Twenty-five years of education and information technologies: Insights from a topic modeling based bibliometric analysis

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Abstract
Education and Information Technologies (EAIT) has been a leading journal in education & educational research since 1996. To celebrate its 25th anniversary and provide a comprehensive overview of the field, a topic modeling-based bibliometric analysis was conducted on the articles published in this journal. The study is constructed upon two methods, bibliometric analysis, and topic modeling. The study aims to find out the trends in publications and citations, prominent countries, affiliations and the status of authors, the prominent topics, and the thematic characteristics of these topics, as well as research interests and trends. The results show that the articles are grouped under the 21 topics. The top five most studied of them have been determined as "Technology acceptance", "Social network-based learning", "Teacher education", "Satisfaction of e-learning" and "E-learning". Finally, the acceleration results of each topic within itself and compared to other topics show that the most accelerated topic is "Gamification", while the most accelerated topic compared to other topics has been determined as "Technology acceptance". The general results of the study shed light on future studies in terms of determining the research interests and trends of publications in the field of educational technologies, EAIT.

Keywords Topic modeling · Bibliometric analysis · Research themes and trends
1 Introduction

The Journal of Education and Information Technologies (EAIT) provides a platform for a wide range of discussions and issues in Computing Education, as well as the various applications of information and communication technology (ICT) in a variety of educational subjects and sectors. EAIT is the official journal of the International Federation for Information Processing’s (IFIP) Technical Committee on Education, published in collaboration with UNESCO. EAIT publishes research articles focusing mainly on the use of information and communication technologies in education and training processes. The editor of the journal is Arthur Tatnall from Victoria University. In its classification made in 2020, Scimago has shown EAIT among the 250 most effective resources in the education category (Scimago, 2021). According to the Google Scholar metrics for 2021, its h5 index value is 52, and thus it ranks fifth among the 20 prominent journals in the field of educational technologies (Google Scholar, 2021). It is indexed in almost all major databases, including Web of Science and Scopus. The journal has an impact factor of 2,917 in the Web of Science Journal Citation Reports.

Many journals around the world have adopted the bibliometric review of a particular journal’s publications specifically to celebrate an event (Chen et al., 2020; Donthu et al., 2020; Gaviria-Marin et al., 2018; Kumar et al., 2021; Singh et al., 2020). Bibliometrics provides a structured analysis of new information, conceptual developments, the dense volume of data and broad knowledge. It is also a useful discipline used to reveal trends over time and identify the most influential authors and affiliations (Aria & Cuccurullo, 2017). Bibliometric analysis is considered an important tool for assessment and evaluation of academic research outcomes (Bardakci et al., 2021; Kushairi & Ahmi, 2021; Martínez et al., 2015; Song et al., 2019). Bibliometric analysis has also been used to examine changing perspectives, voices, and interpretations of theory, findings, and practice in a particular journal. For example, Cobo et al. (2015) in commemoration of the 25th Anniversary of Knowledge-Based Systems, a bibliometric analysis of the journal’s scientific article content between 1991 and 2014 was carried out to describe the journal’s conceptual evolution. With this study, some performance bibliometric indicators based on the citations of the articles in the journal, the h-index, the most cited authors/articles have been revealed. In another study, Merigó et al. (2019) bibliometric analysis of articles in the Soft Computing journal was made. The findings of the study showed that authors from around the world publish regularly in Soft Computing, and the journal has grown significantly in recent years and become one of the leading journals in this field.

Journals in the field of educational technology also celebrated their anniversary using methods such as bibliometric analysis, text/data mining, and topic modelling. Zawacki-Richter and Latchem, (2018), conducted content analysis using text mining on the abstracts and titles of 3674 full texts published in Computers & Education journal between 1976 and 2016. It revealed that it went through four distinct phases, reflecting major advances in educational technology and theories.
of media and learning. In another study, Chen et al., (2019) performed bibliometric analysis to identify research status and trends in educational technology using 3963 articles published in Computers & Education between 1978 and 2018. The results provided important insights into the journal’s research topics, author profiles, and collaborative networks. There are similar studies in the British Journal of Educational Technology – BJET, another prominent journal in the field of educational technology. Bond et al. (2019), conducted content and author analysis using the abstracts and titles of 1777 research articles published in BJET between 1970 and 2018. The findings of the study revealed important information about the common themes in the journal and the authorship status in the published articles. In another study, Chen et al. (2020) performed bibliometric analysis, word cloud analysis and topic modeling analysis of 3710 publications published in BJET between 1971 and 2018. With this study, the publication and citation trends in the journal, the distribution of publication types, the most relevant countries, affiliations, and authors, and finally the thematic features were revealed. The journal of Education and Information Technologies (EAIT), which has come to the fore among educational technologies recently, celebrated a quarter century. Tatnall and Fluck, (2022) used the Historical Research method to identify the topic trends of 1511 articles published in the EAIT journal between 1996 and 2020 and to question the cultural background of the authors. The findings of the study revealed that computer technology is developing rapidly, research methodologies, international collaborations and disciplinary fields are proliferating rapidly.

Although bibliometric analysis studies show the big picture of current research, they cannot provide in-depth insights about studies in the literature based on semantic content analysis (Gurcan, Cagiltay, et al., 2021; Gurcan, Ozyurt, et al., 2021). In this context, in order to carry out in-depth semantic analysis, it is necessary to support bibliometric analysis studies with analyzes using text-data mining methods (Hu et al., 2014). In accordance with this purpose, topic modeling is used effectively and widely (Gurcan & Cagiltay, 2020; Hu et al., 2014; Kang et al., 2019). The topic modeling approach makes it possible to automatically analyze large scientific corpuses containing many articles with a systematic method (Gurcan Cagiltay, & Cagiltay, 2021; Gurcan, Ozyurt, et al., 2021). In other words, topic modeling studies take bibliometric analysis studies one step further and enable more detailed analyzes to be made. Topic modeling analysis studies are considered as necessary and important studies to comprehensively reveal the themes, research interests and trends of studies in any field (Gurcan, et al., 2021a, 2021b; Kang et al., 2019).

As mentioned earlier, it is helpful to look at journals in a particular field of research to identify statements, theories, researches, and the tools in terms of this particular field of research (Zawacki-Richter & Latchem, 2018). Therefore, it is necessary to examine the evolutionary paths, views and explanations of theories, discoveries, and practices in leading journals in the field of educational technologies such as EAIT. The study is also important as it shows the current situation in the publications in the field of educational technologies as EAIT is located at the intersection of education and information communication technologies and is shown among the most influential journals in this field. As mentioned earlier, Tatnall and Fluck (2022) described how EAIT journal’s research interest and publications on
different topics in education and information technology have changed over the past twenty-five years. However, they performed word cloud analysis using only keywords to identify trends in the journal. In this context, the aim of this study inspired by the 25th anniversary of EAIT, is to reveal the performance analysis by determining the publication and citation trends of the journal, prominent authors, affiliations, and countries. In addition, it is aimed to reveal the prominent topics in the articles published in the journal and the conceptual evolution of these topics from the past to the present by using the topic modeling analysis. In this context, answers to the following research questions (RQ) have been sought:

RQ1: What is the trend of publications and citations in the journal by year?
RQ2: Which are the top contributing countries/regions, affiliations and authors?
RQ3: What are the prominent topics in the articles in the journal?
RQ4: How do the prominent topics in the articles in the journal change over time?

2 Method

This study is constructed upon bibliometric analysis and topic modeling. Bibliometrics is used to summarize published information as quantitative statistics, such as the rank of most productive researchers, geographic distribution of authors, rank of most productive affiliations, year of research, and increase in citations (Keshava et al., 2008). Bibliometric analyses allow to identify trends in the field by quantitatively evaluating some features of research in a particular field (Du et al., 2017). On the other hand, topic modeling is frequently used for a similar purpose (Gurcan & Cagiltay, 2020; Gurcan, Cagiltay, et al., 2021; Gurcan, Ozyurt, et al., 2021). Topic modeling is a stochastic method used to find out hidden semantic patterns on texts (Blei et al., 2003). Textual documents contain hidden semantic patterns called "topics", and each of these topics is defined by a probability distribution over a fixed set of words (Blei et al., 2003; Gurcan Cagiltay, & Cagiltay, 2021; Gurcan, Ozyurt, et al., 2021). Latent Dirichlet Allocation (LDA), a widely used model for topic modeling, is frequently used in text mining (Blei et al., 2003; De Mauro et al., 2018). There are topic modeling studies that determine the research interests and trends of articles in different fields with LDA (Chen et al., 2020; Gurcan & Cagiltay, 2020; Gurcan, et al., 2021a, 2021b; Gurcan, et al., 2021a, 2021b). In this context, topic modeling analysis with LDA has been successfully applied to reveal the research interests, tendencies and trends of a journal or a field (Chen et al., 2020). LDA was used in the scope of this study for the topic modeling of the articles published in the journal.

2.1 Data collecting

Scopus database was used to access the articles published in the EAIT journal. The articles in the journal were downloaded from Scopus on 16 November 2021 using the journal’s ISSN number information. At the first stage, all the documents in the
journal were listed with the search made on Scopus. Then, with the researchers’ preliminary review, it was considered appropriate to ignore the "Erratum", "Editorial" and "Retracted" type documents. All other document types were reviewed, and it was decided to include them as articles. As a result of these processes, a dataset containing a total of 1841 articles of the journal scanned in Scopus was created. All information regarding these articles has been downloaded and stored as csv file. This data set was used for bibliometric analysis. A subset of the titles, abstracts, and keywords of the articles in this dataset was used for topic modeling analysis.

2.2 Data analysis

First of all, scientific studies published in the journal were examined by the bibliometric analysis method to reveal the scientific changes and developments specific to the EAIT journal. In this direction, the count of publications and citations, the top contributing countries, affiliations, and authors were determined. There are many criteria to reveal performance analysis in bibliometrics. The count of publications and the count of citations are the most obvious criteria. While the count of publications is a measure of productivity, the count of citations is a measure of impact. The citations per publication and the h-index, which evaluate the count of publications and citations together, are measures used to measure the performance of research components. Performance analysis, although it is descriptive, draws attention to the importance of different components in a research field (Donthu et al., 2021).

Later, the corpus of EAIT journal was made ready for topic modeling analysis with LDA. For this, the processing steps known as data preprocessing in data-text mining and transforming the raw data into a clean dataset (Aggarwal & Zhai, 2013) were followed. First, the tokenization process was applied to separate the texts into simple words. All words were then converted to lowercase, and special characters and punctuation were eliminated. Then, nonsense words and stop words (a, an, is, the, of, for, etc.) were discarded. Finally, lemmatization was performed to obtain the stem of the words. After all these preprocessing steps, the final corpus was produced with the remaining words and LDA analysis was performed on this data set. The coherence value was considered in determining the appropriate count of topics in the LDA analysis. The optimum level of the consistency value is accepted as 0.7 (Blei et al., 2003) and the ideal count of topics is determined for the value closest it. In the study, the count of topics between 15 and 35 were tried, respectively, and the model with 21 topics was found to be ideal. In Fig. 1, the graph of coherence values produced between 15 and 35 topics is given.

3 Findings

3.1 Findings on the trend of publications and citations by year

The total count of publications from 1996 to 2021 which were reviewed is 1841. Figure 2 shows the EAIT publications from 1996 to 2021 and the trend line.
When Fig. 2 is analyzed, it is seen that the count of publications between 1996 and 2012 varies between 15 and 26 publications. Since 2013, the count of publications has noticeably increased. Especially in 2016 and 2021, a great leap is seen, and the count of publications has doubled. The increase of the journal, which published four issues a year until 2015, to six issues as of 2016 may explain this sudden increase in 2016. Moreover, the reason for the dramatic increase in 2021 may be that EAIT has recently been added to the Social Science Citation Index (SSCI) as “Education and Educational Research’s” category. With the increasing demand for the EAIT journal, even a low acceptance rate will lead to an increase in the count of publications. Tatnall and Fluck (2022) reported that EAIT received 2583 applications in 2021 and 252 studies were published (an acceptance rate of about 10%). Therefore, acceptance rate should be considered as an important metric in increases in publications.

**Fig. 1** Graph of coherence values obtained with the number of topic between 15 and 35

**Fig. 2** Distribution of Publications by Years
In addition, when the trend of publications is compared in general, it seems that there has been an increase in the trend since 2012. The citations per publication and the count of citations per publication from 1996 to 2021 are shown in Fig. 3.

When Fig. 3 is analyzed, it is seen that citations to research publications generally increased from 1996 to 2017, although the count of citations remained below 1000. However, citations exceeded 1000 in 2018 and continued to increase, with more than 5000 citations to publications in 2021. In terms of the count of citations per publication, there has been an increase since 1996, and it has the highest value in 2011. It has been determined that there has been a decrease in citations per publication since 2011. Trend analysis of the citation counts of EAIT publications shows the increasing impact of EAIT.

### 3.2 Analyses of countries/regions, affiliations, and authors

In total, 1841 publications were distributed among 111 countries/regions. Table 1 shows the 15 most influential countries in terms of h index, count of publications, count of citations, average count of citations per publication, and total link strength. Ranking is made according to total link strength values. Total link strength (TLS) shows the total strength of an item’s links to other items (Van Eck & Waltman, 2021).

According to Table 1, the USA (242), UK (185) and Greece (172) took the top three places in terms of total link strength. The USA took the top rank, contributing with 222 publications. Other countries contributing the most are Turkey and UK,
respectively. In addition, the USA and the UK were in the first two places in the h index, count of publications and citation indicators. However, in terms of citations per publication, the Netherlands had the highest value (14.07), it was followed by the UK (13.79) and the USA (13.46). 3242 affiliations contributed to the 1841 publications published in EAIT. Table 2 shows the 15 affiliations that contributed the most.

In total, 1841 publications were distributed among 1370 affiliations. As shown in Table 2, we identified the top 15 contributing affiliations. In terms of count of publications, the University of Patras (23), University of Macedonia (21) and University of Thessaly (21) in Greece ranked in the top three places. In terms of the h index, the University of Patras in Greece, the University of North Dakota in the USA and King’s College London in the UK stood out with 10 h indexes. In addition, King’s College London, University of Technology Malaysia, and University of North Dakota drew attention in terms of the count of citations and the average count of citations per publication, respectively. 3964 authors contributed to the 1841 publications published in EAIT. Table 3 shows the top 15 most contributing authors.

The authors with the highest count of publications and h index values are Jared Keengwe from University of North Dakota, Tenzin Doleck from Simon Fraser University and Paul Bazelaïs from John Abbott College, respectively. Jared Keengwe drew attention in terms of the count of citations. He was followed by Joke Voogt from the University of Amsterdam and Mostafa Al-Emran from the British University in Dubai, respectively. These authors also stood out in the average count of

| Country/Region               | 1996–2021 | 1996–2008 | 2009–2021 |
|------------------------------|-----------|-----------|-----------|
| TLS                          | H         | P (R)     | C (R)     |
| United States                | 242       | 26        | 222 (1)   |
|                              | 2988 (1)  | 13.46     | 31 (3)    |
|                              | 721 (2)   | 191 (1)   | 2267 (1)  |
| United Kingdom               | 185       | 25        | 156 (3)   |
|                              | 2151 (2)  | 13.79     | 61 (1)    |
|                              | 1266 (1)  | 95 (5)    | 885 (4)   |
| Greece                       | 172       | 19        | 137 (4)   |
|                              | 1238 (4)  | 9.04      | 22 (4)    |
|                              | 268 (4)   | 115 (3)   | 970 (3)   |
| Turkey                       | 153       | 14        | 173 (2)   |
|                              | 671 (9)   | 3.88      | 0         |
|                              | 0         | 173 (2)   | 671 (7)   |
| Australia                    | 146       | 20        | 122 (5)   |
|                              | 1607 (3)  | 13.17     | 33 (2)    |
|                              | 500 (3)   | 89 (6)    | 1107 (2)  |
| Malaysia                     | 138       | 15        | 72 (7)    |
|                              | 859 (5)   | 11.93     | 1 (10)    |
|                              | 500 (5)   | 71 (7)    | 854 (5)   |
| India                        | 116       | 16        | 99 (6)    |
|                              | 713 (8)   | 7.20      | 1 (10)    |
|                              | 0         | 98 (4)    | 713 (6)   |
| Sweden                       | 93        | 13        | 43 (12)   |
|                              | 457 (12)  | 10.63     | 5 (8)     |
|                              | 36 (8)    | 38 (12)   | 421 (12)  |
| United Arab Emirates         | 80        | 11        | 54 (9)    |
|                              | 394 (13)  | 7.30      | 1 (10)    |
|                              | 6 (10)    | 53 (9)    | 388 (13)  |
| Saudi Arabia                 | 77        | 9         | 42 (13)   |
|                              | 388 (14)  | 9.24      | 0         |
|                              | 0         | 42 (10)   | 388 (13)  |
| Netherlands                  | 71        | 15        | 54 (9)    |
|                              | 760 (6)   | 14.07     | 14 (5)    |
|                              | 167 (5)   | 40 (11)   | 593 (9)   |
| Canada                       | 70        | 15        | 69 (8)    |
|                              | 753 (7)   | 10.91     | 11 (6)    |
|                              | 120 (6)   | 58 (8)    | 633 (8)   |
| Finland                      | 69        | 12        | 49 (10)   |
|                              | 561 (10)  | 11.45     | 4 (9)     |
|                              | 20 (9)    | 45 (9)    | 541 (10)  |
| Israel                       | 63        | 12        | 48 (11)   |
|                              | 543 (11)  | 11.31     | 8 (7)     |
|                              | 110 (7)   | 40 (11)   | 433 (11)  |
| Oman                         | 61        | 9         | 22 (14)   |
|                              | 244 (15)  | 11.09     | 0         |
|                              | 0         | 22 (13)   | 244 (14)  |

Bold values were used to highlight those with noteworthy performance. Abbreviations: P, publication count; ACP, average citations per publication; C, citation count; TLS, total link strength; R, ranking position.
### Table 2  Top Contributing Affiliations

| Affiliations                      | 1996–2021 | 1996–2008 | 2009–2021 |
|----------------------------------|-----------|-----------|-----------|
|                                  | H  | P  | C  | ACP  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  | P  | C  |
| University of Patras             | 10 (1) | 23 (1) | 278 (4) | 12.09 | 7 (2) | 98 (3) | 16 (5) | 180 (6) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of Macedonia          | 7 (4)  | 21 (2) | 141 (13) | 6.71  | 1 (6)  | 4 (8)  | 20 (1) | 137 (10) | 6 (4) | 13 (7) | 17 (8) | 22 (9) | 19 (10) | 16 (11) | 17 (12) | 18 (13) | 19 (14) | 20 (15) | 21 (16) | 22 (17) | 23 (18) | 24 (19) | 25 (20) | 26 (21) | 27 (22) | 28 (23) | 29 (24) | 30 (25) | 31 (26) | 32 (27) | 33 (28) | 34 (29) | 35 (30) |
| University of Thessaly           | 9 (2)  | 21 (2) | 177 (9) | 8.43  | 3 (4)  | 49 (5) | 18 (3) | 128 (11) | 8 (3)  | 20 (3) | 175 (10) | 8.75  | 0    | 0    | 20 (1) | 175 (7) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| McGill University                | 8 (3)  | 20 (3) | 175 (10) | 8.75  | 0    | 0    | 20 (1) | 175 (7) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of Eastern Finland    | 8 (3)  | 19 (4) | 198 (7) | 10.42 | 0    | 0    | 19 (2) | 198 (4) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of the Aegean         | 7 (4)  | 18 (5) | 164 (12) | 9.11  | 1 (6)  | 4 (8)  | 17 (4) | 160 (9) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Victoria University              | 6 (5)  | 17 (6) | 101 (14) | 5.94  | 0    | 0    | 17 (4) | 101 (13) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of North Dakota       | 10 (1) | 17 (7) | 309 (3) | 18.18 | 0    | 0    | 17 (4) | 309 (2) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Bar-Ilan University              | 7 (4)  | 17 (7) | 217 (6) | 12.76 | 4 (3)  | 30 (6) | 13 (7) | 187 (5) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| King’s College London            | 10 (1) | 16 (8) | 667 (1) | 41.69 | 7 (2)  | 396 (1) | 9 (8)  | 271 (3) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| United Arab Emirates University  | 6 (5)  | 15 (9) | 58 (15) | 3.87  | 0    | 0    | 15 (6) | 58 (15) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Deakin University                | 7 (4)  | 15 (10) | 233 (5) | 15.53 | 7 (2)  | 131 (2) | 8 (9)  | 102 (12) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of Twente             | 8 (3)  | 15 (10) | 170 (11) | 11.33 | 8 (1)  | 78 (4)  | 7 (10) | 92 (14) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| University of Technology Malaysia| 9 (2)  | 15 (10) | 419 (2) | 27.93 | 0    | 0    | 15 (6) | 419 (1) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| Open University                  | 9 (2)  | 15 (10) | 185 (8) | 12.33 | 2 (5)  | 21 (7)  | 13 (7) | 164 (8) |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Bold values were used to highlight those with noteworthy performance. Abbreviations: P, publication count; ACP, average citations per publication; C, citation count; H, H-index

### Table 3  Top contributing authors

| Authors             | H  | Country/Region | Affiliations                      | 1996–2021 | 1996–2008 | 2009–2021 |
|---------------------|----|----------------|----------------------------------|-----------|-----------|-----------|
| Jared Keengwe       | 10 | USA            | University of North Dakota       | 17 (304) | 17.88     |           |
| Tenzin Doleck       | 8  | Canada         | Simon Fraser University          | 17 (157) | 11.21     |           |
| Paul Bazelaïs       | 6  | Canada         | John Abbott College             | 10 (101) | 10.1      |           |
| Shah J. Miah        | 4  | Australia      | Newcastle Business School        | 10 (45)  | 4.5       |           |
| David John Lemay    | 3  | Canada         | McGill University               | 9 (90)   | 10.00     |           |
| Stelios Xinogalos   | 5  | Greece         | University of Macedonia         | 9 (77)   | 8.55      |           |
| Nabeel Al-Qirim     | 3  | United Arab Emirates | United Arab Emirates University | 8 (30)  | 3.75      |           |
| Bimal Aklesh Kumar  | 4  | Fiji           | Fiji National University        | 8 (60)   | 7.50      |           |
| Marina Papastergiou | 5  | Greece         | University of Thessaly          | 8 (87)   | 10.88     |           |
| Nikolaos Pellas     | 6  | Greece         | University of Western Macedonia | 8 (95)  | 11.88     |           |
| Joke Voogt          | 5  | Netherlands    | University of Amsterdam         | 8 (296) | 37.00     |           |
| Mostafa Al-Emran    | 5  | United Arab Emirates | British University in Dubai     | 7 (177)  | 25.29     |           |
| Ali Tarhini         | 5  | Oman           | Sultan Qaboos University        | 7 (137)  | 19.57     |           |
| Katerina Tzafilikou | 3  | Greece         | University of Macedonia        | 7 (24)  | 3.43      |           |
| Nicholas Zaranis    | 4  | Greece         | University of Crete             | 7 (117)  | 16.71     |           |

Bold values were used to highlight those with noteworthy performance. Abbreviations: P, publication count; ACP, average citations per publication; C, citation count; H, H-index
citations per publication. Finally, it was noteworthy that 3 authors from Canada were among the top 5 most contributing authors.

### 3.3 Findings of topic modeling analysis

The results of the LDA-based topic modeling analysis to reveal the topics in the articles published in the EAIT journal are given in this section. As a result of the analysis, 21 topics were discovered. Percentage of each topic \( P_t \) was calculated by considering the count of publications \( n \) published on each topic. In Table 4, the topics, the first 15 of the terms that make up the topics, the count of publications on each topic and the rate of topics are given. In addition, Table 4 is listed according to the intensity level at which the topics are studied (count of publications).

As can be seen in Table 4, the most studied topic by authors in the publications in the EAIT journal is "Technology acceptance" \( (f = 20.6\%) \). This is followed by "Social network-based learning" \( (f = 18.1\%) \) and "Teacher education" \( (f = 10.4\%) \) respectively. In other words, these topics come to the fore in the first three ranks in terms of the count of publications. On the other hand, “Gamification” \( (0.2\%) \) draws attention as the least studied topic.

It is important to generate periods for trend analysis of publications in the EAIT journal. Therefore, considering that the first publication of the journal was in 1996, 5-year periods were considered appropriate. In this context, a total of 5 periods, the first period being 6 years and the others 5 years, have been generated. In Table 5, the distribution of the topics, the count and percentage publications on each topic in the relevant period is given.

As can be seen in Table 5, the topic of "Technology acceptance" is the most studied topic and the total count of publications on this topic is 379. The count of publications on this topic according to periods is 7, 4, 8, 35 and 325, respectively. When viewed as a percentage, it is seen that the count and rate of publications on this topic in the last period are 325 and 85.77\%, respectively. In other words, 85.77\% of 397 publications on this topic were made in the last period. Accordingly, similar reading can be done on a line-based basis for all topics.

The acceleration of the topics in the periods was also calculated with two different perspectives. The first perspective is the percentage given in the previous paragraph. That is, it is the percentage distribution of each topic in the relevant period. This value is expressed as \( P_{\text{topic, period}} \). Another percentage calculation is the percentage distribution of each topic in the relevant period compared to other topics. This is expressed as \( P_{\text{topic, i, topics}} \). For example, a total of 118 articles were published in the first period (1996–2001). While 7 of these articles are about “Technology acceptance”, the ratio of this count to the total count of articles in that period is 5.93\% (17/118). Similarly, this rate was obtained as 25.27\% in the last period (2017–2021) (325/1286). In this way, the ratio of each topic to other topics in each period was calculated in this way. In Table 6, the ratio of each topic in the periods and its ratio compared to other topics are given as percentage.

The acceleration of the topics in the periods was also calculated with two different perspectives. With the first perspective, the acceleration of each topic according to the
| Topic name                                      | Topic terms                                                                 | n   | $P_t$ (%) |
|------------------------------------------------|------------------------------------------------------------------------------|-----|-----------|
| Technology acceptance                          | technology, acceptance, adoption, learning, perceive, factor, structural, self-efficacy, usefulness, student, influence, university, behavioral, mobile, effect | 379 | 20.6      |
| Social network based learning                  | student, learning, social, mobile, online, engagement, performance, university, technology, higher, device, impact, networking, facebook, effect | 333 | 18.1      |
| Teacher education                              | ict, teacher, training, technology, information, implementation, policy, communication, university, integration, e-learning, support, factor, teaching, management | 192 | 10.4      |
| Satisfaction of e-learning                     | student, e-learning, factor, university, satisfaction, higher, quality, information, pandemic, covid-19, scale, utaut, data, success, attitude | 110 | 6.0       |
| E-learning                                     | online, technology, learning, teaching, covid-19, pandemic, information, student, faculty, development, higher, skill, university, challenge, factor | 107 | 5.8       |
| Web based learning                             | learning, web, website, network, student, design, library, social, framework, university, data, software, skill, www, information | 103 | 5.6       |
| Use of technology in pre-service teacher education | teacher, technology, pre-service, knowledge, flipped, tpack, mathematics, data, language, integration, programming, learning, student, teaching, classroom | 90  | 4.9       |
| Teacher digital competence                     | digital, teacher, technology, competence, literacy, learning, teaching, knowledge, social, skill, student, professional, development, challenge, attitude | 83  | 4.5       |
| Computer supported collaborative learning       | learning, student, knowledge, computer, collaborative, collaboration, concept, challenge, teaching, information, activity, design, map, environment, data | 80  | 4.3       |
| Game based learning                            | learning, student, game, learner, language, english, online, teaching, experimental, assessment, achievement, control, effect, activity, motivation | 76  | 4.1       |
| Technology enhanced learning environment       | learning, data, environment, learner, student, adaptive, mining, knowledge, e-learning, online, style, blended, design, content, information | 61  | 3.3       |
| Student digital competence                     | learning, student, knowledge, competency, literacy, framework, design, outcome, technology, environment, support, management, teaching, experience, pedagogical | 53  | 2.9       |
| Interactive whiteboards                        | tablet, iwb, knowledge, interactive, learning, whiteboards, video, learner, concept, structure, board, pupil, primary, attitude, technology | 41  | 2.2       |
| Higher education                               | student, learning, online, technology, teaching, higher, information, lecturer, university, internet, perception, special, access, assessment, instructor, | 35  | 1.9       |
| Topic name               | Topic terms                                                                 | n   | \(P_t\) (%) |
|-------------------------|------------------------------------------------------------------------------|-----|-------------|
| Virtual/augmented reality | virtual, learning, reality, student, teacher, video, online, environment, augmented, teaching, emotion, vr, technology, experience, emotional | 26  | 1.4         |
| Early child education   | child, reading, parent, writing, literacy, early, skill, comprehension, intervention, language, autism, young, age, student, adult | 23  | 1.2         |
| Computational thinking  | computer, student, teacher, information, thinking, development, teaching, technology, learning, software, computational, curriculum, practice, skill, secondary | 19  | 1.0         |
| Career support          | student, career, design, method, internet, learning, support, communication, instructional, university, experience, information, collaborative, effect, woman | 12  | 0.7         |
| Skill education         | learning, student, ict, technology, skill, teaching, knowledge, environment, learner, social, classroom, laboratory, distance, virtual, competence | 8   | 0.4         |
| Educational data mining | student, machine, performance, data, artificial, neural, algorithm, learning, prediction, intelligence, mining, ai, higher, predictive, predicting | 6   | 0.3         |
| Gamification            | gamification, student, environment, teacher, learning, design, classroom, team, data, gamified, management, element, principle, practice, training | 4   | 0.2         |
| Topic name                                         | Periods                      | 1996–2001 | 2002–2006 | 2007–2011 | 2012–2016 | 2017–2021 | Total |
|---------------------------------------------------|------------------------------|-----------|-----------|-----------|-----------|-----------|-------|
|                                                   |                              | n         | f         | n         | f         | n         | f     |       |
| Technology acceptance                            |                              | 7         | 1.85      | 4         | 1.06      | 8         | 2.11  | 35    | 9.23  | 325    | 85.75   | 379    | 20.6  |
| Social network based learning                     |                              | 12        | 3.60      | 11        | 3.30      | 12        | 3.60  | 44    | 13.21 | 254    | 76.28   | 333    | 18.1  |
| Teacher education                                |                              | 12        | 6.25      | 16        | 8.33      | 22        | 11.46 | 39    | 20.31 | 103    | 53.65   | 192    | 10.4  |
| Satisfaction of e-learning                        |                              | 5         | 4.55      | 6         | 5.45      | 3         | 2.73  | 18    | 16.36 | 78     | 70.91   | 110    | 6.0   |
| E-learning                                        |                              | 13        | 12.15     | 7         | 6.54      | 4         | 3.74  | 16    | 14.95 | 67     | 62.62   | 107    | 5.8   |
| Web based learning                                |                              | 17        | 16.50     | 5         | 4.85      | 7         | 6.80  | 15    | 14.56 | 59     | 57.28   | 103    | 5.6   |
| Use of technology in pre-service teacher education|                              | 1         | 1.11      | 3         | 3.33      | 1         | 1.11  | 14    | 15.56 | 71     | 78.89   | 90     | 4.9   |
| Teacher digital competence                        |                              | 2         | 2.41      | 3         | 3.61      | 6         | 7.23  | 15    | 18.07 | 57     | 68.67   | 83     | 4.5   |
| Computer supported collaborative learning          |                              | 8         | 10.00     | 6         | 7.50      | 8         | 10.00 | 5     | 6.25  | 53     | 66.25   | 80     | 4.3   |
| Game based learning                               |                              | 4         | 5.26      | 1         | 1.32      | 2         | 2.63  | 13    | 17.11 | 56     | 73.68   | 76     | 4.1   |
| Technology enhanced learning environment           |                              | 3         | 4.92      | 2         | 3.28      | 1         | 1.64  | 11    | 18.03 | 44     | 72.13   | 61     | 3.3   |
| Student digital competence                        |                              | 6         | 11.32     | 4         | 7.55      | 4         | 7.55  | 11    | 20.75 | 28     | 52.83   | 53     | 2.9   |
| Interactive whiteboards                           |                              | 4         | 9.76      | 0         | 0.00      | 5         | 12.20 | 7     | 17.07 | 25     | 60.98   | 41     | 2.2   |
| Higher education                                  |                              | 1         | 2.86      | 0         | 0.00      | 3         | 8.57  | 5     | 14.29 | 26     | 74.29   | 35     | 1.9   |
| Virtual/augmented reality                         |                              | 9         | 34.62     | 2         | 7.69      | 2         | 7.69  | 5     | 19.23 | 8      | 30.77   | 26     | 1.4   |
| Early child education                             |                              | 2         | 8.70      | 2         | 8.70      | 5         | 21.74 | 4     | 17.39 | 10     | 43.48   | 23     | 1.2   |
| Computational thinking                            |                              | 10        | 52.63     | 0         | 0.00      | 5         | 26.32 | 2     | 10.53 | 2      | 10.53   | 19     | 1.0   |
| Career support                                    |                              | 2         | 16.67     | 0         | 0.00      | 1         | 8.33  | 1     | 8.33  | 8      | 66.67   | 12     | 0.7   |
| Skill education                                   |                              | 0         | 0.00      | 1         | 12.50     | 1         | 12.50 | 2     | 25.00 | 4      | 50.00   | 8      | 0.4   |
| Educational data mining                           |                              | 0         | 0.00      | 0         | 0.00      | 2         | 33.33 | 0     | 0.00  | 4      | 66.67   | 6      | 0.3   |
| Gamification                                      |                              | 0         | 0.00      | 0         | 0.00      | 0         | 0.00  | 0     | 0.00  | 4      | 100.00  | 4      | 0.2   |
| Total                                             |                              | 118       | 6.41      | 73        | 3.97      | 102       | 5.54  | 262   | 14.23 | 1286   | 69.85   | 1841   | 100   |

Table 5  Information on topics and their distributions according to periods
Table 6  Percentages for each topic according to the periods within itself and according to other topics

| Topic name                                         | Periods                                                                 |
|----------------------------------------------------|-------------------------------------------------------------------------|
|                                                    | 1996–2001 | 2002–2006 | 2007–2011 | 2012–2016 | 2017–2021 |
| Technology acceptance                              | 1.85      | 1.06      | 2.11      | 9.23      | 85.75     |
|                                                    | 5.93      | 5.48      | 7.84      | 13.36     | 25.27     |
| Social network based learning                      | 3.60      | 3.30      | 3.60      | 13.21     | 76.28     |
|                                                    | 10.17     | 15.07     | 11.76     | 16.79     | 19.75     |
| Teacher education                                  | 6.25      | 8.33      | 11.46     | 20.31     | 53.65     |
|                                                    | 10.17     | 21.92     | 21.57     | 14.89     | 8.01      |
| Satisfaction of e-learning                         | 4.55      | 5.45      | 2.73      | 16.36     | 70.91     |
|                                                    | 4.24      | 8.22      | 2.94      | 6.87      | 6.07      |
| E-learning                                         | 12.15     | 6.54      | 3.74      | 14.95     | 62.62     |
|                                                    | 11.02     | 9.59      | 3.92      | 6.11      | 5.21      |
| Web based learning                                 | 16.50     | 4.85      | 6.80      | 14.56     | 57.28     |
|                                                    | 14.41     | 6.85      | 6.86      | 5.73      | 4.59      |
| Use of technology in pre-service teacher education | 1.11      | 3.33      | 1.11      | 15.56     | 78.89     |
|                                                    | 0.85      | 4.11      | 0.98      | 5.34      | 5.52      |
| Teacher digital competence                        | 2.41      | 3.61      | 7.23      | 18.07     | 68.67     |
|                                                    | 1.69      | 4.11      | 5.88      | 5.73      | 4.43      |
| Computer supported collaborative learning           | 10.00     | 7.50      | 10.00     | 6.25      | 66.25     |
|                                                    | 6.78      | 8.22      | 7.84      | 1.91      | 4.12      |
| Game based learning                                | 5.26      | 1.32      | 2.63      | 17.11     | 73.68     |
|                                                    | 3.39      | 1.37      | 1.96      | 4.96      | 4.35      |
| Technology enhanced learning environment            | 4.92      | 3.28      | 1.64      | 18.03     | 72.13     |
|                                                    | 2.54      | 2.74      | 0.98      | 4.20      | 3.42      |
| Student digital competence                         | 11.32     | 7.55      | 7.55      | 20.75     | 52.83     |
|                                                    | 5.08      | 5.48      | 3.92      | 4.20      | 2.18      |
| Topic name                        | Periods          | 1996–2001 | 2002–2006 | 2007–2011 | 2012–2016 | 2017–2021 |
|----------------------------------|------------------|-----------|-----------|-----------|-----------|-----------|
| Interactive whiteboards         |                  | 9.76      | 0.00      | 12.20     | 17.07     | 60.98     |
|                                  |                  | 3.39      | 0.00      | 4.90      | 2.67      | 1.94      |
| Higher education                 |                  | 2.86      | 0.00      | 8.57      | 14.29     | 74.29     |
|                                  |                  | 0.85      | 0.00      | 2.94      | 1.91      | 2.02      |
| Virtual/augmented reality       |                  | 34.62     | 7.69      | 7.69      | 19.23     | 30.77     |
|                                  |                  | 7.63      | 2.74      | 1.96      | 1.91      | 0.62      |
| Early child education           |                  | 8.70      | 8.70      | 21.74     | 17.39     | 43.48     |
|                                  |                  | 1.69      | 2.74      | 4.90      | 1.53      | 0.78      |
| Computational thinking          |                  | 52.63     | 0.00      | 26.32     | 10.53     | 10.53     |
|                                  |                  | 8.47      | 0.00      | 4.90      | 0.76      | 0.16      |
| Career support                  |                  | 16.67     | 0.00      | 8.33      | 8.33      | 66.67     |
|                                  |                  | 1.69      | 0.00      | 0.98      | 0.38      | 0.62      |
| Skill education                 |                  | 0.00      | 12.50     | 12.50     | 25.00     | 50.00     |
|                                  |                  | 0.00      | 1.37      | 0.98      | 0.76      | 0.31      |
| Educational data mining         |                  | 0.00      | 0.00      | 33.33     | 0.00      | 66.67     |
|                                  |                  | 0.00      | 0.00      | 1.96      | 0.00      | 0.31      |
| Gamification                    |                  | 0.00      | 0.00      | 0.00      | 0.00      | 100.00    |
|                                  |                  | 0.00      | 0.00      | 0.00      | 0.00      | 0.31      |
periods was calculated. While calculating this value, called \( ACC_{\text{topic.period}} \), the \( P_{\text{topic.period}} \) value in the previous period was subtracted from the \( P_{\text{topic.period}} \) value in the relevant period and divided by 5. As the first period is taken as a basis, 4 \( ACC_{\text{topic.period}} \) values were calculated for each topic. If these values are negative, it indicates that the topic has been studied less than the previous period, while positive values indicate that the topic has been studied more than the previous period. For example, these values for “Technology acceptance” were obtained as -0.16, 0.21, 1.42 and 15.30 respectively. (\( P_{\text{topic.period}} \) values were calculated as 5.93, 5.48, 7.84, 13.36 and 25.27, respectively). Accordingly, while only in the second period there are fewer publications on “Technology acceptance” topic in proportion to first period, it has been studied more in all subsequent periods than in the previous period. On the other hand, a variable named \( ACC_{\text{topic_i.topics.period}} \) was used to calculate the acceleration of each topic with respect to other topics within periods. \( P_{\text{topic_i.topics}} \) values were considered in calculating the values of this variable. For calculation of \( ACC_{\text{topic_i.topics.period}} \) value, \( P_{\text{topic.period}} \) value in the previous period was subtracted from the \( P_{\text{topic.period}} \) value in the relevant period and divided by 5. Accordingly, 4 \( ACC_{\text{topic_i.topics.period}} \) values were calculated for each topic. If these values are negative, it means that the topic has been studied less than other topics in the previous period, while positive values indicate that the topic has been studied more than other topics in the previous period. For example, these values for “Technology acceptance” were obtained as 0.09, 0.47, 1.10 and 2.38 respectively. (\( P_{\text{topic_i.topics}} \) values were calculated as -0.09, 0.47, 1.10 and 2.38, respectively). This shows that the rate of “Technology acceptance” topic compared to other topics decreased in the second period, while the ratio of this topic among all topics gradually increased in all subsequent periods. The data in Tables 5 and 6 were converted into graphs and percentage and acceleration graphs were created for all subjects. In Table 7, the count of publications related to each topic, the percentage distribution of the topics and the acceleration graphs are given together. The graphs are based on the last years of the periods and located on the axis on the graph.

Table 7 was created according to the volume ranks of the topics. As seen in Table 7, there are three columns opposite each topic. The first column shows the volume chart according to the count of publications of the topic in the periods. In the second column, the percentages of the topic within the periods and compared to the other topics are given. Finally, in the third column, acceleration graphs are given within the topic and compared to other topics.

Finally, in addition to the concepts of \( ACC_{\text{topic.period}} \) and \( ACC_{\text{topic_i.topics}} \), the acceleration of each topic within itself and and with respect to other topics from the first period were calculated. For the calculation of these values, called \( ACC_{\text{topics}} \) and \( ACC_{\text{topic_i.topics}} \), the \( P_{\text{topic.period}} \) and \( P_{\text{topic_i.topics}} \) values of the relevant topic were used. For each topic, \( ACC_{\text{topics}} \) and \( ACC_{\text{topic_i.topics}} \) were calculated according to Eqs. (1) and (2).

\[
ACC_{\text{topics}} = \frac{(P_{\text{topic.period(2021)}} - P_{\text{topic.period(2001)})}}{4}
\]

\[
ACC_{\text{topic_i.topics}} = \frac{(P_{\text{topic_i.topics(2021)}} - P_{\text{topic_i.topics(2001)})}}{4}
\]

The top five topics accelerated at the highest and the least level were determined, by taking maximum and minimum first five values of \( ACC_{\text{topics}} \) values. Similarly,
Table 7  Volume, percentage, and acceleration graphs for each topic

| Topic name                        | Volume of the topic according to periods (Number of Publication) | The change of the percentage rate of the topic within itself and compared to other topics | The acceleration of the percentage rate of the topic within itself and compared to other topics |
|----------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|
| Technology acceptance           | ![Graph](image1)                                                 | ![Graph](image2)                                                                         | ![Graph](image3)                                                                                     |
| Social network based learning   | ![Graph](image4)                                                 | ![Graph](image5)                                                                         | ![Graph](image6)                                                                                     |
| Teacher education               | ![Graph](image7)                                                 | ![Graph](image8)                                                                         | ![Graph](image9)                                                                                     |
| Satisfaction of e-learning      | ![Graph](image10)                                                | ![Graph](image11)                                                                        | ![Graph](image12)                                                                                     |
| E-learning                       | ![Graph](image13)                                                | ![Graph](image14)                                                                        | ![Graph](image15)                                                                                     |
| Web based learning              | ![Graph](image16)                                                | ![Graph](image17)                                                                        | ![Graph](image18)                                                                                     |
| Use of technology in pre-service teacher education | ![Graph](image19)                                                | ![Graph](image20)                                                                        | ![Graph](image21)                                                                                     |
| Teacher digital competence      | ![Graph](image22)                                                | ![Graph](image23)                                                                        | ![Graph](image24)                                                                                     |
maximum and minimum top five values for $\text{ACC}_{\text{topic}_i}$ were taken and the top five topics with the highest and least acceleration rate compared to other topics were determined. In a sense, these values are regarded as an indicator of the study intensity of the topic within the topic itself and according to other topics. In Fig. 4 and Fig. 5, the related topics and their acceleration values are given together graphically.

As seen in Fig. 4, the most accelerated topic is "Gamification", and it is followed by "Technology acceptance" and "Use of technology in pre-service teacher education". It is seen that two of the first five topics (Technology acceptance and Social network based learning) which have the highest acceleration rate within themselves are the topics with the most publications. On the other hand, while "Gamification" is the most accelerated topic, it has the least count of publications. The publications on this topic in the last period have revealed this value. Two topics whose acceleration rates have slowed down attract the attention. These came out as “Virtual/
augmented reality” and “Computational thinking” topics. Finally, graphical data on the acceleration of the topics with respect to each other are presented in Fig. 5.

As seen in Fig. 5, the most accelerated topic compared to other topics is "Technology acceptance", and it is followed by "Social network-based learning". On the other hand, three of the top five topics (Technology acceptance, Social network based learning and Use of technology in pre-service teacher education) which became prominent compared to other topics, also took their place among the top five topics that have the highest acceleration rate within themselves. Similarly, when the
topics are ranked according to the count of publications, the top five topics (Technology acceptance, Social network based learning and Satisfaction of e-learning, respectively) are also among the topics with the highest acceleration rate compared to other topics. On the other hand, "Web based learning" comes first among the topics with the most slowed down acceleration rate compared to other topics, and it
is followed by "Computational thinking". Four of the top five topics, which have been studied less than other topics, are among the topics with less acceleration rate within themselves. While only the “E-learning” topic seems to be a decreasing topic compared to other topics, it is not among the topics with low acceleration rate within itself.

4 Discussion and conclusions

4.1 Insights from bibliometric analysis

Trend analysis of publications and citations can provide insight into the increasing impact of all journals in general and EAIT publications specific to this study on the academic world. According to the results the total count of citations increased significantly as the total count of publications increased. It is also important to note the relationship between the count of publications and the count of citations indicated by using the citation per-publication index. The citation per-publication index highlights the growing influence of EAIT’s publications, particularly in the field of educational technology, and shows its rapid growth over the period.

According to the country/region analysis, the three most contributing countries are the United States (USA), Turkey and the United Kingdom (UK). The most effective countries in terms of the count of citations are the USA, the UK and Australia. Although Turkey draws attention in terms of the count of publications, it lags other countries in terms of the count of citations and the count of citations per publication. In the first period (1996–2008), UK stood out in terms of the count of publications and citations, while in the second period (2009–2021), the USA drew attention. In addition, Turkey and Greece showed a striking improvement in terms of the count of publications in the second period. In terms of the count of citations per publication, the Netherlands, the United Kingdom, and the USA stand out, respectively. This result shows the worldwide impact of the research conducted by leading scientists in these countries, although the total count of publications in the Netherlands is less than in the USA and UK.

According to the affiliation analysis, the three affiliations that contributed the most were the University of Patras (23), University of Macedonia (21) and University of Thessaly (21) in Greece. It is also noteworthy that four of the top 15 affiliations are from Greece. This shows the academic impact of the publications of authors in Greece at EAIT. In terms of the h index, the University of Patras in Greece, the University of North Dakota in the USA, and King’s College London in the UK stood out with the 10 h index. In addition, King’s College London, University of Technology Malaysia and University of North Dakota drew attention in terms of the count of citations and the average count of citations per publication, respectively. In the first period (1996–2008), King’s College London in UK ranked first in terms of the count of publications and citations. In the second period (2009–2021) research, the University of Macedonia in Greece and McGill University in Canada came to the fore with 20 publications. In addition, 6 affiliations that did not contribute to the first period contributed in the second period. This shows that the journal
is preferred by many countries and supported by affiliations from different countries. In terms of the count of citations, University of Technology Malaysia, King’s College London, and University of North Dakota drew attention, respectively. In general, it can be said that King’s College London, University of North Dakota, and University of Technology Malaysia are the affiliations that contribute the most.

When the countries in Table 1 and the affiliations in Table 2 were compared, it was found that the results were compatible. In terms of affiliations, the countries that contributed the most were Greece (4), Australia (2) and the Netherlands (2). However, only one affiliation stood out among Canada, Finland, the USA, Israel, the UK, the United Arab Emirates and Malaysia. On the other hand, although some countries stand out in Table 1 (for example, Turkey, India, Sweden, Saudi Arabia, and Oman), it is noteworthy that no affiliations are in the top 15. It can be said that these countries focus on the EAIT journal, but the count of publications is not concentrated in a particular affiliation and does not raise a particular affiliation in these countries to the top 15 rankings.

According to the author analysis, Jared Keengwe (USA), Tenzin Doleck (Canada) and Paul Bazelais (Canada) stand out as the three most productive authors. It is not surprising that the top contributing author is from the United States. However, Canadian authors’ contribution to EAIT is also noteworthy. Jared Keengwe (USA) is also a remarkable author in terms of the count of citations. In addition, Joke Voogt (Netherlands) is the second notable author in terms of the count of citations. This may explain why the Netherlands stands out in terms of the count of citations per publication. In addition, it is noteworthy that 5 authors from Greece stand out in the top 15 authors. In this regard, it can be said that authors in Greece have more cooperation among each other than other countries. It is also surprising that among the authors there is an author from Fiji. This shows that the journal is preferred by many countries and supported by affiliations from different countries.

Statistical characteristics of authors in terms of the publication count, citation count and h index can help scholars identify which authors have contributed more to the EAIT community, both in the past and more recently. In summary, as the count of publications and citations continues to increase, EAIT plays an increasingly important role in the field of educational technology and will continue to lead the field with our research results in the future.

4.2 Insights from topic modeling analysis

The topic modeling analysis suggested important results in terms of revealing the trends for the topics, as well as revealing the research tendencies and interests of the articles published in the EAIT journal. The results of the topic modeling analysis showed that the articles in the EAIT journal were grouped under 21 topics. Among these 21 topics, "Technology acceptance", "Social network-based learning", "Teacher education", "Satisfaction of e-learning" and "E-learning" topics became the topics with the highest volume. In other words, these five topics are the most studied topics. It is known that the most voluminous topics are directly related to educational technologies and have an important place in this field. As a matter of
fact, the place of "Technology acceptance", which comes first in this field, is fixed in the literature (Granić & Marangunić, 2019). With the spread of educational technologies and their inclusion in education and training processes, important studies have been carried out on the adoption of technology (Reddy et al., 2021; Revythi & Tselios, 2019). With the increasing role of technology in education, technology acceptance has become even more important for teachers and students. Because technology acceptance is necessary as a basis for the full integration of any digital technology into the classroom environment and the improvement of learning processes (Ifenthaler & Schweinbenz, 2016). The acceptance of an environment, tool or situation, in short, any innovation is a multidimensional and dynamic process. For this reason, there are different theories and models to reveal the factors affecting the acceptance of innovation. Some of these theories and models are based on social psychology and examine the acceptance of innovation by emphasizing internal decision processes at the individual level (Ajzen, 1991; Ajzen & Fishbein, 1977; Davis, 1989; Venkatesh et al., 2003). On the other hand, some focuses on the features of innovation and examines the widespread use of innovation in the system (Moore & Benbasat, 1991). It is not surprising that e-learning” topics have come to the fore. Because recently, many studies on these topics have attracted attention in the literature (Giray, 2021; Gurer, 2021; Mazman Akar, 2019; Siyam, 2019; Sorat & Mohamadi Zeneouzagh, 2021; Toussas et al., 2021).

In order to make trend analysis of the publications in the EAIT journal, a total of 5 periods were generated. In these periods, accelerations of each topic within itself and according to other topics were examined. As a result of this review, it was seen that the most accelerated topics in themselves came out as "Gamification", "Technology acceptance", "Use of technology in pre-service teacher education", "Social network-based learning" and "Higher education". It is seen that two of the top five topics (“Technology acceptance” and “Social network-based learning”) with the most acceleration rate within themselves are the ones with the most publications. This highlights these two topics. On the other hand, "Gamification" is the most accelerated topic, and it has the least rate in terms of count of publications. The abundance of publications on this topic in the last period has revealed this result (Ekici, 2021; Luo, 2021; Ofosu-Ampong et al., 2020). Gamification has got an important place among educational technologies in recent years. As a matter of fact, gamification may result in educational benefit for Generation Y, who expect an interaction between learning and games, and cost savings for the institution and improvement in performance (Liu et al., 2017; Ofosu-Ampong, 2020). Gamification has become a popular technique that can be applied in a variety of contexts to motivate students to engage in certain behaviors and thus improve learning (dos Reis Lívero et al., 2021). Gamification is growing rapidly, maturing towards questions such as what and why to gamify. Empirical and theoretical studies attract attention to prove the effects of gamification. Gamification has received increasing attention in the field of education in recent years (Manzano-León et al., 2021). Kalogiannakis et al., (2021) presented the empirical findings of the latest literature on the use of gamification in science education. The results revealed the latest emerging trends of gamification in science education. The use of gamification in education provides a great benefit for motivation, user interaction and social effects. Saleem et al., (2022) highlighted the
search for gamification literature in e-learning and the reported benefits and challenges of gamification applications in e-learning. The results showed that gamification is increasingly recognized as a useful learning tool for creating more attractive educational environments. Gamification studies in education were also reflected in the EAIT journal and gamification became the main topic in the last period.

The least accelerated topics in themselves came out as "Student digital competence", "web-based learning", "Early child education", "Virtual/augmented reality" and "Computational thinking". Among these topics, "Virtual/augmented reality" and "Computational thinking" topics have negative acceleration beyond little acceleration. In other words, the acceleration rate of these two topics has decreased. Accordingly, these two topics were studied less as the periods progressed compared to the previous periods.

Finally, when the accelerations of the topics were analyzed, interesting results were obtained. As a matter of fact, the top five topics that are studied more than other topics are respectively "Technology acceptance", "Social network based learning", "Use of technology in pre-service teacher education", "Teacher digital competence" and "Satisfaction of e-learning". Two of these five topics ("Technology acceptance", "Social network based learning") that accelerated more than the other topics were found to be common both among the topics with the highest acceleration in themselves and among the top five topics with the highest volume. This situation can be accepted as an indication that these two topics come to the fore. On the other hand, the top five topics whose acceleration slowed down most compared to other topics (in other words, less studied compared to other topics) are respectively "web based learning", "computational thinking", "Virtual/augmented reality", "e-learning" and "Student digital competence". Four of these five topics (except for "e-learning") are also among the least accelerated topics in themselves. Looking at these topics, it can be said that they are generally known topics but have been studied for a long time. For example, with the development of Internet technology, effective learning environments have begun to be created on the web (Boisvert, 2000). Web-based learning, also known as e-learning, has been implemented in many fields since the 2000s (Cook et al., 2010; Hamid, 2001; Moore et al., 2011). On the other hand, computational thinking studies that have started to emerge since 2006 (Wing, 2006) have increased their popularity in many areas (Tekdal, 2021). It is emphasized that augmented and virtual reality technologies are not new and have been used in education for many years (Elmqaddem, 2019). It has been stated that the field of students’ digital competence has also been an important research area since the 2010s (Scuotto & Morellato, 2013). In other words, besides these topics -the topics mentioned above, and which accelerated most compared to other topics- more specific topics have started to be studied.

4.3 In comparison with the research by Tatnall and Fluck (2022)

Tatnall and Fluck (2022) identified the topic trends and cultural backgrounds of the authors of 1511 articles published in EAIT between 1996 and 2020. With the current study, in which the publications between the years 1996–2021 were
analyzed, it was aimed to determine the research interests and trends in the articles published in EAIT. For this purpose, bibliometric analysis supported by topic modeling analysis was conducted. In this way, more detailed analyzes were carried out regarding the prominent topics in the articles. In the country/region analysis, Tatnall and Fluck (2022) focused heavily on identifying productive actors in terms of count of publications. In our study, however, we were more concerned with identifying influential actors based on the H-index and the average count of citations per publication. Although the indices of the two studies were different, similar results were found. Specifically, when the top three countries/regions were analyzed in terms of count of publications, the USA and the UK showed similarity in the first two places. In addition, significant similarities were determined in terms of analyzing these two countries on the basis of periods. When the period-based publication counts were compared, it was found that the United Kingdom until 2008 and the USA after 2009 came to the fore in both studies. When the differences according to countries/regions are analyzed, while Greece drew attention as the third country with the most publications in Tatnall & Fluck (2022), Turkey came to the fore in our study. In this direction, it can be said that Turkey’s influence in EAIT has increased gradually by year of 2021. Tatnall & Fluck (2022) determined the countries of the contributing authors according to the periods. Differently, in our study, the authors who contributed the most to the publications were determined. In our study, we considered the h-index and average citations per publication, in addition to productivity counts, when identifying authors. In addition, affiliation analysis was carried out in the current study, which differed from the previous study in this respect. Thus, this study provided evidence to identify countries/regions, affiliations, and authors from both productivity and effectiveness perspectives.

From a topic analysis perspective, Tatnall and Fluck (2022) performed a word cloud analysis via https://tagcrowd.com using keywords to identify topic trends. They also examined the contents of the articles published in the journal between the years 1996–2020. In our study, however, we adopted topic modeling, where each article is considered a combination of words, each topic is a distribution over words, and each article is a mix of sentence-wide topics. Tatnall and Fluck (2022) investigated how keywords evolved by dividing the entire period into five consecutive periods (i.e., from a periodic perspective). Periodically prominent keywords, higher education (1996–2000/2011–2015/2016–2020) and Information and Communication Technology-ICT (2001–2005/2006–2010) drew attention. Specifically, Tatnall & Fluck’s content analysis described the evolution of research focuses in EAIT publications as evaluation and software (1996–2000), case study and pedagogy (2001–2005), collaboration and learning efficacy (2006–2010), the emergence of e-learning (2011–2015) and mobile and blended learning (2015–2020). We have identified a total of 21 main topics that the EAIT community is concerned with in the last 25 years. The main topics that stand out according to the periods are web-based learning (1996–2001), teacher education (2002–2006/2007–2011), social network-based learning (2012–2016) and technology acceptance (2017–2021). After all, we found somewhat similar insights into evolving trends in the research focus of both Tatnall & Fluck and the EAIT community. In conclusion, this study presented
a comprehensive review of the journal, both supporting the Tatnall and Fluck (2022) study and presenting divergent findings.

4.4 Current status and future directions

In this section, a general point of view is presented in the light of the findings obtained from the topic modeling analysis. With this point of view, the future perspective of the EAIT journal in terms of the current research trend is drawn. The results of the topic modeling analysis showed that the total count of publications on the top five most voluminous (most studied) topics constitutes 60.9% of all publications. "Technology acceptance", "Social network-based learning", "Teacher education", "Satisfaction of e-learning" and "e-learning" are the most voluminous topics. These topics are the most frequently studied topics and have an important place in EAIT journal. Two of these topics (“Technology acceptance” and “Social network-based learning”) are among both the topics that accelerated the most over time and the topics whose volume has increased the most over time among other topics. In other words, these two topics both gain the highest acceleration in time and their volume comes to the fore among other topics. Therefore, these topics should be observed in the future, both in terms of volume and in terms of being among the topics with a rising trend. In addition, "Gamification" is one of the most accelerated topics within itself. Despite its low volume, high acceleration rate of this topic within itself is an indication that this topic has come to the fore recently. In other words, studies on this topic can be observed in the future. Finally, topics such as "e-learning" and "web-based learning" can be interpreted as topics that have lost their popularity, although they have been studied extensively.

5 Limitations and future works

This is in-depth study to track and map EAIT’s research status and trends using a bibliometric analysis and topic modelling. It is also an important study in terms of reflecting the status of publications in the field of educational technologies, EAIT journal. This study is limited to EAIT. Based on this study, comparative studies in the field of educational technologies (such as “Computers & Education”, “British Journal of Educational Technology-BJET”, etc.) can be analyzed together in the future. EAIT is a journal published in the Springer database. Hence the prominent journals in the field of educational technologies can be identified and compared in the databases such as Springer Nature, Elsevier, Wiley, SAGE, and Taylor & Francis etc. This can provide a more comprehensive understanding of the field of study in educational technology. Additionally, additional research with a citation perspective on the relationship between EAIT articles and other journals in the research field is advised to help explore the knowledge structure of the educational technology research community. In addition, EAIT is the official journal of the International Federation for Information Processing’s (IFIP) Technical Committee on Education. Therefore, it is recommended to conduct bibliometric-based topic modeling studies.
in these journals such as "Computers & Security", "International Journal of Critical Infrastructure Protection" and "Entertainment Computing" which are members of IFIP. Finally, the use of traditional LDA for topic modeling analysis is important and up to date but can be considered as a limitation. Comparative analyzes can be made with different versions of LDA in future studies. Additionally, word frequency analysis can be used as a complement to LDA. Finally, considering the findings obtained from this study, significant contributions can be made to the field by making in-depth analyzes on the most voluminous topics and the topics that have become prominent in recent years.

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