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Social Structure and Citation Patterns in the Journal of Education and Information Technologies

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ABSTRACT

Objective: The Education and Information Technologies (EAIT) journal is a leading journal in the field of educational technology, providing a platform for researchers to share their work and educators to stay informed about advancements in the field. This bibliometric study aims to investigate the social structure and citation patterns within the EAIT journal, identifying key collaborators, influential research areas, and factors impacting article citation.

Methods: This paper conducts a bibliometric analysis of the EAIT journal based on the Scopus citation database. It explores and visualizes collaboration networks among authors, institutions, countries, and regions. Additionally, the study investigates the impact of document characteristics on citation counts. The data were collected from Scopus. The search was limited to documents indexed in the EAIT journal. This data was exported in a bibliographic format (.bib) and subsequently processed using appropriate software.

Results: The results unveil the journal's impact, identify opportunities for collaboration, and pinpoint emerging research areas and trends. Additionally, we propose strategies to maximize publication impact. The implications of the journal's social structure and citation patterns for publishing research in educational technologies are also discussed.

Conclusion: This study unveils the complex interplay of authors, institutions, and research themes within the EAIT journal. By examining collaboration patterns and citation metrics, we identify key players, emerging trends, and factors influencing research impact. Our findings offer valuable insights for researchers seeking to enhance their visibility and contribution to the field. While focused on a single journal, this research provides a foundation for understanding the broader educational technology landscape and informs future research endeavors.

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Introduction

In recent years, there has been an increasing interest in utilizing technology to improve teaching and learning methods. Various studies, such as Banda and Nzabahimana's (2023) investigation into the effects of PhET interactive simulation-based learning on motivation and academic performance among Malawian physics students, and Adıgüzel, Kaya, and Cansu's (2023) study on the transformative potential of ChatGPT in education, highlight the expanding research on technology's impact in the educational sector. Additionally, other studies by Zhukova et al. (2023), Cavanagh and Kiersch (2023), Rintaningrum (2023), Li et al. (2024), and Amores-Valencia et al. (2023) have enriched the understanding of how technology can be leveraged in education to improve teaching and learning outcomes.

Given this landscape, the journal of *Education and Information Technologies* (EAIT) provides an essential platform for researchers and educators to exchange and stay updated on the latest developments in educational technology. EAIT, a peer-reviewed journal published by Springer, addresses the intersection of education and technology, covering topics such as educational multimedia software design, technology integration in classrooms, online learning, digital learning environments, E-learning, and Library and Information Sciences. Since its inception in 1996, the journal has become a leading publication in the field of educational technology. Indexed in major citation databases such as Web of Science and Scopus, EAIT is readily accessible to researchers, educators, and practitioners in the educational technology sector.

Over time, EAIT has developed a strong academic reputation with steady growth in education and information technology. By 2020, it was ranked Q1 in Education, E-learning, and Library and Information Sciences, and in 2023, it achieved an impact factor of 4.8. To advance further, more focus on evaluation research and bibliometric analysis is required.

Bibliometric analysis has become a vital tool for the assessment and evaluation of academic research output (Godin, 2006). Its popularity has grown among researchers who seek to analyze previously published research works, as it provides valuable insights into the performance of specific journals (Ninkov et al., 2022). By utilizing a citation-based research approach, bibliometric analysis offers a comprehensive understanding of publication performance within a specified time frame (van Raan, 2014). It provides objective and reliable metrics to evaluate research output, impact, and visibility. Collaborative analysis examines the social structure and collaborative network of authors, institutions and countries and regions in a research field or a journal (Kumar, 2015). This information helps researchers identify potential collaborators in their field. These studies offer a quantitative analysis of publications, citations, authors, and collaborations, enabling researchers to gain a comprehensive understanding of the research landscape (van Raan, 2019). In recent years, the application of bibliometric analysis has gained

prominence in the academic community, facilitating the examination of scholarly journals and providing valuable insights into their publication trends and impact.

The increasing number of publications in bibliometric analysis of journals indicates the need for and importance of assessing the research outputs and outcomes of journals. Bibliometric analysis can also reveal the visibility and influence of journals within both the academic community and the public.

Several bibliometric studies have been conducted in the field of educational technologies and information processing in education. Mustapha et al. (2021) examined the effectiveness of digital technology in education during the COVID-19 pandemic. Donmus Kaya (2022) focused on the use of Web 2.0 tools in educational research. Chen et al. (2023) visualized trends in computational thinking research. Rojas-Sánchez et al. (2023) conducted a systematic review and bibliometric analysis on virtual reality (VR) in education. Hincapie et al. (2021) explored the educational applications of augmented reality. Kushairi and Ahmi (2021) analyzed the flipped classroom approach. Abuhassna et al. (2023) studied the trends of using the Technology Acceptance Model (TAM) for online learning. Gupta et al. (2022) conducted a bibliometric analysis on TAM. Zhang et al. (2022) examined literature on online learning in higher education during the pandemic. Goksu (2021) mapped mobile learning research. Khan and Gupta (2022) focused on mobile learning in the education sector. Schöbel et al. (2021) studied game concepts in digital learning environments.

In this regard Chen et al. (2019) conducted a bibliometric analysis focusing on the top-ranked journal on educational technology over the past 40 years. They explored research topics, author profiles, and collaboration networks within the field. Chen, Zou, and Xie (2020) took a topic modeling-based bibliometric perspective to examine the *British Journal of Educational Technology* and its content over a span of fifty years. Tatnall and Fluck (2022) reflected on the past and future of the Education and the Information Technologies journal, discussing its contributions to the field. Ozyurt and Ayaz (2022) employed a topic modeling-based bibliometric analysis to gain insights into EAIT over a period of twenty-five years. Additionally, Al Mamun et al. (2021 & 2022) contributed to the field with their articles on flipped learning in engineering education and the identification and evaluation of technology trends in K-12 education. In addition, Dao et al. (2021) conducted a bibliometric analysis of Research on Education 4.0 during the 2017–2021 period, highlighting the current state of research in this area. Furthermore, Bardakci et al. (2022) explored collaborations, concepts, and citations in educational technology, providing a trend study through bibliographic mapping.

This study aims to surpass previous studies, such as Tatnall and Fluck (2022) and Ozyurt and Ayaz (2022), that examined the topical coverage of the EAIT for its 25th anniversary, by focusing on the social structure of the journal. The social structure reveals the scientific

collaboration networks of authors, institutions, and countries and regions, which can identify the key actors, topics, and relationships in the scientific community, as well as the gaps and opportunities for collaboration and future research. The aim of this bibliometric study is to provide a comprehensive analysis of the EAIT and its publications. Through the analysis of various aspects, including the social structure and citations predictions of the journal, we aim to achieve the following objectives:

1. Explore collaboration networks among authors, organizations, and countries: By examining collaboration networks, we can identify research trends, collaboration patterns, and the impact of published articles. This analysis will shed light on the global nature of research in the field and highlight potential areas for collaboration and future research endeavors.
2. Investigate the impact of document characteristics on citation counts: By analyzing document characteristics such as document types, access, and authorship numbers, we aim to understand their influence on citation rates. This analysis will provide actionable strategies for researchers to maximize the impact of their work.

Overall, this study aims to contribute to the existing knowledge on the EAIT and provide valuable insights for researchers, academics, and educators working in the field of educational technology. The findings will facilitate a better understanding of the collaboration opportunities, and factors that influence the impact of published articles.

Materials and Methods

1. Data Source and Search Method

We used the Scopus database to extract the bibliographic data of EAIT, which covers the journal from 1996 to 2023. The Web of Science database only covers the journal since 2018. Our search strategy involved searching the ISSN field for the ISSN number of EAIT.

2. Data Extraction

We downloaded the bibliographic data of 3171 EAIT publications from Scopus in CSV format. We prepared the data by checking and correcting the variations in the names of institutions and authors such as different spellings. We used Microsoft Excel 2016, VOSviewer version 1.6.19.0, SPSS version 27, SPSS Modeler (Clementine) version 18.0 and Tableau Public to store and analyze the data. We reported the citation counts and descriptive statistics of document type. We also analyzed and reported the number of publications, citation counts, average citation per publication, average normalized citations, and H-index for countries, institutions, and authors in EAIT. Finally, we extracted the pattern of the impact of five independent variables, namely document type, author counts, research funding, access type, and international collaboration, on the citation counts of the publications.

3. Data Analysis

We performed a bibliometric analysis of EAIT using various software tools and methods. We extracted the information related to the document types, H-index, and publication age from Excel format. We used VOSviewer software and CSV file to draw the collaboration network of countries, institutions, and authors. VOSviewer is a free Java software that can map the scientific networks and structures of a collection of publications. We also obtained the bibliographic information, such as the number publications, citation counts, average citations, and average normalized citations, from the output of VOSviewer. We used SPSS and IBM SPSS modeler software (Clementine) and CHAID algorithm to discover the pattern of citations in EAIT. IBM SPSS Modeler is a data mining and text analytics software application from IBM. It is used to build predictive models and conduct other analytic tasks. CHAID algorithm is a data-mining algorithm that can analyze the patterns, differences, and relationships between a response variable (dependent variable) and one or more predictor variables (independent variables). This algorithm can reveal more complex relationships between variables and is often used on smaller, grouped, and tree-structured data. We used Tableau Public software to draw the geographical map of active countries/regions in the world in EAIT publications. Tableau Public is a free software that can create interactive data visualizations and share them online.

Results

1. Document type

EAIT has published a total of 3,171 documents between 1996 and July 2023 in the Scopus citation database. These documents have received a combined 53,555 citations, resulting in an average citation rate of 11.21 per publication. On an annual basis, each article receives an average of 2.50 citations. Among the various document types, articles make up the majority, accounting for 86.47 percent of the total publications. Notes, reviews, and conference papers exhibit a higher average citation rate. Notably, notes and reviews have the highest citation rate among all document types. Table 1 provides a comprehensive overview of the different document types along with their respective average citation rates.

Table 1. Document types in the EAIT

Document types	Publications		Citations	Average citations	Ave. citations per year
	Count	Percent			
Article	2,742	86.47	30,594	11.17	2.44
Review	224	7.06	3,690	16.55	4.59
Editorial	92	1.83	129	1.40	0.29
Erratum	51	1.42	9	0.18	0.07
Conference paper	45	1.10	737	16.38	0.88
Note	13	0.41	369	28.38	9.90
Retracted	4	0.13	27	6.75	3
Total	3171	100	35,555	11.21	2.50

2. Contributions of countries/regions to EAIT publications

Figure 3A depicts a geographical map illustrating the contributions from 115 countries/regions in publishing documents in the EAIT. Turkey and the United States (U.S.) ranked first and second, respectively, with 332 and 330 publications. China, Australia, and the United Kingdom (U.K.) followed with 265, 245, and 200 publications, respectively. The top 20 countries/regions with the highest number of publications were evaluated for their average citations, and Saudi Arabia, the Netherlands, Finland, the U.K., and Malaysia had the highest average citation per document (Figure 3B).

The collaboration network of 63 countries/regions with 10 or more publications is visualized in eight clusters, as demonstrated in Figure 3C. The size of the nodes illustrates the number of publications of each country/region, and the links between the nodes represent the collaboration between countries/regions. The U.S. exhibited the highest network density and total link strength, followed by the U.K., China, Australia, and Malaysia. Turkey ranked 7th in terms of total link strength, even after the United Arab Emirates, jointly with Saudi Arabia and Finland. The first cluster (red) involves the collaboration of 13 countries/regions from Europe, Asia, South America, and Oceania, centered on the U.K., Turkey, Greece, and India. The second cluster (green) comprises the collaboration of 12 countries/regions from North America, Oceania, East Asia, Europe, and East Africa centered on the U.S., Australia, the Netherlands, and Canada. The third cluster (blue) shows the collaboration of eight Western Asian, Northern European, and North African countries focused on Saudi Arabia, Germany, and France. The fourth cluster (yellow) includes the collaboration of six Southeast Asian countries/regions along with Qatar, with China and Hong Kong playing the biggest roles. The fifth cluster (purple) involves seven European and Asian countries/regions centered around Malaysia, Finland and Iran. The sixth cluster (turquoise) represents the collaboration between Spanish and Vietnamese authors with Colombia, Mexico, Chile, and Morocco. The seventh cluster comprises the collaboration between the U.S., Southwest Asian countries (Oman, Jordan, and Kuwait), and Eastern European countries (Russian Federation and Kazakhstan), with Oman and Jordan also playing important roles. Finally, the eight cluster (brown) involves Norway's collaboration with three African countries – Nigeria, South Africa, and Ghana.

Figure 3D shows the overlay visualization of countries/regions' publications over time by gradient colors (the closer to yellow means the nearer time of publication). Iraq, China, Mexico, Taiwan, Rwanda, South Africa, Palestine, Indonesia, Tunisia, Vietnam, and Turkey have been the most active countries/regions in publishing documents in the EAIT in recent years. Additionally, New Zealand, Italy, the U.K., the Netherlands, Denmark, Greece, Australia, Chile, Ireland, and France have a more extended history of publications in the EAIT.

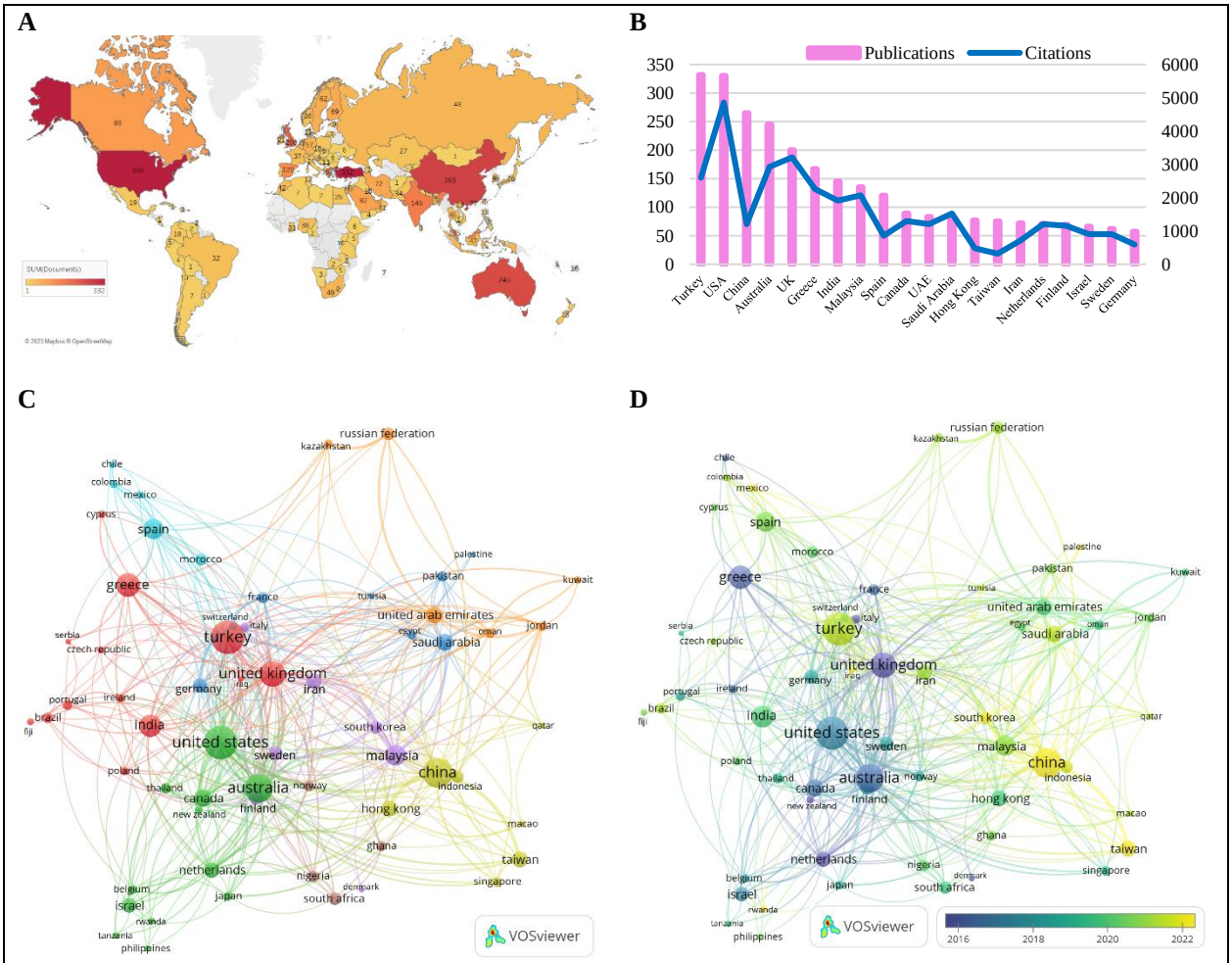

Figure 3. Contributions of different countries/regions to publications.

(A) Geographic map of contributor countries/regions.

(B) Histogram of top 20 countries/regions in terms of the number of publications and citations.

(C) Collaboration network visualization between countries/regions. (D) Overlay visualization map.

3. Analysis of institutional distribution

In EAIT, Victoria University from Australia emerges as the leading institution with 91 publications. Following that, Universiti Sains Malaysia with 29 publications, University of Macedonia and University of Patras from Greece with 26 publications each, and Universiti Teknologi Malaysia and University of Eastern Finland with 25 publications each occupy the subsequent ranks. Among the top 20 institutions, there are five universities from Greece, three universities from Malaysia and Hong Kong, two universities from China and Turkey, and one each from Australia, Finland, the U.S., Iran, and the Netherlands. Universiti Teknologi Malaysia, University of Crete, University of Patras, McGill University, and Universiti Malaya exhibit

higher average citation per publications (Figure 4A). A considerable number of institutions in EAIT either did not engage in collaboration with other institutions or had limited collaborative efforts. The density map in Figure 4B illustrates the distribution of significant institutions involved in EAIT publications. Despite the significant contributions of universities such as UAE University and Bar-Ilan University of Israel, their level of institutional collaboration remains small.

Figure 4C presents the collaboration network of 67 institutions with 10 or more publications, organized into seven clusters. The first cluster (red) comprises 12 universities from Turkey, and one university from the U.S. The second cluster (green) encompasses the collaboration of with Southeast Asian universities from Hong Kong, China, and Taiwan, with five, two, and one universities, respectively with universities from Australia (2 universities), the U.S. (one universities) and Canada (1 universities). The collaboration in this cluster is influenced by Hong Kong universities. The third cluster (blue) is influenced by Scandinavian universities, with four universities from Finland, two from Norway, and one from Sweden. Additionally, three universities from Malaysia, Indonesia, and the U.K. are also present in this cluster. The fourth cluster (yellow) consists of eight universities from Greece, along with one university each from the U.K. and Spain. The fifth cluster (purple) encompasses the collaboration of nine universities from seven countries, including two universities from the U.S. and the Netherlands, along with universities from Malaysia, Ghana, Belgium, Saudi Arabia, and Israel. The sixth cluster (turquoise) involves the collaboration of three universities from Malaysia, 2 universities from Iran, and one university each from Australia and Saudi Arabia. Lastly, the seventh cluster (orange) comprises six universities from Southeast Asian countries, namely China, Singapore, and Taiwan, with three, two, and one university respectively.

Historically, the seven universities from China and Taiwan in the second and seventh clusters represent the newest active institutions in EAIT. These emerging institutions include Beijing Normal University, National Taiwan University of Science and Technology, South China Normal University, Ministry of Education of China, Central China Normal University, East China Normal University, and National Taiwan Normal University, respectively. University of Twente, University of Birmingham, Deakin University, Aristotle University of Thessaloniki, and University North Dakota have the oldest publications in EAIT.

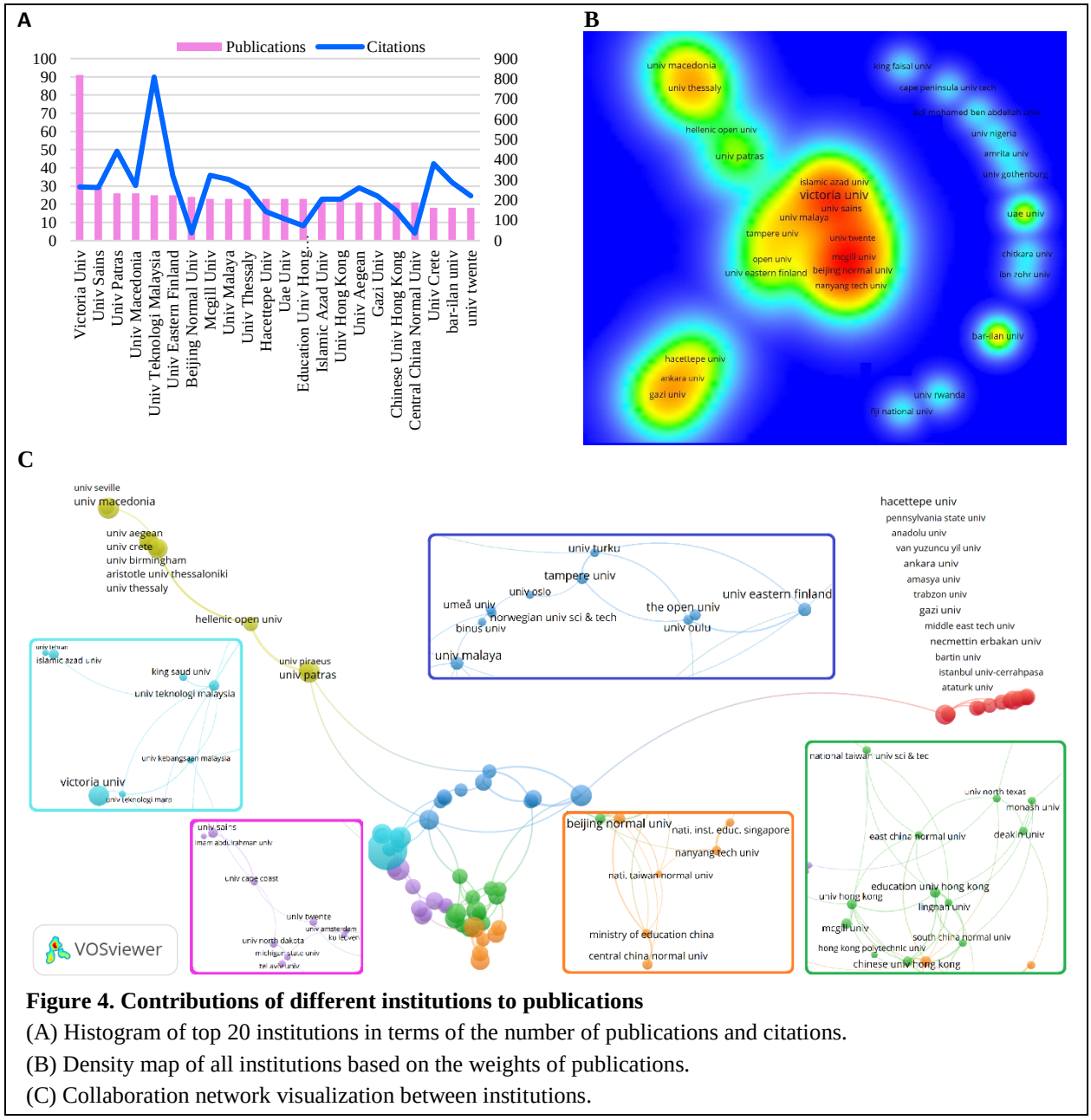

Figure 4. Contributions of different institutions to publications

(A) Histogram of top 20 institutions in terms of the number of publications and citations.

(B) Density map of all institutions based on the weights of publications.

(C) Collaboration network visualization between institutions.

4. Author collaboration network

Figure 5A depicts the co-authorship network of EAIT authors in 10 clusters. Out of 94 authors with five or more publications in EAIT, only 35 were included in the co-authorship network, while the rest were excluded due to either having no co-authored publications or belonging to clusters of less than three members.

The cluster 1 (red) consists of five authors from North America, 3 from McGill University, one from Simon Fraser University and another from Colorado Mesa University. They mainly research computer-based learning and analytics in higher education. The cluster 2 (green) comprises three authors from United Arab Emirates universities (The British University in Dubai, United Arab Emirates University and College of Information Technology) and one author from Sultan Qaboos University in Oman. They focus on information technology and e-learning in higher education.

The cluster 3 (blue) includes four authors from Hong Kong universities (3 authors from The Education University of Hong Kong and one author from Lingnan University), who investigate technology-enhanced learning and analytics and methods of bibliometric and systematic review.

The cluster 4 (yellow) consists of four authors from the University of Rwanda. They mainly research computer-based learning and assessment in chemistry education in Rwanda. The cluster 5 (pink) comprises three authors from Central China Normal University, one of whom is also affiliated with the State University of New York at Oswego. They focus on technology integration and teacher professional development. The cluster 6 (turquoise) includes three authors from Greek universities who work on machine learning and semantic technologies for enhancing learning pathways.

The cluster 7 (orange) consists of three authors from the University of Crete who research educational apps and mobile devices for early childhood education in Greece. The cluster 8 (brown) comprises three authors from University of North Dakota, University of Amsterdam and University of Cape Coast who work on ICT and pedagogy in mathematics education.

The cluster 9 (pink) includes two authors from Fiji National University and one author from University of the South Pacific from Fiji who work on different aspects of design, development, and evaluation of mobile learning applications. The cluster 10 (light red) consists of two authors from Guru Nanak Dev University and one author from Chitkara University who work on artificial intelligence and education policies.

The publications of the authors of clusters 8, 7, 2, and 1 were older than those of other clusters, respectively. The publications of the authors of clusters 4, 5, 3, and 10 were more recent than those of other clusters. Figure 5B depicts the density map of all 94 authors with five and more publications. Red color indicates higher degree and green color indicates lower degree of the authors. Arthur Tatnall, Shah Jahan Miah, and Stelios Xinogalos are three prolific authors of EAIT who did not appear in the co-authorship network due to lack of co-authored publications.

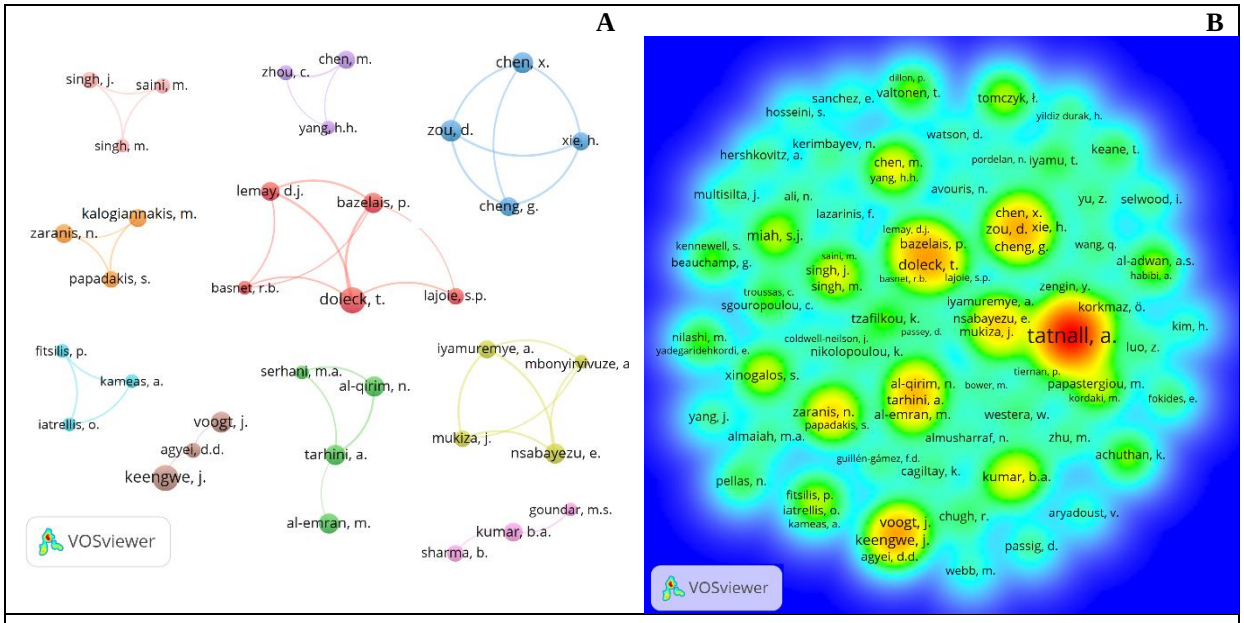

Figure 5. Visualization map of research authors
(A) Collaboration network visualization of authors.
(B) Density map of all authors based on the weights of publications.

Table 2 presents 18 authors with the highest number of publications of EAIT with nine or more publications. The publication year of these authors shows that they were more active in recent years. Arthur Tatnall is the most prolific author of EAIT by far. However, most of his publications (93.42 percent) are editorial and erratum, which result in a lower citation rate than others. Jared Keengwe and Tenzin Doleck tied for second place, with 17 publications each. Among the top 18 authors, Mostafa Al-Emran with 10 publications and an average citation of 47.6, Joke Voogt, with 11 publications and an average citation of 42.27 and Nicholas Zaranis with 9 publications and an average citation of 28.6 are ranked first to third in terms of citation. The last column shows the H-index of the authors. The H-index is a metric that measures both the productivity and citation impact of a researcher's publications. It is calculated by finding the largest number of publications that have been cited at least that many times. Jared Keengwe, Tenzin Doleck, and Mostafa Al-Emran are ranked first to third with 10, 9 and 8 respectively.

Table 2. Most prolific authors in *EAIT*

Rank*	Author	Affiliation**	Publications	Citations (Rank**)	Avg. Citations (Rank**)	H index (Rank**)
1	Tatnall, Arthur	Victoria University, Australia	75	105	1.38	6
2	Keengwe, Jared	University of North Dakota, the U.S.	17	375	22.06	10 (1)
	Doleck, Tenzin	Simon Fraser University, Canada	17	277	16.29	9 (2)
3	Miah, Shah Jahan	University of Newcastle, Australia	13	135	10.38	7
4	Zou, Di	Education University of Hong Kong	12	23	1.92	3
5	Voogt, Joke	University of Amsterdam, Netherlands	11	465	42.27 (2)	7
	Chen, Xieling	The Education University of Hong Kong	11	17	1.55	2
6	Al-Emran, Mostafa	British University in Dubai, United Arab Emirates	10	476	47.6 (1)	8 (3)
	Tarhini, Ali	Sultan Qaboos University, Oman	10	250	25	5
	Bazelais, Paul	John Abbott College, Canada	10	174	17.4	6
	Xinogalos, Stelios	University of Macedonia, Greece	10	142	14.2	7
	Al-Qirim, Nabeel	United Arab Emirates University	10	49	4.9	3
	Nsabayezu, Ezechiel	University of Rwanda	10	30	3	3
7	Zaranis, Nicholas	University of Crete, Greece	9	258	28.6 (3)	6
	Kumar, Bimal Aklesh	Fiji National University, Fiji	9	179	19.89	6
	Lemay, David John	McGill University, Canada	9	163	18.11	6
	tzafilkou, k.	University of Macedonia, Greece	9	82	9.11	6
	Cheng, Gary	The Education University of Hong Kong	9	19	2.11	3

*Rank Based on Publications count, and the tie publications has same rank.

**The last affiliation of the authors is considered.

**Rank based on 18 most frequently published authors.

5 The impact of document characteristics on citation counts

Previous studies on citation analysis have examined the effects of various factors, such as document type, access type, author counts, research funding, and international collaboration, on the citation counts of publications. In this study, we aim to investigate how these characteristics influence the citation counts of EAIT publications in relation to each other. We use the age of the publications as a control variable in the data-mining model and calculate the average citation per year for each publication. To dichotomize the citation variable according to the median of the data, we choose one citation per year for each publication as a criterion for dividing the publications into less-cited and highly-cited groups. That is, a publication is considered highly-cited if it receives one or more citations per year, and less-cited otherwise.

Figure 6A shows the predictor importance of each variable in the model. The three variables, author counts, access type, and document type, have an equal effect (33.3%) on the citation counts, while the other two variables are not significant. Figure 6B shows the decision tree and the pattern of variables affecting citations in EAIT. Based on the one citation per year, 42.82% of the publications are less-cited and 57.18% are highly-cited. The first-level predictor is document type, which indicates that articles, review, notes, and conference paper have a higher probability (59.49%) of being highly-cited than other types of documents. The second-level predictor is access type. Open access articles increase the likelihood of articles being highly-cited by about 7%. The third-level predictor is author counts. Articles with at least three authors increase the likelihood of non-open access articles being highly-cited by more than 8 percent compared to single-author and two-author articles.

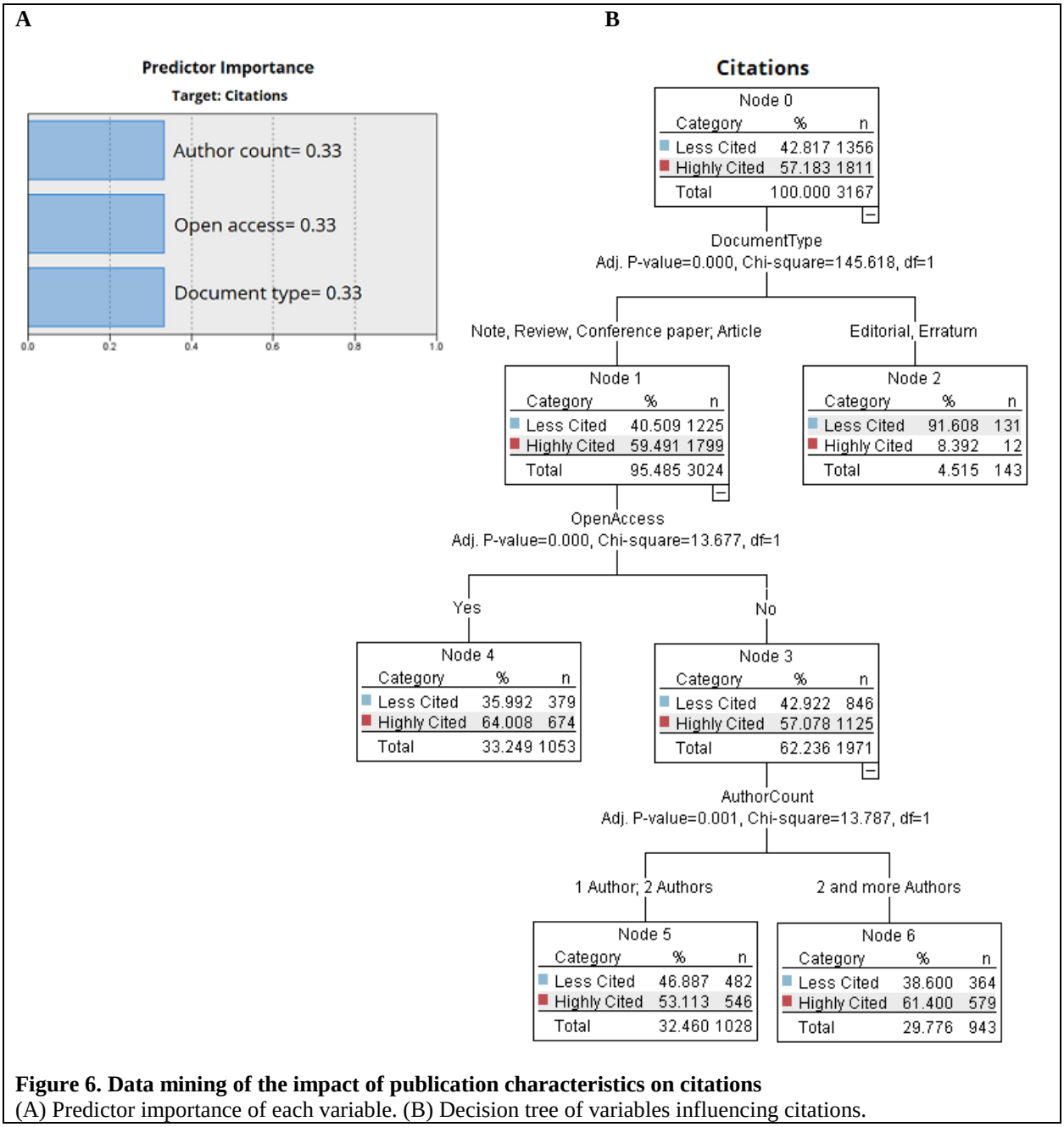

Figure 6. Data mining of the impact of publication characteristics on citations
(A) Predictor importance of each variable. (B) Decision tree of variables influencing citations.

Discussion

Our analysis of the document types in the EAIT reveals that research articles constitute more than 86 percent of the documents, with review articles being the second most prevalent type. Given the high average citation rate of reviews, their publication can be further increased compared to all types, provided that they meet the criteria of being high-quality reviews and consistently receive citations. The citation count in the EAIT is notably high, which justifies the

journal's placement in the first quartile of journal rankings in Web of Science and Scopus. Moreover, the average number of citations per year for notes is also high. However, the number of notes published in the journal is not substantial, comprising only 13 publications, 9 of which are specifically related to Covid-19. This signifies the researchers' inclination towards this type of publication.

Analysis of country and region participation reveals significant global involvement in the EAIT. The number of contributing countries and regions has grown from 97 in 2021 (Tatnall & Flucke, 2022) to 115 as of July 2023. This expansion signifies increasing interest and participation from diverse countries and regions. Notably, Turkey has experienced remarkable growth in publications, surpassing the U.S. for the top position. This aligns with predictions by Tatnall and Flucke (2022), and Ozyurt and Ayaz (2022), highlighting expanding Turkish research outputs. Similarly, China has demonstrated significant progress, ascending from 15th position in 2021 (Tatnall & Flucke, 2022) to third in July 2023. For research impact, Saudi Arabia, the Netherlands, Finland, the U.K., and Malaysia are the top-ranking countries by average citations per publication, providing evidence of high quality and influence. Compared to Ozyurt and Ayaz (2022), Saudi Arabia has undergone striking growth in average citation per publication over the past three years, further emphasizing research excellence. International collaboration plays a crucial role in advancing EAIT research. The U.S., the U.K., China, Australia, and Malaysia are core countries with high international collaboration. Despite significant publications, Turkey exhibits relatively lower international collaboration compared to output volume. The country collaboration network shows a complex, diverse structure with eight distinct clusters varying in size and composition. The U.S., the U.K., China, Australia, Malaysia, United Arab Emirates, Turkey, Finland, Saudi Arabia, and the Netherlands emerge as influential members, highlighting central roles in facilitating international ties. These clusters reveal intriguing cross-regional collaboration patterns, emphasizing the global collaborations in the EAIT. Overall, these findings illuminate the global landscape and countries and regions participation in the EAIT, underscoring the importance of collaboration in advancing knowledge.

The findings provide valuable insights into the institutional landscape contributing to the EAIT. Victoria University from Australia emerges as the leading institution with the highest number of publications, due in large part to the editorship of Arthur Tatnall. Compared to Ozyurt and Ayaz (2022), Universiti Sains Malaysia along with institutions from Malaysia, China, Hong Kong, Turkey, and Iran have undergone striking growth in publications count over the past three years. The top 20 institutions by publication count reflect prominent countries participating in the EAIT, including institutions from Greece, Malaysia, Hong Kong, China, Turkey, Australia, Finland, the U.S., Iran, and the Netherlands. While numerous institutions from various countries contribute to the EAIT, it is important to highlight that some institutions have either not engaged

in collaboration or have had limited collaborative efforts. The density map provides a visual representation of the distribution of significant institutions involved in EAIT publications, underscoring the need for increased collaboration within and between institutions. Analysis of the institutional collaboration network reveals patterns of collaboration among contributing institutions in EAIT publications. The involvement of institutions from diverse countries and regions contributes to the formation of a social structure within this collaboration network. Examination of the collaboration network indicates that institutions in the first and fourth clusters, associated with universities from Turkey and Greece, exhibit weaker and more limited collaboration. This highlights the necessity for Turkish and Greek institutions to establish stronger collaborations with other institutions to foster knowledge exchange and advancement in the field of educational technology and learning. Analysis of historical trends shows institutions from China and Taiwan in the second and seventh clusters represent the newest active participants in the EAIT. Their increasing contributions highlight the growing research participation from these regions.

The co-authorship network analysis provides valuable insights into the collaborative patterns and research foci of prolific authors in the EAIT. The network reveals a segmented structure comprising 10 distinct clusters. The small size of the network, with only 35 of the 94 productive authors included, indicates limited co-authorship overall. The clusters exhibit strong geographical and institutional concentrations, with authors from the same country or university frequently grouping together. This suggests that physical proximity and shared institutional environments play a key role in facilitating collaboration. Several clusters align with specialized research areas pursued by different author groups. For instance, Cluster 1 from North America focuses on learning analytics and computer-based learning. Cluster 2 from the UAE and Oman examines IT and e-learning in higher education. Cluster 3 from Hong Kong investigates technology-enhanced learning and bibliometrics. This demonstrates the value of co-authorship in enabling concentrated investigation within specific sub-topics. The density map further emphasizes that some highly productive EAIT authors like Arthur Tatnall, Shah Jahan Miah, and Stelios Xinogalos tend to publish independently without co-authors. While valuable in itself, solo authorship limits opportunities for complementary collaboration and knowledge sharing. Analysis of the timing of publications exhibits varying levels of recency among the clusters and authors. This provides insight into the changing landscape of contributors over time as new scholars enter the field. Examining authors by citation impact reveals differences in the broader influence of their work. While productivity in terms of volume is important, citation rates had better reflect research quality and significance. Compared to Ozyurt and Ayaz (2022) Di Zou, Xieling Chen, and Joke Voogt, researchers from the Education University of Hong Kong and the University of Amsterdam, have shown remarkable growth in their publications count over the past three years. Overall, analyzing this co-authorship network enhances our understanding of collaborative

activity in the EAIT and identifies potential avenues to strengthen cooperative ties and widen research perspectives. Targeted outreach to solo authors and bridging partnerships between clusters could enrich the scholarly community.

The analysis of document characteristics provides useful insights into the factors affecting citation counts for EAIT publications. Of the variables examined, document type, access type, and author counts emerged as having the strongest effect in the predictive model. The identification of document type as the first level influential factor highlights that specific document categories like articles, reviews, notes, and conference papers have substantially higher prospects of accruing citations compared to other types. This effect may be attributable to the perceived quality, relevance and wider readership associated with these manuscript categories within the EAIT research community. Open access was found to further increase the citation likelihood for articles by 7 percent, underscoring the boost in visibility and access provided by making research outputs freely available. This finding reinforces the notion that open science practices can amplify the impact and reach of scholarly work. Finally, a higher author counts also emerged as a positive indicator of citation potential, especially for non-open access articles. Having three or more authors increased the citation probability for such articles by over 8 percent compared to solo or dual-authored works. This suggests that collaborative publications tend to generate greater engagement, possibly due to integrating diverse expertise. While factors like funding and international status did not manifest significant effects in this dataset, the identified variables still provide useful insights into potential strategies researchers can adopt to maximize the impact of EAIT publications. Depending on resource limitations, pursuing open access, collaborative publications, and strategic manuscript categories could help amplify scholarly influence. Further analysis of additional variables and disciplinary sub-contexts may reveal other actionable patterns.

Conclusion

The Education and Information Technologies (EAIT) journal stands as a cornerstone in the field of educational technology. Established as a platform for researchers, educators, and policymakers, EAIT provides a comprehensive forum to explore the complex interplay between information and communication technologies (ICT) and education. From the micro-level of classroom applications to the macro-scale of national educational policies, the journal delves into a broad spectrum of topics, fostering critical dialogue and knowledge sharing within the community. As the official journal of the International Federation for Information Processing (IFIP) Technical Committee on Education, EAIT has solidified its position as a leading authority in the field, consistently publishing high-quality research that informs both theory and practice.

This bibliometric analysis focuses on the social structure and citations predictions of the EAIT and provides valuable insights into the publication and citation patterns, global and institutional collaboration, authorship collaboration and factors influencing impact. The findings reveal a multidisciplinary, globally collaborative field experiencing dynamic evolutions in response to educational contexts, e-learning, and emerging technologies. Document types, access, and authorship numbers significantly influence citation rates, providing actionable strategies for maximizing impact. The analysis of participations and collaborations highlights leading countries, institutions, and authors as well as opportunities for enhanced connectivity. Together, these quantitative insights help map the social structure of the EAIT research domain. While limited to one journal, this analysis establishes a knowledge baseline and models analytic techniques applicable to other learning technology publications. Additional research across broader sources can further enrich understanding of this dynamic, socially-shaped field.

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All authors contributed equally to the conceptualization of the article and writing of the original and subsequent drafts.

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Ethical considerations

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Conflict of interest

The authors declare no conflict of interest.

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