

ARTIFICIAL INTELLIGENCE IN EDUCATIONAL MANAGEMENT: EVOLUTION, CONTRIBUTORS AND FUTURE DIRECTIONS

George SECĂREANU^{a}, Ștefanuț-Iulian BUHUȘ^b, Ioana-Marcela CIOANTĂ-PĂCURARU^c*

^{a, b, c} The Bucharest University of Economic Studies, Romania

ABSTRACT

With the increasing use of artificial intelligence (AI) technologies in education, the number of published studies in the field has increased. Numerous studies and surveys have highlighted that the integration of artificial intelligence in the educational process is an extremely complex and vital phenomenon. However, there remains a gap in the scholarly discourse regarding the presentation of this knowledge base through a bibliometric analysis. This study aims to provide an overview of the evolution of this existing literature on this topic by identifying articles published in journals indexed in the Web of Science Core Collection (WoS) database between 2003 and 2024. The search used terms such as "intelligent assistance", "machine learning", "chatgpt", "education", "educational management", "school improvement", "school management", "teacher" resulting in an initial total of 6264 articles. Subsequently, following the application of inclusion and exclusion criteria, 254 studies were retained for analysis. The contribution of this study lies primarily in highlighting the systematic methodologies used in the analyzes of research in educational management. In addition, collaboration patterns between authors, universities and countries are presented and analyzed. The findings provide researchers with valuable insights into the detailed evolution of educational management under the impact of new technologies. In addition, based on these findings, some suggestions were made for identifying new research themes in this field, both conceptually and empirically. The results of the analysis reveal a growing interest in the use of AI in the educational field, bringing both significant opportunities and certain risks.

KEYWORDS: *artificial intelligence, education, educational management.*

DOI: 10.24818/IMC/2024/05.10

1. INTRODUCTION

Educational management plays a crucial role in ensuring the smooth and effective operation of educational institutions. By combining various resources and implementing strategic planning, educational managers strive to foster an environment that promotes learning and development for all participants in the education system. Research on the use of modern technologies in educational management has received significant academic attention for over half a century, resulting in a vast body of literature on the topic. The integration of Artificial Intelligence (AI) into educational management is increasingly reshaping the educational landscape, with applications that range from improving administrative efficiency to creating personalized learning experiences, thereby enhancing student outcomes and institutional effectiveness. The potential of AI in educational management is significant, promising to boost efficiency and improve learning results. In recent

* Corresponding author. E-mail address: georgeseceanu@yahoo.com

years, the importance of AI within the educational sector has grown due to its ability to enhance learning across diverse contexts (Hwang et al., 2020). However, no large-scale analyzes have been conducted to comprehensively investigate the various aspects of this domain.

The field of AI in education (AIEd) has demonstrated notable technological advancements, innovative theoretical frameworks, and impactful pedagogical results (Roll & Wylie, 2016). AIEd includes various applications such as intelligent tutoring systems that assist in content delivery, provide feedback, and track student progress (Bayne, 2015). The advantages of AIEd are widely recognized; it can deliver customized support and identify knowledge gaps, enabling educators to implement personalized and adaptive instruction effectively (Guan et al., 2020).

Furthermore, AI-driven solutions facilitate algorithmic decision-making that supports real-time evaluations of complex skills and knowledge (Chen et al., 2021). These AI-enhanced educational systems can analyze classroom dynamics and student engagement, allowing for the early identification of at-risk students and timely interventions. The scientific literature is essential for gaining a comprehensive understanding of the evolution and current status of this field. This can be achieved by exploring research motivations, assessing scientific collaborations, and identifying research themes. Given the rapid growth of AIEd research, synthesizing existing literature at the intersection of educational management and artificial intelligence is both timely and necessary to provide insights into the future of education. The widespread adoption of AIEd, coupled with the lack of quantitative analysis of its extensive literature, underscores the need for a thorough bibliometric analysis to better understand the implications of AI use for students as direct beneficiaries of education and for educational management as a whole. The insights gained from bibliometric analysis in areas like educational management and artificial intelligence can assist researchers and educators in selecting research topics and evaluating the effectiveness of educational processes. To this end, we employed topic-based bibliometrics to quantitatively analyze 6.264 articles published between 2000 and 2024. Our goal was to identify key trends and themes within the field of Artificial Intelligence in Education (AIEd), with a focus on the following aspects: shifts in topic popularity, leading publication sources, countries/regions, institutions, and patterns of scientific collaboration. Our review was structured around five research questions:

- Q1: What has been the progression of articles related to Artificial Intelligence in Educational Management published from 2003 to 2024?
- Q2: Who are the most prolific researchers based on the number of articles published in WoS?
- Q3: Which primary sources, countries or regions, and institutions have contributed to these publications?
- Q4: How has collaboration manifested between various countries and institutions in this field?
- Q5: What key research topics have been explored in relation to the use of artificial intelligence in educational management?

A more complex look at the existing literature in the field of educational management regarding the integration of new technologies is necessary because this visibly impacts the education of new generations. From a methodological point of view, the bibliometric indicators regarding the number of publications, the most prolific authors, networks created between countries, institutions and various sources help to identify the scientific evolution of the respective field. At the same time, this allows researchers to be more aware of the channels to make contributions by identifying important authors from whom to learn methods and techniques for adapting the educational process to technological innovations.

2. LITERATURE REVIEW

2.1 The evolution of AI in education

2.1.1 The First Applications of AI in Education

Since the 1950s, the year of the emergence of AI, technologies have been increasingly used to facilitate the educational system and training in various fields (Perrotta & Selwyn, 2019). Until today, applications of artificial intelligence in education) have been made for the development of teaching and learning activities, including the preparation and dissemination of information, collaboration, but also the assessment of skills and performance.

Initially, the use of AI in education focused on intelligent tutoring systems that helped students learn through automated and personalized interactions. In the 1990s and 2000s, AI was mainly used to develop intelligent tutoring systems and adaptive learning platforms that provided personalized feedback and guidance (Roll & Wylie, 2016). These systems represented a first attempt to replace or complement the role of the teacher through AI technologies.

2.1.2 Expanding and Diversifying the Use of AI in Education

Since the 2010s, AI has expanded its influence in education beyond teaching into the realm of educational management. Artificial intelligence has been used to optimize administrative processes such as academic performance forecasting, absence management and dropout prevention (Alvarado-Uribe et al., 2022). Machine learning algorithms have played a central role in these processes, analyzing student data to identify patterns and make accurate predictions. In the field of education, Artificial Intelligence is becoming an important component, as most of the educational activity is represented by teaching and learning, i.e. intensive cognitive activities based on knowledge. This gives rise to AI applications that can process information, solve problems based on algorithms and a knowledge base, but at the same time can support and even improve the teaching and learning skills of educators and students.

2.1.3 The Emergence and Spread of Machine Learning

Machine learning, a branch of AI, has seen exponential growth and has been increasingly applied in educational management to improve decision-making. Recent research has shown that ML can be used to analyze complex data and improve educational experiences, from predicting academic performance to improving assessment processes (Demir & Güraksın, 2022; Ahajjam et al., 2022). Since the period of the COVID-19 pandemic, interest in AI and ML has grown significantly, and research has increasingly focused on the application of these technologies to enhance online and hybrid learning (Mittal et al., 2022). This fact generated a series of studies that examined the applications in question, which led to revision and improvement research on the use of AI in education. Many of these researches have been done in a general field, but there are also works that focus on specific areas, for example chatbots, precision education, but also mathematics.

2.2 The contribution of specialized literature

Although the topic of artificial intelligence in education only began to be studied very carefully at the beginning of the 21st century, there is still a body of reviews on artificial intelligence in education focused on quantitative methodologies. Most reviews used narrative synthesis or systematic reviews with limited sample sizes. Thus, Roll and Wylie (2016) assessed the strengths and opportunities within AIEd, highlighting a transformative shift in classroom learning practices and interactions with educators driven by various AI technologies. Their study highlights the revolutionary way in which these technologies are integrated into the daily lives of students, but also the emergence of commitments from the community to use artificial intelligence more and more in the field of education. Another study by Chassignol et al. (2018) attempted a first review of

the literature related to the use of artificial intelligence in education starting from the following premises: personalized teaching materials, innovative teaching strategies, technology-assisted assessment and communication between learners and educators. This review used 47 articles published in the *International Journal of Artificial Intelligence in Education (IJAIED)* in the years 1994, 2004 and 2014. However, a truly systematic review belongs to Zawacki-Richter et al. (2019), including 146 publications on artificial intelligence in higher education, with a focus on functions such as profiling and prediction.

Goksel and Bozkurt (2019) analyzed publications on this topic published between 1970 and 2018. The previously mentioned authors identified three important themes addressed by most of the analyzed studies: the personalization of learning styles through adaptability, the use of intelligent guidance systems and the integration of artificial intelligence in processes of training. A bibliometric analysis for the period 2007-2017 was carried out by Lucena et al. (2019b) totaling 132 publications and concluding that the use of artificial intelligence in education is just beginning. Analyzing 45 publications related to AIED, Chen et al. (2022), highlighted some existing gaps in AIED applications such as insufficient data protection and the need for user privacy regulations. Guan et al. (2020) highlighted the growing interest in online education design since the 2000s, but also the growth of personalized learning since 2009, through student profiling and learning analytics. Tang et al. (2021) systematically reviewed the literature on AI applications in e-learning, especially analyzing the frequent citation network in order to identify future research directions in this field. Thus, artificial intelligence can become extremely effective in personalizing learning scenarios by using those Bayesian networks to predict student characteristics. However, we note that most of the analyzes and reviews listed above looked primarily at the period 2007-2019, using quantitative methods based on a limited number of studies. This approach does not provide a comprehensive understanding of the major implications of artificial intelligence in making the educational act more efficient. Given that the COVID-19 pandemic stimulated the use of AI in education, this lucu opened up new approaches to the importance of the digitization of education as well as the emergence of new studies and research in this field. We also note a gap in examining the correlation of artificial intelligence applications with fundamental principles pertaining to educational management. Therefore, in this study, I insisted on the bibliometric analysis of the entire corpus of studies on the topic of artificial intelligence in educational management in order to identify future research directions.

3. RESEARCH METHODOLOGY

3.1 Establishing objectives

The objective of the investigation of this topic is to identify the evolution and implications of the use of artificial intelligence in the field of educational management by analyzing the existing studies in the theory and specialized pedagogical practice. The main goal is to examine the increased interest of researchers regarding the integration of algorithms in the efficiency of educational management starting from technological advances and shifting educational needs. Also, a secondary objective of the research is to highlight the importance of this topic within various academic institutions globally.

3.2 Data retrieval and preprocessing

Publications related to the use of artificial intelligence in educational management from 2003 to 2024 were collected on September 29, 2024 using the Web of Science (WoS) database. The search process used terms related to artificial intelligence ("artificial intelligence", "automatic intelligence", "intelligent assistance", "machine learning", "chatgpt", "intelligent system", "openai", "generative ai"), as well as to words related to education ("education", "vocational training", "digital

education", "primary school*", "secondary school*", "high school*", "elementary school*", "teaching" and "learning", "school improvement"). Thus, a first search generated 6264 publications, distributed over several categories, as can be seen in figure 1.

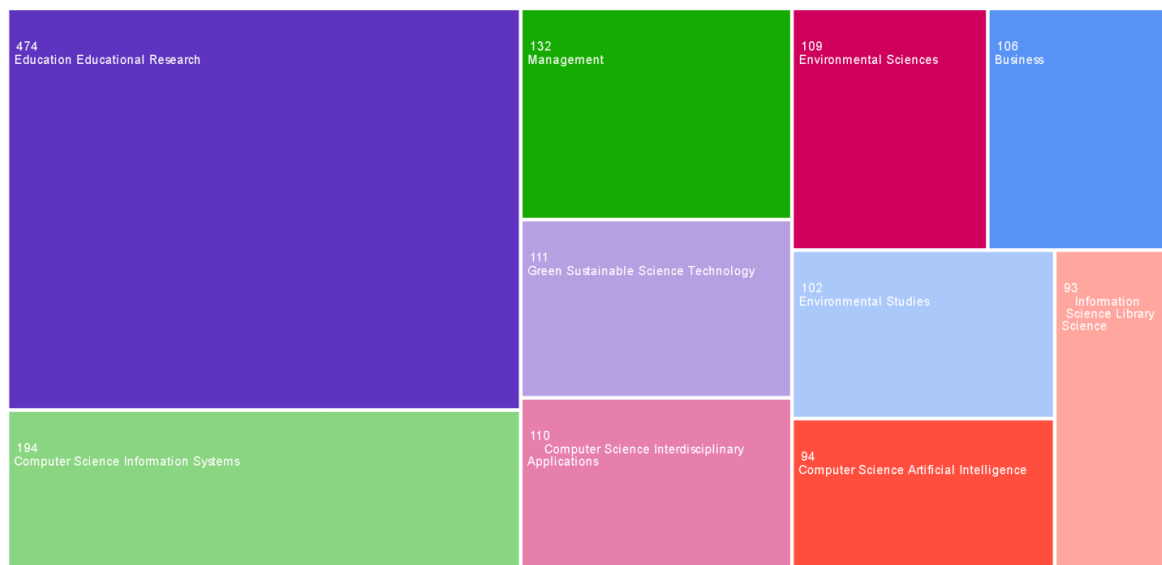


Figure 1. Initial distribution of publications by category

Source: Authors' own research, based on data extracted from WoS

In the next stage, we focused on the selection of articles that make direct reference to educational management by introducing some terms from this semantics, such as: „educational management”, „classroom management”, „educational leadership”, „school management”.

Table 1. Search equation

	Topic	Search terms
1	Subject	„artificial intelligence”, „automatic intelligence”, „intelligent assistance”, "machine learning", „chatgpt”, "intelligent system", „openai”, „generative ai"
2	educational management approach	education", "vocational training*", "digital education", teaching" and "learning", "school improvement", educational management”, „classroom management”, „educational leadership”, „school management”.
3	Context	„school” OR „university”
4	Level	„kindergarten” OR „elementary school” OR „primary school” OR „middle school” OR „secondary school” OR „Bachelor” OR „high* school” OR „master” OR „doctor”

Source: own elaboration

Using the previously mentioned terms, a search equation presented in Table 1 was developed to identify relevant studies in the Web of Science (WoS) database. Thus, the search equation focused both on terms close to the main subject (artificial intelligence) and on a contextual approach to this subject: education in schools and universities, in all stages or levels. This equation was used to search for documents using the "TS" formula in WoS, i.e. "title, abstract and keywords". Subsequently, some specific inclusion and exclusion criteria were added to filter and refine the studies, shown in Table 2.

Table 2. Inclusion and exclusion criteria

	Inclusion criteria	Exclusion criteria
1	Published between 20003 to September 2024	published before 2003
2	English	Not in English
3	Indexed in Web of Science	Not indexed in Web of Science
4	Publications related to education and educational mangement	Non-education publications
5	Open access	Not open access
6	Article, Book, Chapters, Early Access, Letter, Proceeding Paper, Review Article	Published retracted

Source: own elaboration

The introduction of the search terms and the inclusion and exclusion criteria shown in Tables 1 and 2, followed the recommendations of Zawacki-Richter et al. (2020) on systematic reviews in educational research. We also considered Marín's (2022) directions for research in the specific field of educational technology.

The first 3 exclusion criteria from the previous table generated 370 publications, which were refined by categories tangential to education and educational management according to inclusion criterion 4.

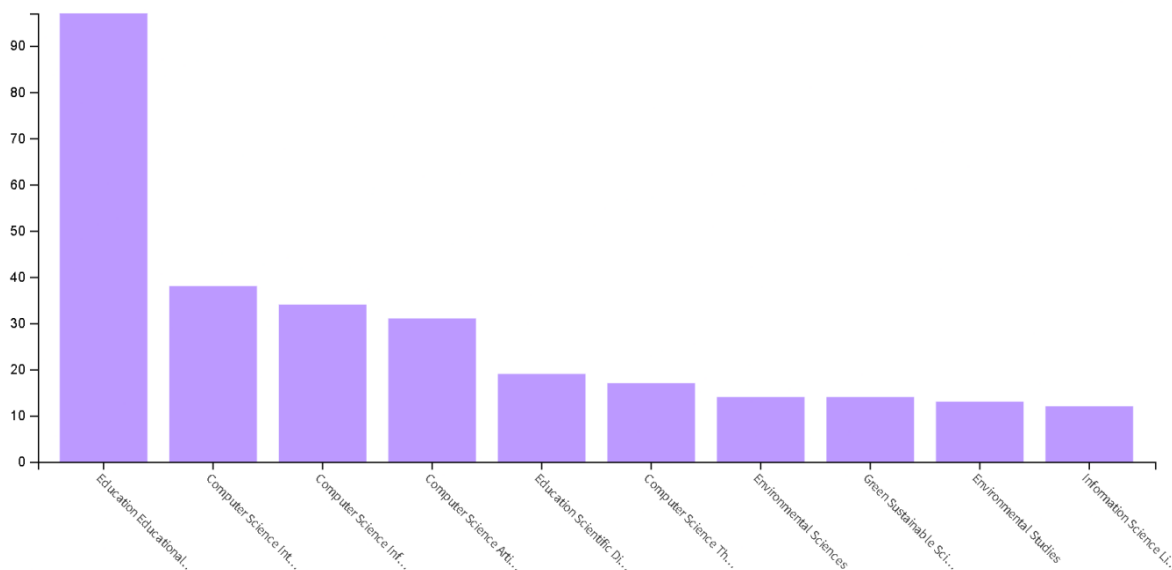


Figure 2. Publications related to education and educational mangement

Source: Authors' own research, based on data extracted from WoS

A total of 256 publications were obtained, of which 2 were retracted by the authors. Therefore, the final document submitted for analysis contains 254 systematically collected publications, starting from 2003 and up to 2024.

3.3 Data analysis

Data analysis was performed using VOSviewer version 1.6.20, adhering to the five-step methodology proposed by Zupic and Cater (2015). thus, I followed the following steps:

1. designing the research starting from the formulation of the research questions mentioned in the introduction and selecting the appropriate bibliometric method to address them.
2. data extraction and refinement by choosing the WoS database and creating those specific inclusion and exclusion filters in order to obtain the most relevant and comprehensive bibliometric information.
3. visual representation of existing maps and networks using the VOSviewer application for the purpose of a more in-depth analysis.
4. selecting appropriate VOSviewer software options to ensure accuracy, such as number of valid cases, relationship intensity.
5. Interpretation of the results generated graphically and scripturally.

Basic methodologies for AI analysis in educational management and scientific mapping were used throughout the data analysis process (Noyons et al., 1999). Initially, it focused on identifying key scholars, institutions, and publications related to the topic. After this, scientific mapping was used to describe the dynamics in different scientific fields and disciplines (Zupic & Cater, 2015).

To achieve a thorough analysis, the frequency distribution of research on artificial intelligence in education was examined over different years, highlighting prolific authors, influential journals and the countries involved. In addition, metrics such as the number of published articles, frequently used keywords, and highly cited articles were analyzed. On the other hand, scientific mapping provided valuable information on keyword usage, co-authorship patterns, and collaboration trends across institutions and countries.

4. DESCRIPTIVE ANALYSIS OF BIBLIOMETRIC DATA

4.1 Main Information about the Articles

Table 3 below presents the key data information. In essence, the study examined 1481 journal articles published in 260 sources between 1994 and 2024. As depicted in the table, the average citation count per article stands at 14.35, with an annual average of 1.62 citations per article. There are 1651 author keywords. The number of authors of single-authored articles is 199, with 1343 articles having multiple authors.

Table 3. Article Information in the Sample

	Description	Results
1	Timespan	2003-2024 (september)
2	Sources	196
3	Documents	254
4	Citing Articles	1679
5	Times Cited	1764
6	Average citations per document	6,94
7	Average years from publication	11,54
8	H-index	22
9	Author's Keywords (DE)	943
10	Keywords plus (ID)	313
11	Authors of single-authored documents	19
12	Authors of multi-authored documents	870
13	Co-Authors per doc	3,42

	Description	Results
14	International co-authorships	15.78
15	article	170
16	book, chapter	2
17	article; early access	13
18	review	21

Source: Authors' own research, based on data extracted from WoS

4.2 Annual numbers of AIEd publications and citation

The first stage of the research focused on the temporal distribution of the frequency of publications and the number of citations regarding the use of artificial intelligence in educational management. Graph 3 (figure 3) illustrates the frequency distribution of articles per year and the trajectory of citations since 2003, when the first 3 articles on this topic are recorded. The total number of publications between 2003-2024 is 254, covering a period of almost 22 years. The evolution of publications and citations has experienced an upward trend and a significant increase since 2019, when the number of publications reaches 13 and citations to 34. The interest and attention given to the subject will continue in the following years, with the peak being reached in 2024. Thus, although the analysis captured only the first 9 months of 2024, we note that this has become the most prolific year, with a total of 82 published articles and a number of 723 citations.

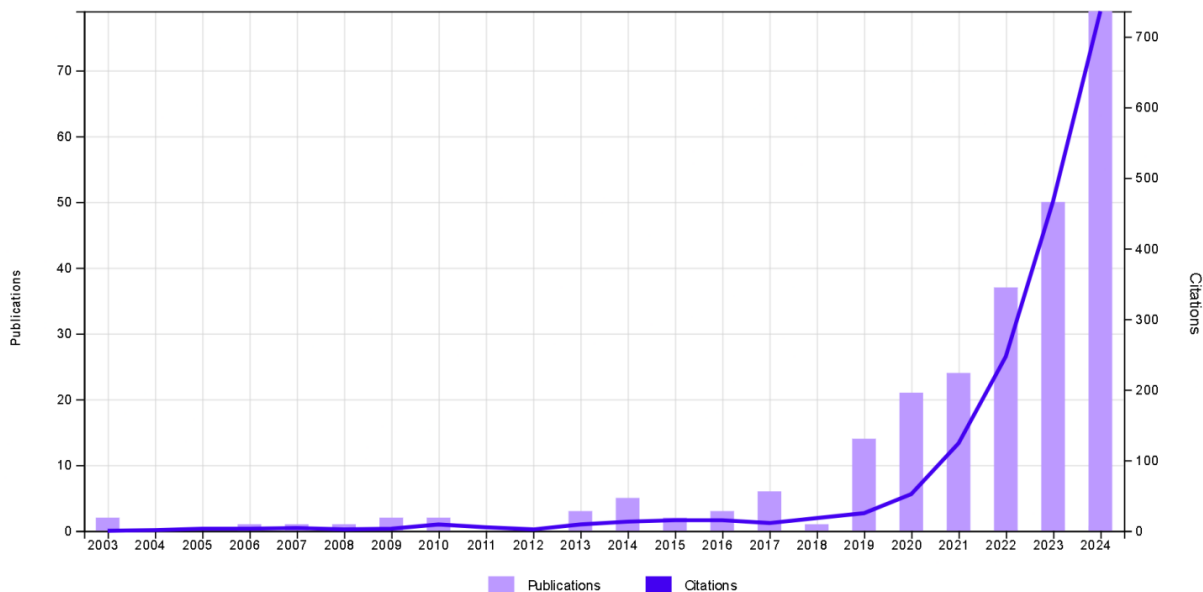


Figure 3. Times Cited and Publications Over Time

Source: Authors' own research, based on data extracted from WoS

Figure 3 shows the number of articles and citations published from 2003 to 2024, indicating a general upward trend, but also a spectacular evolution starting from the period 2019-2020 as a result of the opportunities arising with the implementation of online education in the particular context determined of Covid 19. With the widespread use of digital means in education, there is also a growing interest in identifying the impact of the use of artificial intelligence on performance and learning outcomes.

4.3 The most prolific authors by the number of articles

The second question led to the identification of the most prolific authors in this field, starting from the number of articles written and the number of citations collected by each author. Thus, table 3 lists the first ten authors who have shown increased attention to the field, impacting further research by citing them by other authors. From the total of 870 authors, the majority of authors (95%) contributed an article to highlight the variables involved in the integration of artificial intelligence in education. Only 19 authors were identified who elaborated 2 studies in the field, and their ranking was done according to the number of citations. According to the data generated by the search in WoS and analyzed through Vosviewer, we observe 4 authors with 2 studies each that have accumulated a very high number of citations, thus, Ratten Vanesa, from La Trobe University, holds the highest position in terms of the influence exerted on research in this field with 151 citations. Following closely, Arpaci Ibrahim, with 141 citations, is the second most prolific and quoted author, while Kuleto Valentin and Păun Dan occupy third place in this ranking, with 100 citations each.

Table 4. The most prolific authors by the number of articles

Author	Articles	Citations (f)
Ratten Vanessa	2	151
Arpaci Ibrahim	2	141
Kuleto valentin	2	100
Păun Dan	2	100
Bonifatti Angelo	1	125
Brunetti Frederico	1	125
De Longhi Alberto	1	125
Matt DominiK	1	125
Orzes Guido	1	125
Strunga Martin	2	89
Urban Renata	1	89

Source: Authors' own research, based on data extracted from WoS

Regarding the contributions made to the research in this field, we note the article by Ratten (2023) which highlights the practical and managerial implications generated by the use of chatgpt in education and the critical need to re-examine existing educational practices in relation to technological innovations. We also note Ratten's (2023) suggestions for management educators regarding the use of new technologies, ChatGPT, in education. It recommends that teachers design new assessments that combine technology with creative thinking, "include contextual studies that make ChatGPT difficult, or simulate environments in which ChatGPT has no knowledge" (Ratten, 2023).

Regarding the practical implications of using AI-based chatbots for learning purposes, Al-Sharafi et al. (2022) suggest that they should be tested before being implemented in order to ensure an engaging experience for users in the educational environment. In this regard, it becomes essential to develop "conversational agents based on machine learning algorithms to personalize responses and provide the best user experience" (Al-Sharafi et al., 2022).

Applied research on 123 respondents by Kuleto et al. (2021) proved that artificial intelligence can bring visible benefits at the level of deep learning by developing computer vision, as well as by providing optimized prediction and testing.

4.4 Top publication sources

In total, 196 sources were identified, the first 10 ranked by the number of documents totaling 49 titles, approximately 20% of the total. The most prolific source is the journal Sustainability, having a Current Impact Factor of 3.3 and publishing 13 articles totaling 186 citations. The journals Education Sciences and Education and information Technologies also collected 6 articles each and a number of 108 citations and 20 citations, respectively. Other important sources are the journals British Journal of Education Technology and International Journal of Artificial Intelligence, which, although they only have 2 articles on this subject, still attracted the attention of researchers through the large number of citations, 54 citations for the first journal, respectively 52 citations, for the second journal. Comparing the number of publications in the approximately 22 years, we note that most sources have become more and more interested in the last 5 years in the intersection of the 2 fields: education and information technologies.

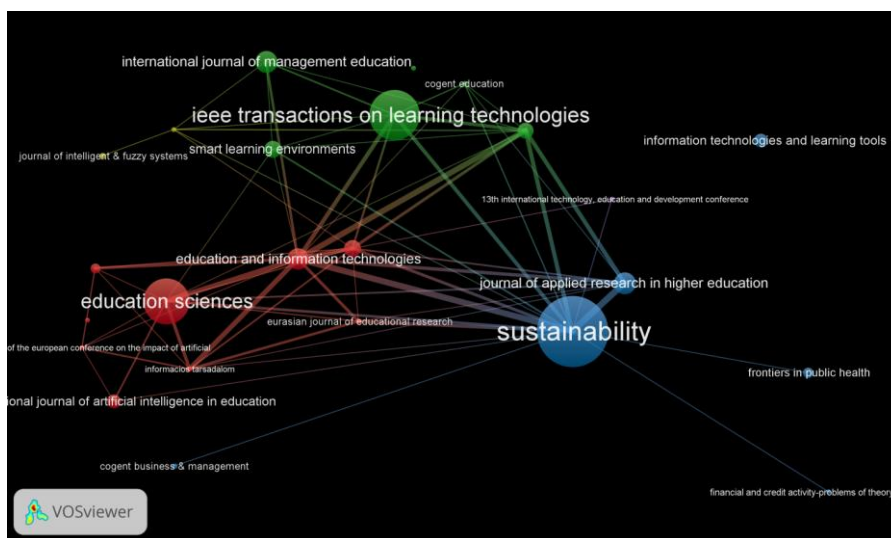


Figure 4. Network of publication sources

Source: Authors' own research, based on data extracted from Wos

Figure 4 illustrates networks among the top 29 sources, delineating six significant groups and two separate positions. The most important is the red cluster, covering the largest number of sources (8 sources) among which we mention the most prolific journals (Education Sciences, Education and Information Technologies and British Journal of Education Technology). The green cluster also includes 5 important sources such as Interactive Technology and Smart education and Cogent Education which address various current topics in educational research, including curriculum and instruction, policy, assessment, leadership, psychology, technology, and comparative education. The comparison of the 6 clusters highlights the fact that all 29 journals, both open access and traditional journals, contributed to the dissemination of knowledge about the use of artificial intelligence in educational management, based on a close collaboration network.

4.5 Top countries/regions and institutions

The third research question looked at the list of the most productive countries and the collaboration network between them. The results show that China, the United States of America and Spain are the most productive countries, generating about 35% of all publications, but also a very large number of citations (531 citations).

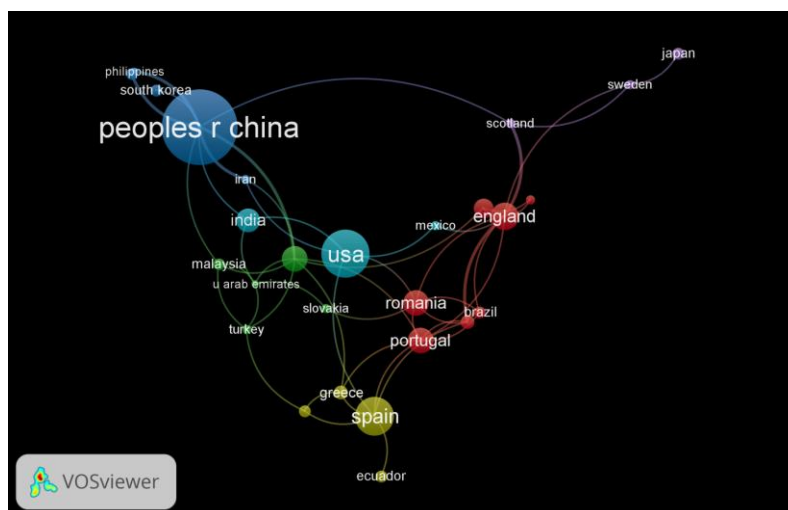


Figure 5. Network of publications by country
 Source: Authors’ own research, based on data extracted from Wos

Figure 5 illustrates the collaboration network between 29 countries out of a total of 72, grouped into 6 groups. As illustrated, China is in the center of the blue cluster with only 5 items, and the United States of America is in the turquoise cluster. Australia (green cluster- 5 itmes) and England (red cluster-7 items) also create the most prominent collaborative links in this area, demonstrated by the high number of citations recorded by articles from these countries.

Table 5. The Ten Most Productive Countries based on the Number of Articles

Country	Articles	%	Citations
China	40	15.7	184
The United States of America	24	9.4	253
Spain	19	10	94
Ukraine	14	7.4	35
England	13	5.1	65
Romania	12	4.7	127
Portugal	12	4.7	30
Australia	12	4.7	310
India	11	4.3	30
Rusia	9	3.5	12
Total	166	65.3	1140

Source: Authors’ own research, based on data extracted from WoS

In conclusion, we can see that the research identified 72 countries/regions, China ranked first with 40 publications, but in terms of citations Australia particularly attracted attention with the very high number of citations, suggesting that although there were only 12 studies have been published in this country, however, the quality of the research is high. It should be noted that most countries/regions and institutions have become more and more interested in integrating artificial intelligence into the efficiency of educational management over the last 10 years.

4.6 Scientific collaborations

From an institutional perspective (Figure 6), the collaboration network between organizations must be studied very carefully in the last 5 years, since during this period the subject has seen great development in various academic environments from various countries. Thus, it should be noted

that among the most productive institutions are universities from Ukraine (5 publications) and Turkey (4 publications).

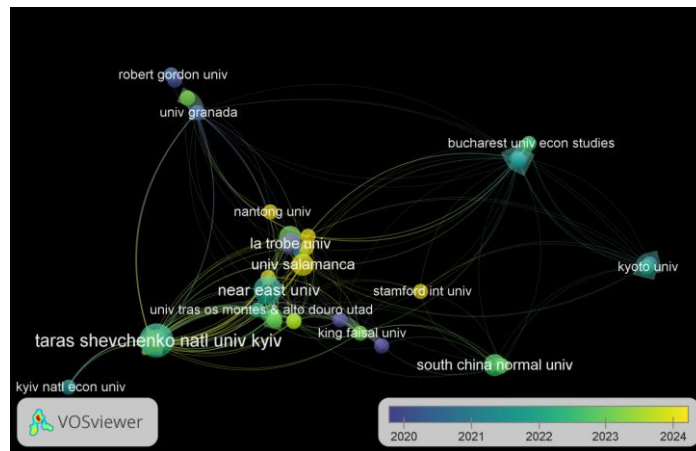


Figure 6. The collaboration network between the organizations between the years 2020-2024

Source: Authors’ own research, based on data extracted from Wos

The collaborative network between academic institutions illustrated in Figure 6 provides a complex overview of global research efforts on the role of artificial intelligence in education. Since there is a relatively low number of researches between the years 2003-2019, we will pay more attention to institutions active in the period 2020-2024. 465 educational institutions were identified, of which 34 met the collaboration condition of at least 2 links. These 34 institutions were subsequently grouped into 11 large clusters, the largest comprising 11 items with La Trobe University in Australia at the centre. The peak of research activity on this topic in 2024 has as its central institution the University of Salamanca (Spain) which benefits from an extensive collaboration network with top universities such as Stamford University or Kyoto University. Based on the existing networks between these academic institutions, we can observe a growing interest, especially in the last 4 years, within academic institutions around the world in exploring the benefits of artificial intelligence in making education more efficient. Among the closest partners of the previously mentioned institutions, we also mention two presences from the Romanian academic environment: Spiru Haret University and The Bucharest University of Economic Studies.

Table 6. The most prolific universities

University	Country	Number of articles	Citations
Taras Shevchenko National Unyversity of Kyiv	UKRAINE	5	23
Near East University	TURKEY	4	30
La Trobe University	AUSTRALIA	3	152
South China University of Technology	CHINA	3	11
Tecnológico de Monterrey	MEXICO	3	4
University of Salamanca	SPAIN	3	9
Spiru Haret University	ROMANIA	2	100
University Business Academy in Novi Sad	SERBIA	2	100
The Bucharest University of Economic Studies	ROMANIA	2	81

Source: Authors’ own research, based on data extracted from WoS

The attention given to the topics related to the opportunities and challenges of integrating AI in education by renowned universities in Australia, the USA (Stanford University) and UK(Robert

Kuleto's (2021) research posits that artificial intelligence and machine learning can enhance personalized learning through the use of new technologies in education. They can also contribute to increasing the degree of interactivity, of the requirement for motivation and enthusiasm and the desire for experimentation and simulation. Among the benefits of these cutting-edge technologies in the process of presenting information and acquiring knowledge, we can mention the exploration through artificial intelligence of virtual reality and augmented reality, aspects that can impact the quality of the educational act.

Developing engaging mechanisms for third parties involved in education can enhance the potential of beneficiaries and broaden the scope of knowledge exploration. It is crucial that the emotional responses of users remain balanced and rational, staying within acceptable limits as we consider future research and the advancement of educational practices. While emotions play a vital role in learning within technology-driven environments (Li et al., 2023), current AI applications often lack emotional depth and have limited ability to connect with users on an emotional level. For instance, flow theory (Csikszentmihalyi, 1990) presents a promising framework for guiding future research on AI in education (AIED) applications, particularly in preschool settings. Flow is characterized by a state of deep focus and enjoyment.

As we discuss development, research, and productivity enhancement, it is also essential to address ethical considerations, which represent a significant area for future inquiry. Looking ahead, researchers stress the need for greater ethical considerations. The growing integration of AI technologies in education raises various risks and ethical dilemmas, including concerns about personal data privacy, algorithmic biases, and the autonomy of both students and teachers (Akgun & Greenhow, 2022; Du Boulay, 2023). For example, the analysis of learning data can lead to aggressive personal data collection practices. Beneficiaries may acquire knowledge from tools like ChatGPT or other AI models, while educators might become overly reliant on analytical results for decision-making, which can create challenges that necessitate additional support (Du Boulay, 2023). Moreover, it has been noted that AI-based translation tools often perpetuate gender stereotypes when translating texts from languages that do not specify gender. Consequently, machine learning algorithms used in AIED assessment applications may similarly reinforce such biases.

Based on the networks formed between the keywords used by the authors, five thematic areas that may be of interest for future research were identified. First, the role of human experts is indispensable because AI still lacks nuance, context, and common sense. Therefore, optimal ways for GenAI tools to be used together with human experts modifying and approving learning materials generated by GenAI must be identified in the near future (Giannakos et al., 2024).

A second area concerns the use of AI tools to increase the yield and productivity of learning (Prather et al., 2023). This will require long-term tests and evaluations of the impact of GenAI use on student learning to clarify under what circumstances student learning outcomes and competencies are affected over time.

The third area aims to design technology to create new content, but also to make predictions, to provide feedback and personalized recommendations to learners.

The fourth area identified for future research concerns the establishment of a policy framework by developing guidelines, regulations and laws to govern GenAI tools in education. In this regard, future work should explore how the use of GenAI tools could affect justice, equity, diversity and inclusion in education, as well as the potential impact on vulnerable, marginalized and disadvantaged.

The fifth future trend will focus on developing the skills needed to use and objectively evaluate GenAI technologies. Therefore, further research will be needed to identify the new competencies required for teaching and learning with GenAI tools.

Although Artificial Intelligence can generate many innovations in education, significant risks should not be overlooked, especially in terms of academic cheating and plagiarism. Thus, students

can use various AI tools to gain advantages in terms of assessment such as generating Essays, solving problems in mathematics or physics, using paraphrasing and translation tools or even generating fake data and presenting it as real (Dien, 2023). From this perspective, the use of AI tools for cheating generates negative consequences for students by undermining the educational process, degrading the quality of education, and even damaging the integrity of academic institutions (Xie et al., 2023). To minimize these risks, education is trying to adapt by using certain plagiarism detection software (Copyleaks and ZeroGPT) but also by developing new assessment methods: oral exams or personalized assignments, promoting originality and creativity (Cotton et al., 2023). Another important factor in the responsible use of AI by students is their awareness of the importance of academic integrity by highlighting honest academic practices, promoting originality and critical thinking.

To improve the educational process with the help of AI, one of the major challenges will be to develop effective strategies for promoting academic integrity and the responsible use of technology. Most of the papers reviewed in this study present the opportunities and challenges of using ChatGPT in education but also consider the difficulties of detecting and preventing plagiarism, as well as ensuring the ethical and responsible use of these tools.

6. CONCLUSION

This in-depth topic-based bibliometric study traces current advances in educational management using artificial intelligence in the first two decades of the 21st century. Social network analysis, by visualizing scientific collaboration, also reveals an invisible collaboration network of countries /regions and institutions participating in AIEd research, intuitively helping to show collaborative relationships and potential scientific collaborators (Chen et al., 2022). In addition, topic modeling, capable of extracting themes from large-scale textual data, helps to understand the scientific structure of past and present AIEs (Roberts et al., 2014). dynamics of the subject. The network of ad plus keywords and keywords used by the authors highlighted the complexity and interdisciplinary nature of the subject. At the same time, based on the items used by the keyword clusters, research foci were identified as well as perspectives on the future directions of educational management in relation to artificial intelligence (Chen et al., 2022). Thus, the main authors presented in chapter 2 regarding the literature review, but also the researches of the most prolific or influential authors in the field, have outlined the opportunities and risks that loom over education by intersecting with AI tools. Among these we note the benefits related to personalized learning and the design of the educational system with greater generalization. However, it should not be neglected that as educational institutions implement these technologies, ethical implications will arise so that AI ensures inclusion and equity in education, but also aspects related to data protection and objective verification of information. Certainly educational management will be visibly shaped by how effectively these challenges are managed while harnessing the advantages and opportunities of AI. The conclusions of theoretical and applied studies converge on the fact that educational institutions must embrace these technologies and adapt new training and teaching methods to meet the expectations of new generations.

This paper provides information on the main existing studies related to the use of artificial intelligence in education. The studies analyzed in this paper, as well as the existing relationships between various authors, institutions or keywords, highlight the importance of the topic worldwide but also the numerous efforts to understand the benefits and risks that technology brings to education. Regarding the implications for educational management, the research emphasizes the need to develop policies or strategies that promote an efficient, assumed and responsible use of artificial intelligence in the education system.

Limitations: Although the research attempts to encompass the evolution of education under the impact of artificial intelligence worldwide, it only uses the Web of Science database, requiring future bibliometric research that addresses other databases, such as Scopus, Jstor, Science Direct, SpringerLink, etc. Also, although studies are numerous and growing in recent years, there is still a small number of practical or applied research, most of which are theoretical approaches, which requires market studies and impact analyses on the effects of artificial intelligence on education in both the short and long term.

Therefore, we can say that the integration of AI in education is still in its infancy and future quantitative and qualitative research will provide more information about the implications of using AI in education.

ACKNOWLEDGEMENT

This study was carried out at the Doctoral School of Management at the Bucharest University of Economic Studies.

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