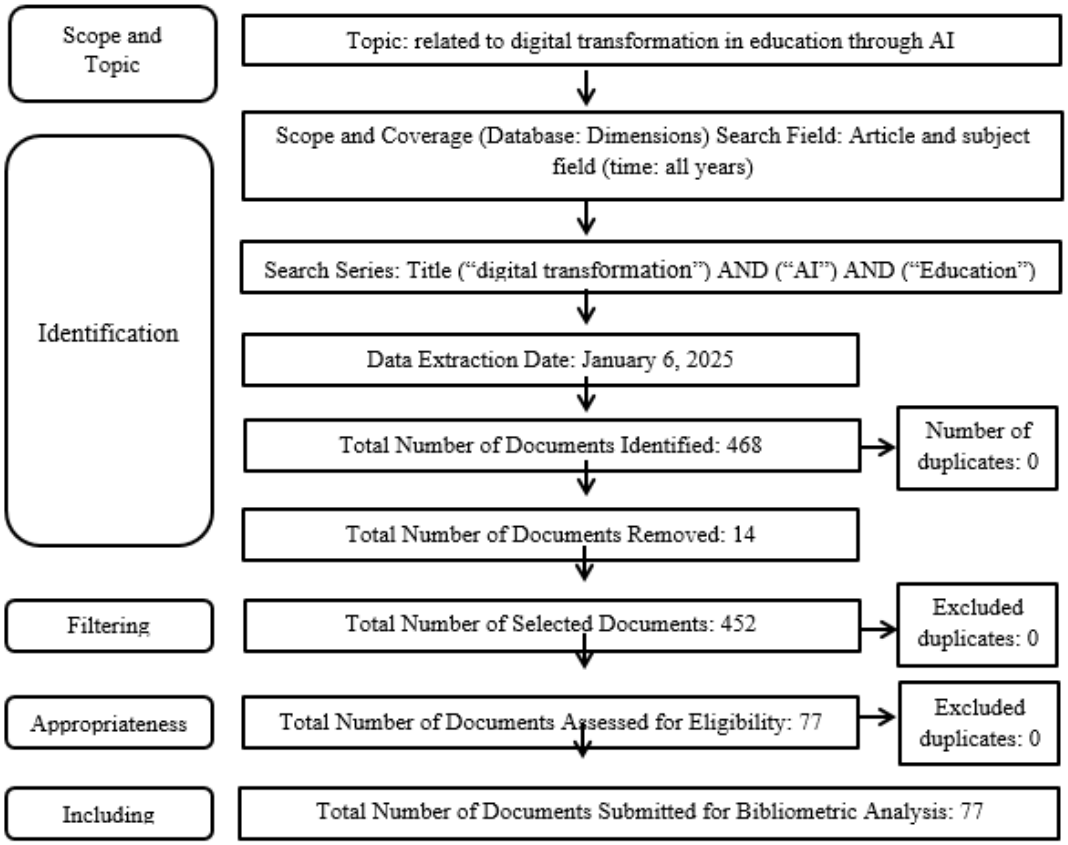

Figure 1. Series of data collection processes

This study employs bibliometric visualization methods and bibliometric analysis. Bibliometric analysis is a quantitative method that employs both evaluative and descriptive approaches to illustrate research trends and the principal characteristics of various publications (Wang et al., 2021). The techniques for bibliometric analysis are categorized into two main groups: performance analysis and mapping (Donthu et al., 2021).

The analysis of the obtained results includes the number of publications each year, documents with the highest citations, institutions with the most citations, journals with the most citations, and the usage of keywords by authors. This is followed by mapping or identification, which includes Network Visualization, Overlay Visualization, and Density Visualization. The research focuses on digital transformation in education through AI, facilitated by the VOSviewer application through the analysis of events using keywords. The researcher establishes a threshold for displaying the research focus, requiring a minimum of 2 publications that use the keywords together.

Results and Discussion

In showing the results of the bibliometric analysis in this study, refer to Donthu et al. (2021). Beginning with the number of documents and citations from countries, institutions, journals, authors, and the co-occurrence of keywords. This bibliometric analysis was conducted only in a few countries identified through specific keywords. Therefore, the researchers tailored their approach based on specific needs, starting with the number of citations and publications from institutions or universities and documents. Subsequently, the results of the co-occurrence analysis of keywords were visualized using VOSviewer, including Network Visualization and Visualization Overlays.

Trends in Number of Publications

Publications related to digital transformation in education through AI have undergone a data collection process, resulting in 77 publications from 2021 to 2025 that meet the established criteria. A descriptive bibliometric analysis was then conducted. The analysis will cover publication trends, citation trends, the distribution of countries and journals, and the focus areas of the research in detail.

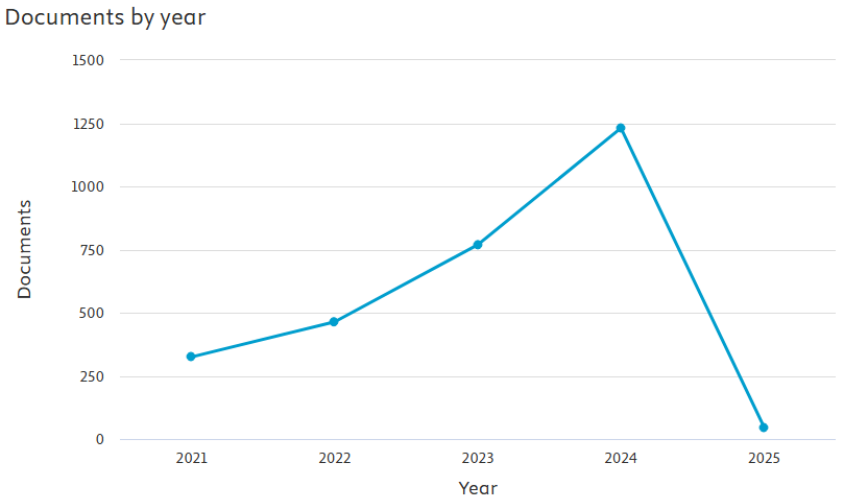

Figure 2. Number of publications on digital transformation through AI in the last 5 years

In the picture above, it can be seen the number of publications related to digital transformation through AI in the last five years. In 2021 there were 325 publications, or 11,46%, related to digital transformation through AI, then in 2022, there were 464 publications or 16,36%, which means a increase from the previous year. In 2023 there were 764 publications, or 27,12%. In 2024, it also increased to 1.231 publications or 43,41%, and in 2025 it decreased to 47 publications or 1,65%. It happened because researchers collected data in the beginning of 2025. The screening and feasibility that have been processed produce 77 documents related to digital transformation in education through AI which can be seen in Figure 3.

Reviewing the 77 publications selected over the past five years, there has been a notable increase, followed by a decline in the last years. In 2024, there were 39 publications, an increase of 20 from the previous year, but a decrease of 6 by 2022. This decline is likely due to the impact of the Covid-19 pandemic, which affected global activities, including education, through widespread lockdowns. Therefore, digital transformation is growing rapidly. Overall, the number of publications on digital transformation in education has significantly decreased, as evidenced by the trend line indicating a downward trajectory.

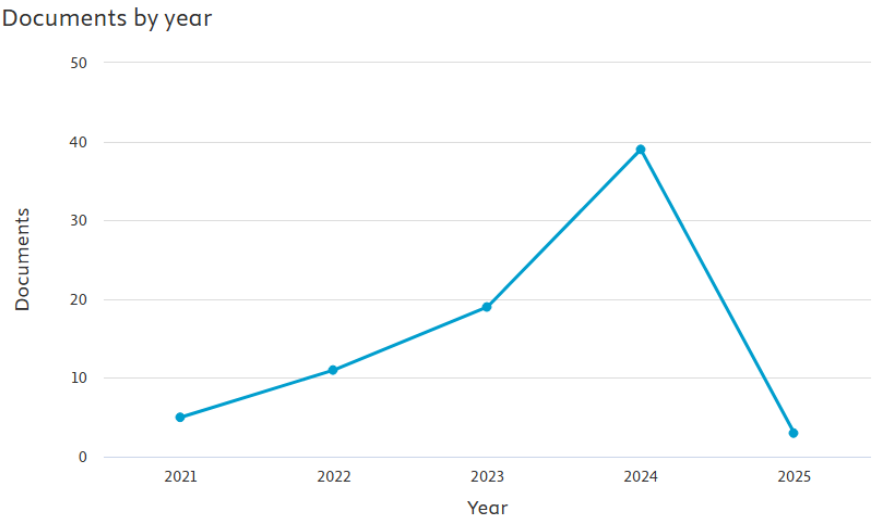

Figure 3. Number of digital transformations in education

Publication Trends by Document Type

The number of documents can be categorized based on the type of sources they originate from. The types of publications on digital transformation in education through AI from 2021-2025 are detailed in Table 1.

Tabel 1. The number and percentage digital transformation in education through AI in 2021-2025 by type of document

No	Document Type	Number of Publications	Percentages
1.	Article	44	57,14%
2.	Conference Paper	26	33,76%
3.	Book Chapter	7	9,10%
Total		77	100%

Based on the table above, the highest number of documents related to digital transformation in education through AI from 2021-2025 are article publications, totaling 44 publications or 57,14%. The second most common type is conference papers, with 26 publications or 33,76%, followed by 7 book chapter. The dominance of article publications is likely because many researchers are interested in studying digital transformation in education through AI.

Institute Bibliography Partner

Several institutions and universities have published documents indexed by dimensions related to digital transformation in education through AI. The table below highlights the institutions or universities with the highest number of cited publications, followed by the total number of citations.

Table 2. The number and percentage of digital transformation in education through AI in 2021- 2025 by publisher

No	Publisher	Number of Publication	Number of citations
1.	IEEE Global Engineering Education Conference Educon	6	25
2.	Sustainability Switzerland	6	115
3.	Administrative Sciences	2	78
4.	Advances In Transdisciplinary Engineering	2	7
5.	Computers And Education Artificial Intelligence	2	9

The data above highlights the trend of journals with most documents on digital transformation in education through AI. "IEEE Global Engineering Education Conference Educon" ranks first with 6 documents and 25 citations, followed by "Sustainability Switzerland" in second place with 6 document and 115 citations. Among the top 5 journals, two of them is indexed by Scopus Quartile 1, namely "Sustainability Switzerland" and

"Computers and Education Artificial Intelligence", one is indexed by Scopus Quartile 2, "Administrative Sciences." The other journals are indexed by Copernicus, Google Scholar, Crossref, and others. This indicates that research on digital transformation in education through AI aligns with the focus and scope of these journals, providing valuable insights for researchers looking to publish their work in this field.

Table 3. Publications with the highest number of citations related to digital transformation in education through AI in 2021 – 2025

No	Writer's Name	Title	Publisher	Year	Number of Citations
1.	Wach, K., Duong, C.D., Ejdys, J., Paliszkiewicz, J., Ziemba, E.	The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT	Entrepreneurial Business and Economics Review	2023	169
2.	Okunlaya, R.O., Syed Abdullah, N., Alias, R.A.	Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education	Library Hi Tech	2022	111
3.	George, B., Wooden, O.	Managing the Strategic Transformation of Higher Education through Artificial Intelligence	Administrative Sciences	2023	78
4.	Bucea-Manea-ţoniş, R., Kuleto, V., Gudei, S.C.D., Ilić, M.P., Păun, D.	Artificial Intelligence Potential in Higher Education Institutions Enhanced Learning Environment in Romania and Serbia	Sustainability (Switzerland)	2022	60
5.	Alavi, S., Habel, J	The human side of digital transformation in sales: review & future paths	Journal of Personal Selling and Sales Management	2021	46
6.	Tait, E., Pierson, C.M.	Artificial Intelligence and Robots in Libraries: Opportunities in LIS Curriculum for Preparing the Librarians of Tomorrow	Journal of the Australian Library and Information Association	2022	34
7.	Adarkwah, M.A., Amponsah, S., van Wyk, M.M., Metwally, A.H.S., Wang, H.	Awareness and acceptance of ChatGPT as a generative conversational AI for transforming education by Ghanaian academics: A two-phase study	Journal of Applied Learning and Teaching	2023	31
8.	Aldoseri, A., Al-Khalifa, K.N., Hamouda, A.M.	AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact	Sustainability (Switzerland)	2024	28
9.	Cain, W.	Prompting Change: Exploring Prompt Engineering in Large Language Model AI and Its Potential to Transform Education	TechTrends	2024	25
10.	Quy, V.K., Thanh, B.T., Chehri, A., Linh, D.M., Tuan, D.A.	AI and Digital Transformation in Higher Education: Vision and Approach of a Specific University in Vietnam.	Sustainability (Switzerland)	2023	24

Document Bibliography Pair

Scopus indexed documents digital transformation in education through AI are published in international journals. Documents with more than 10 citations are presented in the following Table 3. According to Table 3 provided, it is evident that the publication titled "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT" authored by Wach, et al., (2023) holds the top position with 169 citations. Following this, the second-ranking publication is "Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education" authored by Okunlaya, et al., (2022) with 111 citations. The third-ranked publication is "Managing the Strategic Transformation of

Higher Education through Artificial Intelligence" authored by George & Wooden (2023) with 78 citations. In fourth place is the publication "Artificial Intelligence Potential in Higher Education Institutions Enhanced Learning Environment in Romania and Serbia" authored by Bucea-Manea-ţoniş, et al., (2022) with 60 citations. Lastly, the fifth-ranked publication is "The human side of digital transformation in sales: review & future paths" authored by Alavi & Habel (2021) with 46 citations. These aforementioned documents serve as valuable references for further research focusing on the implementation of the digital transformation in education.

Trends in Digital Transformation in Education Through AI

The data sourced from the Dimensions database was extracted in RIS format and imported into VOSviewer software for bibliometric analysis. A criterion was established for shared keywords, necessitating each keyword to feature in a minimum of 2 distinct documents to be incorporated into the VOSviewer visualization. Documents meeting this criterion showcase numerous keywords appearing concurrently in at least 2 documents. Researchers identify and associate these keywords with research phenomena concerning digital transformation in education through AI. These keywords signify the prevailing terms utilized in digital transformation research. The depicted figure below illustrates the trends in research on digital transformation in education through AI.

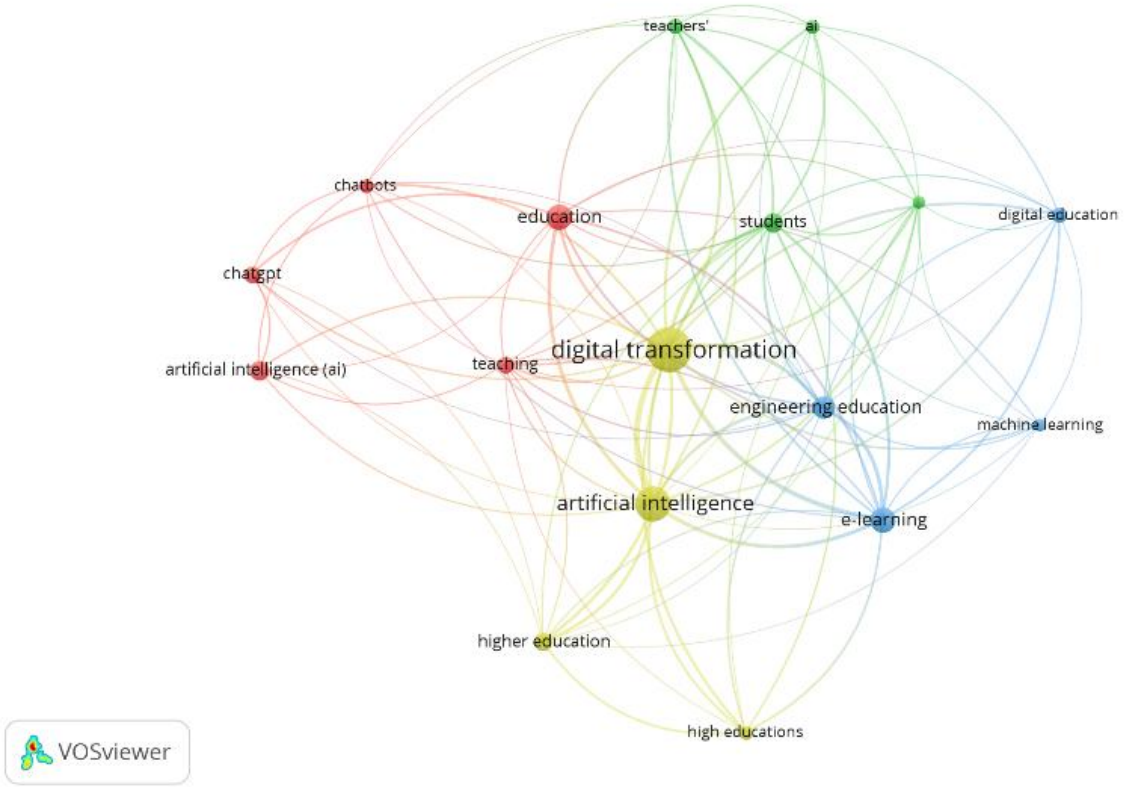

Figure 4. Network visualization of the emergence of shared keyword

The visualization above presents a network representation of shared keywords, with a minimum requirement of 2 occurrences. "Digital Transformation" emerges as the most prevalent keyword, appearing in 57 shared instances, indicated by the size of its corresponding circle. The larger the circle, the more extensively the keyword has been employed by researchers exploring digital transformation in education. Additional insights into the utilization of shared keywords are available in the accompanying Table 4.

In the provided Table 4, it's evident that digital transformation has captured significant interest from researchers. This is demonstrated by its inclusion as a shared keyword in 17 joint events. Following closely, the keyword "artificial intelligence" appears in 36 joint events, making it the most prevalent keyword after digital transformation. Other frequently used keywords include education, e-learning, engineering education, students, artificial intelligence (AI), higher education, chatgpt, teaching, teachers', digital education,chatbot, AI, high educations, education computing and machine learning. Figure 5's network visualization reveals 4 clusters encompassing 17 items related to digital transformation. These clusters are as follows: 1) Cluster 1 (red in color)

consists of 5 items; 2) cluster 2 (colored green) consists of 4 items; 3) cluster 3 (blue in color) consists of 4 items; and 4) cluster 4 (in yellow) consists of 4 items (see Figure 5).

Table 4. Keywords that have the most common occurrences related to digital transformation in education through AI

No	Keyword	Cooccurence
1.	Digital Transformation	57
2.	Artificial Intelligence	36
2.	Education	19
4.	E-learning	19
5.	Engineering Education	16
6.	Students	12
7.	Artificial Intelligence (AI)	12
8.	Higher Education	10
9.	ChatGPT	8
10.	Teaching	8
11.	Teachers'	7
12.	Digital Education	7
13.	Chatbot	6
14.	AI	6
15.	High Educations	6
16.	Education Computing	5
17.	Machine Learning	5

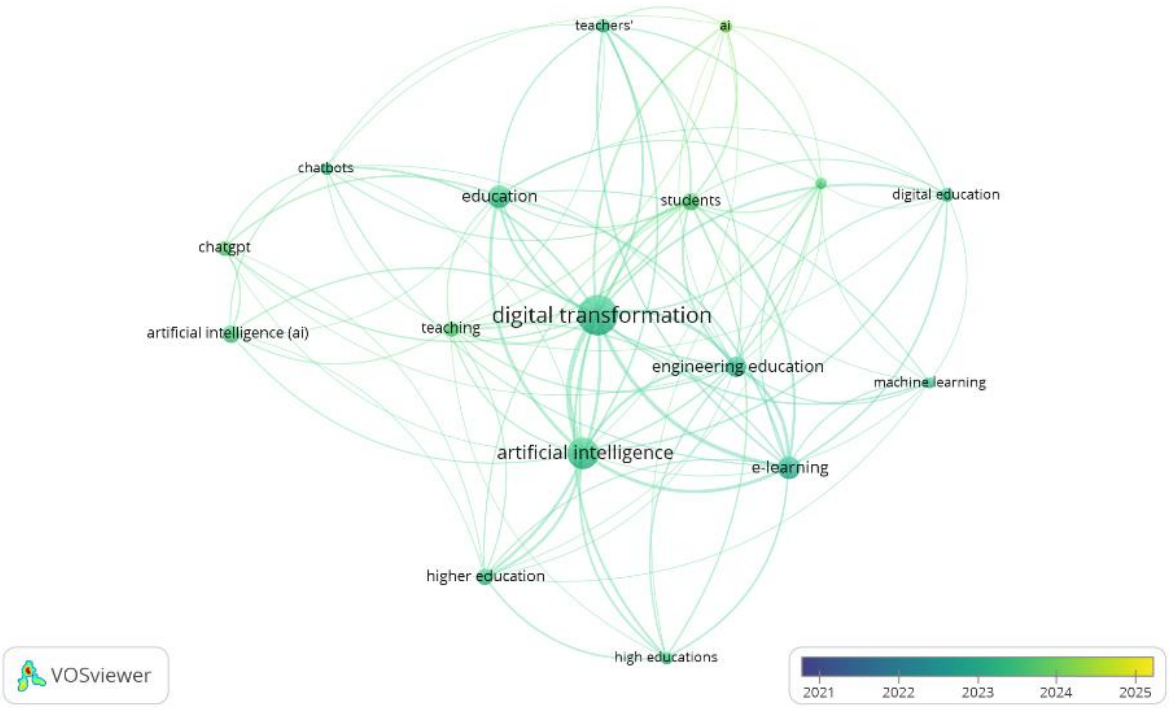

Figure 5. Overlay visualization of the emergence of shared keywords based on the year of publication

The image illustrates the temporal distribution of keywords using three distinct colors, Keywords highlighted in yellow were frequently used together around 2025. Those in green were predominantly grouped around 2023-2024, while the blue indicates the co-usage of keywords between 2021-2022. This color-coding reveals how terminology has evolved over time. New themes emerging in recent research include keywords like AI and artificial intelligence. Conversely, older themes are represented by keywords such as e-learning and machine learning. This shift suggests a dynamic landscape in digital transformation in education through AI, reflecting changing priorities and areas of focus. Additionally, this evolving trend is evident in the geographic spread of countries actively engaging in digital transformation in education through AI initiatives, as detailed in Table 5.

Table 5. The distribution of countries with the most applications of digital transformation in education through AI

Country	Documents	Citations
China	10	47
Germany	8	83
United States	8	176
India	6	18
Australia	4	42
Romania	4	62
Saudi Arabia	4	11
Viet Nam	4	218
Ghana	3	32
Japan	3	17

The table above underscores the prominence of digital transformation in education through AI, with China at the forefront, each contributing 10 publications. Trailing them are Germany and the United States, with 8 documents each. India has made a notable contribution with 6 documents, while Autralia, Romania, Saudi Arabia and Viet Nam have each produced 4 publications. Lastly, Ghana and Japan with 3 publications. This pattern indicates a significant and growing interest in igital transformation through AI, particularly within the educational sector.

From the discussion above, it's clear that research and the volume of publications on digital transformation in education through AI have shown a consistent upward trend over the years. The journal "IEEE Global Engineering Education Conference Educon" has the highest number of documents on this subject, totaling 6. Additionally, the study by Wach et al. (2023), titled "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT," stands out with 169 citations. In terms of keyword analysis, "artificial intelligence" frequently co-occurs with digital transformation, appearing in conjunction with 36 events. Visualized keywords indicate trending research focuses on various aspects of digital transformation in education through AI, such as education, e-learning, engineering education, students, artificial intelligence (AI), higher education, chatgpt, teaching, teachers, digital education, chatbot, AI, high education, education computing and machine learning. Emerging themes like AI and artificial intelligence signify new and evolving issues in the field. These trends present valuable opportunities for future research in digital transformation through AI within the educational context.

Conclusion

The publication trend in dimensions-indexed journals related to digital transformation in education through AI tends to decrease yearly. The journal " IEEE Global Engineering Education Conference Educon" has the highest number of documents on this subject, totaling 6. Additionally, the study by Wach et al. (2023), titled "The dark side of generative artificial intelligence: A critical analysis of controversies and risks of ChatGPT," stands out with 169 citations. In terms of keyword analysis, "artificial intelligence" frequently co-occurs with digital transformation, appearing in conjunction with 36 events. The visualized keywords indicate trending research focuses on various aspects of digital transformation in education through AI, such as education, e-learning, engineering education, students, artificial intelligence (AI), higher education, chatgpt, teaching, teachers', digital education, chatbot, AI, high educations, education computing and machine learning.

Recommendations

Emerging themes like AI and artificial intelligence signify new and evolving issues in the field. These trends present valuable opportunities for future research in digital transformation through AI within educational. Then for further research, to expand the keywords that will be used on research topics, and in searching for or collecting data, you can use databases other than dimensions such as Scopus and Web of Science (WoS).

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPESS journal belongs to the authors.

Conflict of Interest

* The authors declare that they have no conflicts of interest

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