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RESEARCH ARTICLE

Investigation of research trends in educational technologies based on scientometric method (1965–2020): a cross-comparative study between publications from the world and the UK

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Abstract

Considering the increasing importance of educational technologies and the debates about the role of technology in education, it is of great importance to reveal research trends in educational technologies. It is also possible to present the big picture of trends and the comparative role of the UK in this picture, which is one of the main countries leading the research trends in the educational technology field. Carrying the existing studies in the literature to a wider range with the comparison of England and the world will levered the literature up to a seminal point. This study is aiming to identify and compare research trends in the educational technology field both in the world and the UK. For this purpose, the studies from 1965 to 2020 indexed in the ERIC database were reviewed by using data mining techniques. The analysis of studies indexed in the field of educational technologies in the ERIC database presented in terms of four fields: Descriptor, Title, Abstract, and Audience. The data were analyzed in terms of these variables and divided into four categories: target audience, methodology, approaches, and technology. Findings have important implications for the field.

Keywords Educational technology · Scientometric method · Data mining · Research trends

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Introduction

The field of educational technology is a dynamic field of study that is eager to integrate rapidly developing technologies into educational settings. Many universities use innovative technology-based education methods to meet the diverse needs of students and to compete in education markets around the world (Stacey & Gerbic, 2008). Since the early 2000s, teachers and educators have been increasingly interested in using technology (Bonk & Graham, 2005) as a result of the prevailing use of online technologies. Educational technology studies help us to understand the technology adaptation process and gain better insight regarding the current use of these technologies and possible future scenarios.

Educational technology has become an increasing topic of discussion in both academia and the general population in recent years (Selwyn, 2013). Some scholars view educational technology as a way to save education systems that need a major improvement (Collins & Halverson, 2009; Stallard & Cocker, 2014), however, some others believe that educational technology undermines the best practices of traditional educational approaches (Cuban, 2013; Thomas & Brown, 2011). In an era of such critical debates and diverse thoughts about the role of technology, examining research trends in the educational technology field can provide insight to better understand the role of technology, to set a strategic stand and to make appropriate decisions (Author, 2020).

Big data analysis

Analyzing a large set of data in education can provide identification and visualization of research trends and encourage new research designs for future studies (Daniel, 2019). Although Big Data in Education is a more recent phenomenon with the availability of large amounts of educational data stored in institutional databases, it is likely that educational research will become a data-intensive field in which methods and techniques from Data science are used (Daniel, 2019). Data Science primarily deals with the development and use of processes as well as the development of tools to distinguish and extract valuable information AQ1 from complex data (Leek, 2016; Waller & Fawcett, 2013). The use and application of data science principles and techniques in educational research can provide high benefits (Klašnja-Milićević et al., 2017).

Data mining method is one of the big data analysis methods. It is an analysis method performed to extract meaningful information, new patterns, and transform data into information from unstructured and large amounts of text data sources (He et al., 2013; Tsantis & Castellani, 2001). Data mining standard methods include text classification, text clustering, ontology and taxonomy creation, document summarization and latent corpus analysis (Feinerer et al., 2008). For big data analysis or data mining, data or information about data is stored in different formats. AQ2 Therefore, in big data studies, researchers follow different ways and methods for visualizing, presenting and making sense of the data. In this study, it was aimed to compare the titles, abstracts, subjects and types of the studies in order to determine the research trends.

Educational technology research trends in literature

It is not easy for educational technology professionals to find reliable data on current trends in the field (Kimmons, 2020). This poses a problem for policymakers who have trouble knowing what technologies are being used and researched, educators who have trouble

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knowing how to adapt to changing needs and possibilities, and researchers who have difficulty dealing with promising technologies and their meaningful problems (Kimmons, 2020). To address the aforementioned challenges, above there is a need for research trend studies that inform the researchers about the ongoing developments. Research trends in the field of educational technologies in different periods have been reported by literature (Hsu et al., 2013; Baydas et al., 2015; Reeves & Oh, 2017; Chen et al., 2019; Xie et al., 2019; Bodily et al., 2019; Bond et al., 2019; Lai and Bower, 2019; Author, 2020; Chen et al., 2020a, 2020b). These reviews provide a solid ground for other researchers, particularly for those seeking to advance educational technology research, and also provide useful implications for practitioners (Reeves & Lin, 2020). For instance, Hsu et al. (2013) analyzed abstracts of 2997 research studies published in SSCI indexed six peer-reviewed journals between 2000 and 2010. Primarily, they reported research trends focused on research topics in six journals by applying automated data mining methods to abstracts of the studies in each journal. The study identified three research areas: technology integration, acceptance of emerging technologies, and learning environments. These research areas were emphasized by the journal and research strengths by country. In another study, Baydas et al. (2015) examined 1255 research studies in *Educational Technology Research and Development (ETR&D)* and *British Journal of Educational Technology (BJET)* from 2002 to 2014. They used content analysis to compare, contrast, and categorize the research methods, subjects, data collection tools, sample selection methods, sample sizes and data analysis methods of the studies. The results revealed that the most studied subjects were instructional design and learning environments, and the least studied subjects were in the field of cultural issues and cognitive learning. Research trends change over time according to the development of information technologies and paradigm changes.

Considering research purposes and methods to analyze research trends, Reeves & Oh (2017) examined research studies in the *ETR&D* journal from 1989 to 2014. They extended the analysis study conducted by Reeves (1995) examined the studies in the ETR&D journal during a 6-year period from 1989 to 1994. Their analysis included a close reading of the entire contents of 104 studies. They identified a decrease in the number of quality literature review and theoretical studies while an increase in the studies with descriptive goals. To examine the trends in the research area of instructional design and technology Bodily et al. (2018) analyzed 65 journals between 2007 and 2017 using the Scopus database. They examined the keywords and found that "WebCT (2007), hypermedia (2008), digital natives and community (2010), blog (2011), blog and social learning (2012), digital literacy, online discussion, and wikis (2013), MOOCs and social network analysis (2014), and MOOCs, gamification, flipped classroom, and open education (2015 and 2016)" (p. 72) were emerging themes in respective years. Going back even further and studying research trends over a single top journal in the field, Zawacki-Richter & Latchem (2018) conducted a systematic review to analyze research studies published in *Computers and Education (C&E) Journal* from 1976 to 2016 to determine the research trends. Results revealed the following research themes: "the advancement and growth of computer-based instruction (1976–1986); stand-alone multimedia learning (1987–1996); networked computers as tools for collaborative learning (1997–2006); and online learning in a digital age (2007–2016)" (p. 136).

Focusing on adaptive/personalized learning, Xie et al. (2019) examined the developments of technology-enhanced adaptive/personalized learning by reviewing the 161 journal articles published from 2007 to 2017 using the Web of Science database. The study suggests that personalized/adaptive learning has always been a trending topic in the field. Distinctively, Lai & Bower (2019) analyzed the evaluation of technology usage in education

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by conducting a systematic review of 365 studies published in *C&E* from 2015 to 2017. They concluded that the evaluation of learning technology use tends to focus on learning, affective elements, behaviors, design, technology, pedagogy, presence and institutional environment.

Carrying out trends in educational technologies in a wider range, Bond et al. (2019) analyzed the titles and abstracts of a total of 1777 articles published in BJET from 1970 to 2018. Using text mining technique, key concepts and themes that emerged in each decade of the fifty years were identified, and these were, then, compared to those found in a previous analysis of C&E journal and to the most cited BJET publications every decade. According to the concept map analysis of Bond et al. (2019) that research focus in BJET publications changed as follows: *multimedia learning and the Open University* (1970–79), evolution from *audio-visual equipment* to *computer-based learning* (1980–89), *the evolution of distance education*, and *interactive learning* (1990–99) as well as *learning analytics* and *collaborative learning using mobile devices* (2010–18). In a similar study, Chen et al. (2019) analyzed research topics, author profiles, and collaboration networks on educational technology in C&E Journal from 1978 to 2018 through a bibliometric analysis using the Web of Sciences database. They examined 3963 studies and found popular topics such as "interactive learning environment, teaching/learning strategies, pedagogical issues, and improving classroom teaching." (p. 580). The study also addressed collaboration among authors, institutions and regions around research studies. Following this study, Chen et al. (2020), carried a topic-based bibliometric analysis of articles published in C&E journal from 1976 to 2018. They analyzed the research topics, topic trends over time, distribution of these topics according to location and the institutions. *Game-based learning, technology-enhanced classroom pedagogy, blended learning, online social communities, mobile language learning* and *e-learning* are found to be trending topics in the field. Similarly, Chen et al. (2020), conducted a bibliometric analysis for 3710 studies published in BJET from 1971 to 2018 by using the Web of Science database. The purpose of their study is to determine the publication and citation trends, paper types, reveal the most relevant countries, authors and their affiliations and thematic features by analyzing abstracts and titles by using a word cloud and topic modeling analysis. According to the study, blended learning, online social communities, socialized e-learning, mobile-assisted language learning and game-based learning have received increasing attention from the BJET community, while problem-based learning, online professional training and teacher education are also increasingly losing interest.

Recently, Author (2020), adopted a systematic review approach and used data mining and analysis techniques. He analyzed 666 research studies from peer-reviewed journals indexed in the Scopus database, published between 1993 and 2019. The results of the analysis showed that social sciences, computer science and engineering dominate the field of educational technology. The US and the UK have been the leading countries of research studies. There have been rising concerns in the field such as ethical issues, and effectiveness of technology integration. The themes in the field were identified as follows: ''Multimedia learning and instructional design between 1993–1999, convergence of educational technology, distance education and online learning environments, and educational technology integration in traditional learning settings between 2000–2004, revising curriculum for educational technology, educational technology in higher education and distance education, and the bottleneck of the significant differences in educational technology research between 2005–2009, online learning and higher education, integration of ICT and full potential of educational technology between 2010–2014, data-driven, smart educational technology, big data, and learning analytics between 2015–2019'' (p.6).

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In a most recent study, Kimmons (2020), examined the titles and abstracts of 7708 research studies over the past 5 years and identified common tools by extracting links from 51,496 K to 12 schools and 1317 university websites through the US. The study results showed that some of the most studied topics are online learning, online teaching, e-learning, mobile learning, mobile games, distance learning and blended learning. The common tools that the schools and universities linking are Facebook, Twitter, Google Docs and Youtube.

The aim and significance of the study

The above studies in the related literature have usually examined a limited number of journals such as BJET, C&E and ETR&D, and the data was generated through databases such as Scopus, and Web of Science. This study aims to look at research trends in a broader sense by analyzing all research studies published between 1965 and 2020 by using the Educational Resources Information Center (ERIC) database. The rationale for identifying 1965 as the starting point is that the database has been indexing articles from 1965 to onwards. ERIC, sponsored by the Institute of Educational Sciences of the US Department of Education, is an authoritative database of indexed and full-text educational research and resources. ERIC allows access to bibliographic records of literature and sources from 1965 to the present (ERIC, 2020). By expanding the previous studies, this study revealed trends in the educational technology field due to the size and diversity of the index structure in the ERIC. In addition, considering that the ERIC database will help us to see the trends in the field, it is also possible to present the big picture of trends and the comparative role of the UK in this picture, which is one of the top countries contributes educational technology research (Hsu et al., 2013; Zawacki-Richter & Latchem, 2018; Bond et al., 2019; Chen at al., 2019, 2020; Author, 2020). When the findings of the studies examined in the literature (Hsu et al., 2013; Baydas et al., 2015; Reeves & Oh, 2017; Chen et al., 2019; Xie et al., 2019; Bodily et al., 2019; Bond et al., 2019; Lai and Bower, 2019; Author, 2020; Chen, et al., 2020a, 2020b) are considered in terms of a specific journal, period and different variables, this study intends to provide a panoramic outlook of educational technology research trends which further enables the researchers to compare and contrast the trends in the UK and the world. Considering the continuous development of educational technologies in the world, in parallel with the literature, this study aims to reveal the studies indexed in the field of educational technologies in the ERIC database in terms of four variables: descriptor, title, abstract, and audience. Findings obtained considering these variables were categorized into four labels: target audience, methodology, approaches, and technology. Taking these arguments to the central, the purpose of this study is sought to answer the following research questions:

RQ 1. What are the differences between research trends in the educational technology field in the United Kingdom and over the world?

RQ 2. What are the similarities between research trends in the UK and over the world?

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Method

In this study, a text-mining based scientometric analysis were used to present research trends published in the educational technology field both in the world and UK. Scientometric method which is a measurement and analysis of scientific data (Abercrombie et al., 2012) explores bibliographic data, such as author, publication year, and country of origin, using quantitative methods such as text mining (Broadus, 1987). Scientometrics is often conducted using bibliometrics, a measurement of scientific publications. The goal of scientometrics research is to learn more about how scientific research on a particular subject, a larger area of study, or even the entire body of knowledge develops (Li et al., 2021). This is done by extracting information from citation databases on the relevant scientific literature, usually focused on journal articles, papers from conference proceedings, theses, and other sorts of writing. In recent years, scientometric mapping has grown in popularity as a method for analyzing research topics, particularly in the safety science community, thanks to the growth of data science and visualization techniques. A research domain's structure in terms of collaborative networks or development history, important papers or journals, and topic focus areas can all be quickly and thoroughly understood via data mining and visualization. Text-mining which is one of the data mining techniques for big data analysis. Data mining is an analysis method performed to extract meaningful information and new patterns from unstructured and large amounts of textual data sources, and to transform data into information (He et al., 2013). There are two different road maps put forward by Gandomi & Haider (2015) and Chen & Zhang (2014) that can be followed in data mining processes. When the processes in these road maps are summarized in general, the processes of obtaining data from data sources, preparing it for the analysis process, performing data analysis and presenting the data by visualization come to the fore.

For the study, the studies published in the field of educational technologies and indexed in the ERIC database were analyzed comparatively in terms of descriptor, abstract, title, and audience variables, in general and UK origined studies. In order to achieve this goal, the article records indexed in the ERIC database (www.eric.ed.gov) were downloaded and recorded in a separate XML file for each year. After recording all data, the Python libraries were converted to Pandas data frame data type by using The ElementTree XML API (https://docs.python.org/3/library/xml.etree.elementtree.html) and Pandas (McKinney, 2010) libraries in order to process the ERIC data more easily in the later stages of the program. Then, using Pandas libraries, column names were standardized, unnecessary redundancies were removed, column names were changed, and only the data columns required for analysis were selected. After these operations, the file was saved to the computer with a file type that provides easy reading and writing. In this way, it is possible to compare the studies of UK origin in terms of various variables with the studies conducted around the world, to reveal the status of the studies and research trends in the field of educational technologies.

Sample

ERIC database which is an internet-based digital library was used as a data collection source. The reason why the ERIC database is used for the study is the indexing of over 1000 journals and containing more publications on educational technologies. ERIC provides a searchable database on educational research, and the articles indexed by ERIC are

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available to users in a downloadable format as XML files in the page called ERIC Download (https://eric.ed.gov/?download). Each study indexed in ERIC has an ERIC Record and includes a variety of descriptors (abstract, audience, author, etc.) for each publication. The fields and definitions applicable to the studies in the ERIC database can be found in the guide to the ERIC Record at https://eric.ed.gov/pdf/ERIC_Field.pdf. While some of the relevant areas of the publications indexed by ERIC are determined by the institution/journal providing the study, some are appointed by ERIC. Some examples of fields assigned by ERIC are location, education level and descriptor fields.

In this study, the publications were classified by using the location descriptor in ERIC and the publications based in the UK were compared with those in other parts of the world. In the first phase, a search was made using the keywords Educational Technology, Computer Uses in Education, Electronic Learning, Information Technology and Technology Uses in Education and the studies were limited. In the second phase, these obtained studies were divided into UK origin and others.

When the scanned publications about educational technologies before May 2020 were searched, a total of 13,258 publications were reached in ERIC. Therefore, the publications indexed in ERIC formed the data of the research in order to better reveal the current situation regarding the research on educational technologies. Articles published by January 2020 and indexed in the ERIC database and published as separate XML files for each year starting from 1965 to 2020 are included in the study. In this context, a total of 13,258 articles published between 1965 and 2020 formed the sample of the research. ERIC's core collection covers the years from ERIC's inception in 1965 to the present day. ERIC also includes some studies published before 1966 and a growing digital collection of historical material held by the National Library of Education. The historical collection consists of reports and bulletins from previous offices of the Ministry of Education. However, these historical studies are still in the indexing process, so not all previous studies are fully accessible on the ERIC website (https://eric.ed.gov/?faq-content). Therefore, some data findings below do not include descriptors for ERIC record before 2008 since they were not indexed in the online ERIC database yet.

In this direction, although the studies on educational technologies steady but slightly fluctuating trend until 2003, both in the world and in the studies of UK origin; afterwards, the studies gained momentum. Studies conducted in the field of educational technologies are examined in terms of the number of general publications (General publication count), and there are a total of 151,090 publications. The number of studies and cumulative studies included in the scope of the research for each year are shown in Fig. 1.

The number of research in the UK generally shows a similar trend. There is an increasing trend in the number of studies overall. However, there was a decrease in the number of UK based studies between the years 2002–2005, between 2012 and 2013 and 2016–2018; and there was a decrease in the number of general based studies between the years of 2003–2004, 2012–2013 and since 2017. Also, there has been a significant increase in the number of studies carried out in the field of educational technologies in the UK between 2005 and 2009 and 2013–2014 while there has been an increase for the general publications between 2004 and 2009, and 2013–2016.

Data analysis

In the process of examining the publications obtained, first the data were converted to Microsoft Excel format. Then a word transcript was created. A Python library (https://

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Table 1 Coding scheme for four fields

Labels of publications in the descriptor field	Categories
College students, college faculty, higher education and undergraduate students,	Target audience
Case studies, comparative analysis, interviews, qualitative research, questionnaires, statistical analysis	Method
Computer assisted instruction, computer mediated communication, computer uses in education, electronic learning, student attitudes, teacher attitudes, teaching methods, technology integration, technology literacy, technology uses in education	Approach
Computer software, educational technology, handheld devices, internet, information technology, Social networks, video technology, web sites	Technology
Labels of publications in the Title field	
Child, school, higher, teacher	Target audience
Assessment, design, effect, impact	Method
Classroom, development, environment, e-learning, interactive, language, learning, online, perception, practice, science, skill, system, teaching	Approach
Computer, digital, information, social, technology, virtual	Technology
Labels of publications in the Abstract field	
Child, school, students, higher, teacher	Target audience
Design	Method
Development, language, learning, online, program, system, teaching, academic, approach, practice, skill, support	Approach
Computer, digital, information, social, technology, virtual, web	Technology
Labels of publications in the Audience field	
Administrators, community, counselors, media staff, parents, policymakers, practitioners, researchers, students, support staff, teachers	Target audience

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Comparison of research trends in terms of descriptors of the publications

Descriptors are assigned for each publication in the ERIC database and indicate the subjects specified in the publication. The findings obtained according to the descriptors are comparatively included in Fig. 2, and the findings reveal the subjects of research studies in the educational technology field in the United Kingdom and the rest of the world.

When the most frequent studies in the field of educational technologies are compared with the UK based studies on descriptor variables to present differences, the results for each category (target audience, method, approach, technology) presented in Table 2 below. The subjects of the studies under the target audience variable showed some similarities and differences in the following years listed in the Table 2 below. For example, UK based studies in 2014, 2015 and 2017 do not include college students as the target audience, while studies in general include college students in 2014 through 2019. College faculty were only mentioned in UK based publications in 2019. Case studies were mentioned in UK-based studies in 2008, 2011, 2013, 2014, 2015, 2016, 2017 but they were never mentioned in publications in general.

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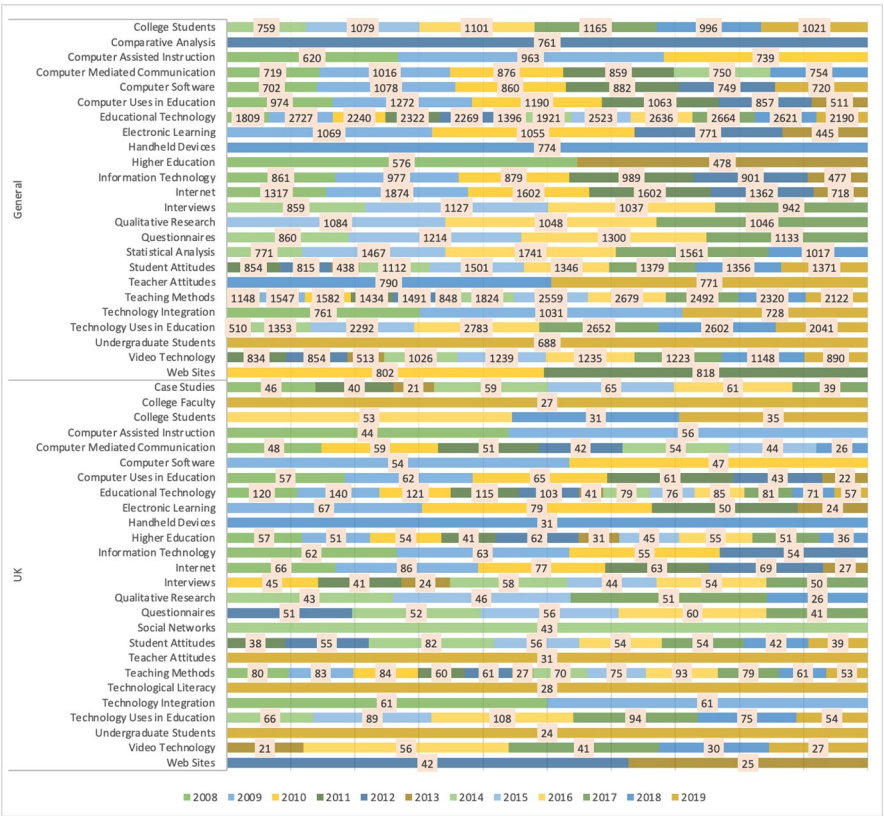


Fig. 2 Comparative results of the research trends in terms of descriptor field in educational technology in the UK and general

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Comparison of research trends in terms of abstract field

The ERIC Record of each publication indexed in ERIC has an abstract. The abstract provides a brief summary of the publication. The findings obtained according to the abstract field are comparatively included in Fig. 3, and the findings reveal the research trends in the educational technology field in the United Kingdom and over the world.

When the most frequent studies in the field of educational technologies are compared with the UK based studies on abstract field to present differences, the results for each category (target audience, method, approach, technology) presented in Table 3 below. The term child were mentioned in UK based publications in 2014, 2015, 2019, while it never mentioned in publications in general. The term practice were mentioned in UK based publications in 2012, 2013, 2014, 2017, while it never mentioned in publications in general.

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Table 2 The comparison of subjects under four variables in terms of descriptor field in ERIC records of publications

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
College students	2014,2015, 2016, 2017, 2018, 2019	2016,2018,2019	2
College faculty	–	2019	–
Higher education	2008,2013	2008,2009,2010,2011, 2013,2014,2015,2016,2017,2018	45
Undergraduate students	2019	2019	3
Method			
Case studies	–	2008, 2011,2013,2014,2015,2016,2017	–
Comparative analysis	2012	–	–
Interviews	2014, 2015, 2016, 2017	2014, 2015, 2016, 2017	8
Qualitative research	2015, 2017	2015, 2017	5
Questionnaires	2014, 2015, 2016, 2017	2014, 2015, 2016, 2017	6
Statistical analysis	2014,2015,2016,2017,2018	–	–
Approach			
Computer assisted instruction	2008,2009,2010	2008,2009,2010	4
Computer mediated communication	2008, 2009,2010,2011,2014,2018	2008,2010,2011, 2012,2014, 2015,2018	6
Computer uses in education	2008,2009,2010, 2011,2012,2013	2008,2009,2010, 2011,2012,2013	5
Electronic learning	2009,2010, 2012,2013,	2009,2010,2011,2013	7
Student attitudes	2013	–	–
Teacher attitudes	2018, 2019	2019	2
Teaching methods	2008,2009,2010,2011,2012,2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	4
Technology integration	2008, 2009, 2019	2008, 2009	5
Technology literacy	–	2019	–
Technology uses in education	2013, 2014, 2015, 2016, 2017,2018, 2019	2013, 2014, 2015, 2016, 2017,2018, 2019	3
Technology			

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Table 2 (continued)

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
Computer software	2008, 2009, 2010, 2011, 2012, 2019	2009, 2010	2
Educational technology	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016,2017,2018,2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016,2017,2018,2019	4
Handheld devices	2018	2018	4
Internet	2008,2009,2010,2011,2012,2013	2008,2009,2010,2011,2012,2013	5
Information technology	2008,2009,2010, 2011, 2012, 2013	2008,2009,2010,2012	5
Social networks	–	2014	–
Video technology	2011,2012, 2013, 2014,2015, 2017,2018,2019	2014,2016, 2017,2018,2019	2
Web sites	2010, 2011	2012, 2013	–

*The ratio of the studies conducted in the relevant category in the UK to the general in the years when the studies were similar to the general

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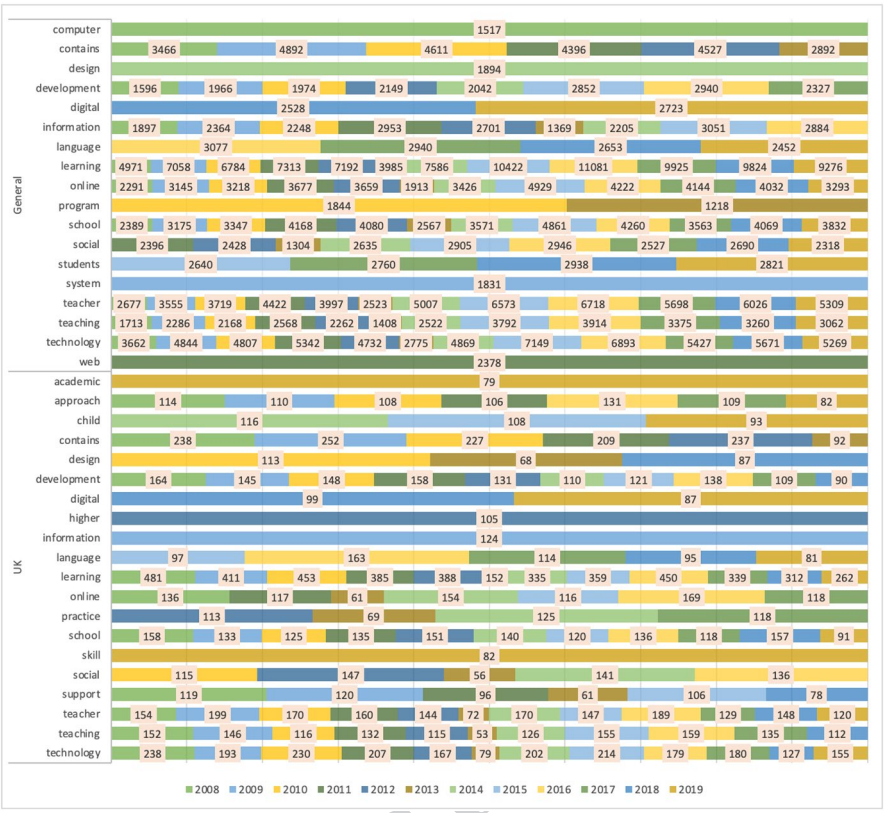


Fig. 3 Comparative results of the research trends according to the Abstract field in educational technology in the UK and over the world

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Comparison of research trends in terms of title of the publications

The ERIC is also used in the Title field in ERIC Record. Title which is the title of the publication involves subtitle, series name, and report number when applicable. The findings obtained according to the Title field are comparatively included in Fig. 4, and the findings reveal the research trends in the educational technology field in the United Kingdom and over the world.

When the most frequent studies in the field of educational technologies are compared with the UK based studies on Title field to present similarities and differences, the results for each category (target audience, method, approach, technology) presented in Table 4 below:

Table 3 The comparison of subjects under four variables in terms of Abstract field in ERIC records of publications

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
Child	–	**2014, 2015, 2019**	–
Hhigher	–	**2012**	–
School	2008, 2009, 2010, 2011, 2012, **2013**, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2014, 2015, 2016, 2017, 2018, 2019	3
Students	**2015, 2017, 2018, 2019**	–	–
Teacher	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	3
Method			
Design	**2014**	**2010, 2013, 2018**	–
Approach			
Academic	–	**2019**	–
Approach	–	**2008, 2009, 2010, 2011, 2016, 2017, 2019**	–
Development	2008, 2009, 2010, 2012, 2014, 2015, 2016, 2017	2008, 2009, 2010, **2011**, 2012, 2014, 2015, 2016, 2017, **2018**	7
Language	2016, 2017, 2018, 2019	**2015**, 2016, 2017, 2018, 2019	5
Learning	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	5
Online	2008, **2009, 2010**, 2011, **2012**, 2013, 2014, 2015, 2016, 2017,**2018, 2019**	2008, 2011, 2013, 2014, 2015, 2016, 2017	2
Practice	–	**2012, 2013, 2014, 2017**	–
Program	**2010, 2013**	–	–
Skill	–	**2019**	–
Support	–	**2008, 2009, 2011, 2013, 2015, 2018**	–
System	**2009**	–	–
Teaching	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, **2019**	4

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Table 3 (continued)

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
Technology			
Computer	**2008**	–	–
Digital	2018, 2019	2018, 2019	4
Information	**2008**, 2009, **2010, 2011, 2012, 2013, 2014, 2015, 2016**	2009	0.6
Social	**2011**, 2012, 2013, 2014, **2015**, 2016, **2017, 2018, 2019**	**2010**, 2012, 2013, 2014, 2016	3
Technology	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	4
Web	**2011**	–	–

*The ratio of the studies conducted in the relevant category in the UK to the general in the years when the studies were similar to the general

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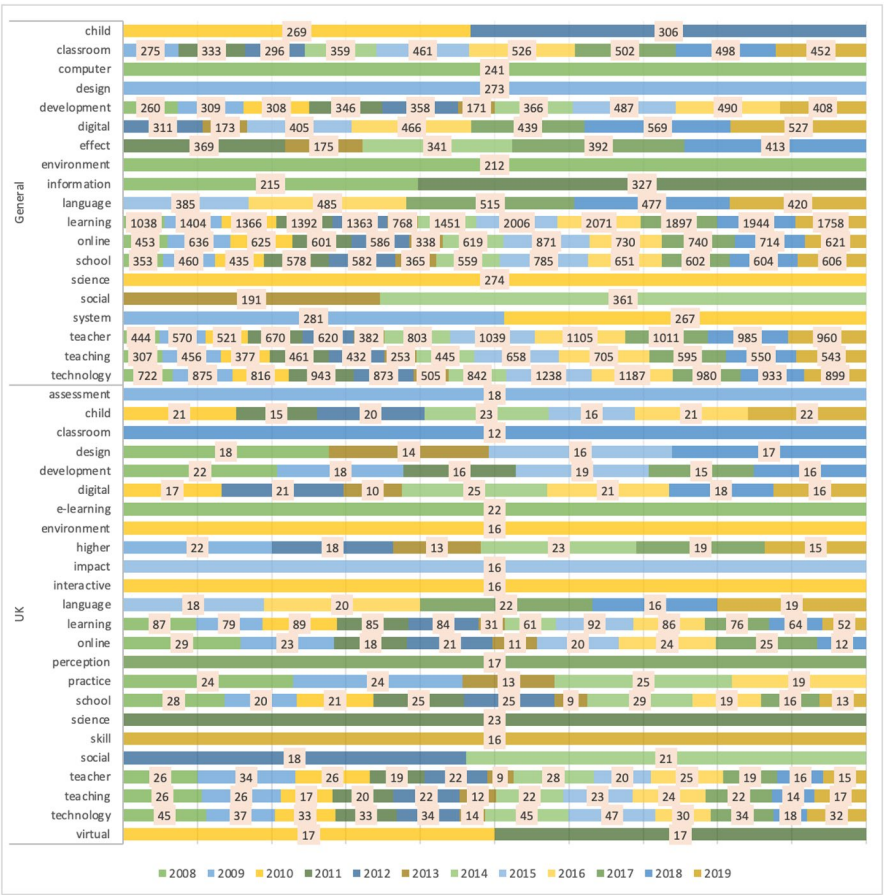


Fig. 4 Comparative results of the research trends according to the title field in educational technology in the UK and over the world

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Comparison of research trends in terms of audience field

There is also a field called Audience in ERIC Record which presents the target audience for the publication. If the audience is specified in a publication, this field is populated only if the target audience is specified in the publication. The findings obtained according to the audience field are comparatively included in Fig. 5, and the findings reveal the research trends in the educational technology field in the United Kingdom and over the world.

When the most frequent studies in the field of educational technologies are compared with the UK based studies on audience variable to present similarities and differences, the results presented in Table 5 below. The term community mentioned in publications in general in 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2019, while it never mentioned in UK based publications.

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Table 4 The comparison of subjects under four variables in terms of Title field in ERIC Records of Publications

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
Child	2010, 2012	2010, **2011**, 2012, **2014, 2015, 2016, 2019**	24
School	2008, 2009, 2010, 2011, 2012, 2013, 2014, **2015**, 2016, 2017, **2018**, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2016, 2017, 2019	3
Higher	–	**2009, 2012, 2013, 2014, 2017, 2019**	–
Teacher	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2
Method			
Assessment	–	**2009**	–
Design	**2009**	**2008, 2013,2015,2018**	–
Effect	**2011,2013, 2014, 2017, 2018**	–	–
Impact	–	**2015**	–
Approach			
Classroom	**2009, 2011, 2012, 2014, 2015, 2016, 2017**, 2018, **2019**	2018	0.3
Development	2008, 2009, **2010**, 2011, **2012, 2013, 2014**, 2015, **2016, 2019**	2008, 2009, 2011,2015, **2017, 2018**	3
Environment	**2008**	**2010**	–
e-Learning	–	**2008**	–
Interactive	–	**2010**	–
Language	2015, 2016, 2017, 2018, 2019	2015, 2016, 2017, 2018, 2019	4
e-Learning	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	0.5
Online	2008, 2009, **2010**, 2011, 2012, 2013, **2014**, 2015, 2016, 2017, 2018, **2019**	2008, 2009, 2011, 2012, 2013, 2015, 2016, 2017, 2018	2
Perception	–	**2017**	–
Practice	–	**2008, 2009, 2013, 2014, 2016**	–

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Table 4 (continued)

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity* (%)
Science	**2010**	**2011**	–
Skill	-	**2019**	–
System	**2009, 2010**	–	–
Teaching	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	4
Technology			
Computer	**2008**	–	
Digital	2012, 2013, **2015** 2016, **2017**, 2018, 2019	**2010**, 2012, 2013, **2014** 2016, 2018, 2019	4
Information	**2008, 2011**		
Social	**2013**, 2014	**2012**, 2014	7
Virtual		**2010, 2011**	
Technology	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	4

*The ratio of the studies conducted in the relevant category in the UK to the general in the years when the studies were similar to the general

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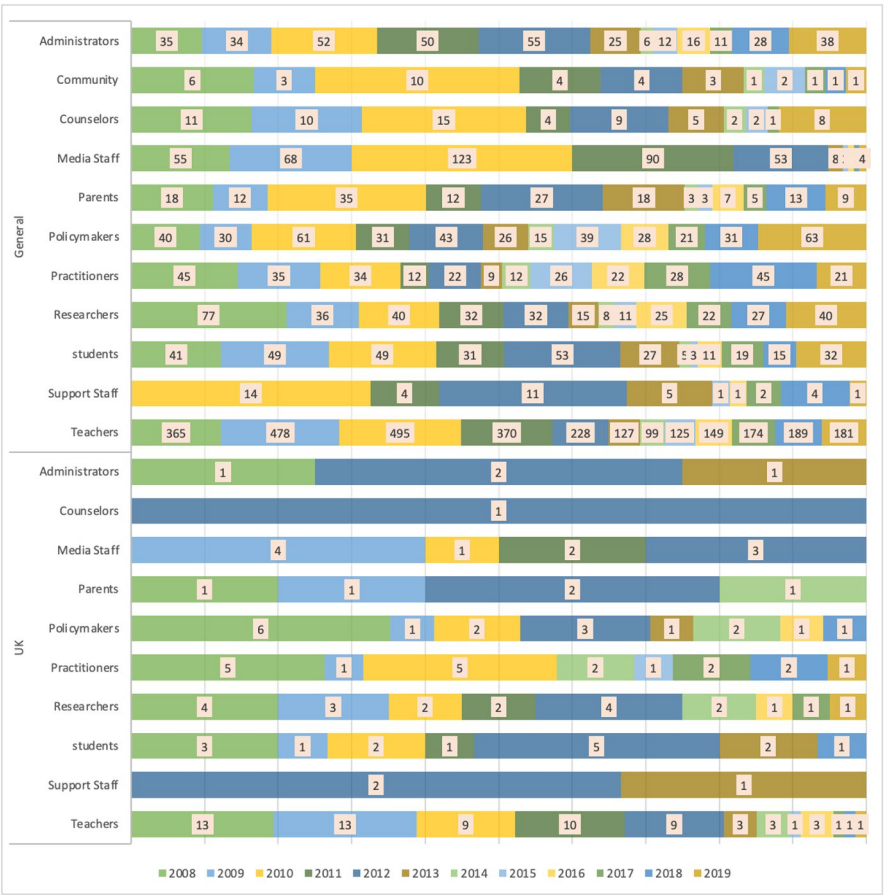


Fig. 5 Comparative results of the research trends according to the Audience field in educational technology in the UK and over the world

Conclusion

The research trends of the studies conducted in the field of educational technologies in the world and UK origin are discussed below in terms of differences and in four categories (target audience, method, approach and technology) in terms of four fields of ERIC Record: descriptor, title, abstract and audience variables.

Differences in descriptor, title, abstract and audience fields

When the findings obtained in terms of the Descriptor field are examined under the target audience category, it is concluded that the trends of the studies conducted in the world and the studies of UK origin differ on college faculty in 2019. This finding indicates that the studies of UK origins bring a different direction to the field and differ from the world-wide

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Table 5 The comparison of subjects under four variables in terms of Audience field in ERIC Records of Publications

Target audience	Years mentioned in publications in General	Years mentioned in UK based publications	Percentage of similarity*
Administrators	2008, **2009, 2010, 2011**, 2012, 2013, **2014, 2015, 2016, 2017, 2018, 2019**	2008, 2012, 2013	1
Community	**2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2019**	–	
Counselors	**2008, 2009, 2010, 2011**, 2012, **2013, 2014, 2015, 2017, 2019**,	2012	1
Media staff	2009, 2010, 2011, 2012, **2013, 2015, 2016, 2017, 2018, 2019**	2009, 2010, 2011, 2012	2
parents	2008, 2009, **2010, 2011, 2012, 2013**, 2014, **2015, 2016, 2017, 2018, 2019**	2008, 2009, 2014	3
Policymakers	2008, 2009, 2010, **2011**, 2012, 2013, 2014, **2015**, 2016, **2017**, 2018, **2019**	2008, 2009, 2010, 2012, 2013, 2014, 2016, 2018	4
Practitioners	2008, 2009, 2010, **2011, 2012, 2013**, 2014, 2015, **2016**, 2017, 2018, 2019	2008, 2009, 2010, 2014, 2015, 2017, 2018, 2019	6
Researchers	2008, 2009, 2010, 2011, 2012, **2013, 2018** 2014, 2015, 2016, 2017, 2019	2008, 2009, 2010, 2011, 2012, 2014, 2015, 2016, 2017, 2019	5
Students	2008, 2009, 2010, 2011, 2012, 2013, 2018, **2014, 2015, 2016, 2017, 2019**	2008, 2009, 2010, 2011, 2012, 2013, 2018	4
Support staff	2012, 2013, **2010, 2011, 2015, 2016, 2017, 2018, 2019**	2012, 2013	7
Teachers	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 2019	2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 2019	2

*The ratio of the studies conducted in the relevant category in the UK to the general in the years when the studies were similar to the general

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trend. However, according to the findings considering the title field, the target audience appears to be *higher* in the UK-based studies. According to the abstract variable, while *child* and *higher* are the target groups in UK-based studies, *students* stand out worldwide.

When the most common studies related to educational technologies are compared with UK-based studies in terms of Descriptor field in the method category, it is found that descriptors related to *statistical analysis* and *comparative analysis* are assigned for general studies, but not studies of UK origin. Nevertheless, it is concluded that studies of UK origin make extensive contributions to the field of educational technologies by focusing more on *case studies*. However, according to the findings obtained in terms of Title field, assessment and *impact* are prominent in studies of UK origin; The *effect* stands out in studies conducted around the world.

When the results are examined in the approach category according to the Descriptor field, *technology literacy* stands out in studies conducted in the UK, and *students' attitude* stands out in studies conducted worldwide. On the other hand, the analysis of the results examined in terms of Title field according to the approach category, while *e-learning, interactive, perception, practice* and *skill* came to the fore in the studies conducted in the UK, only the *system* came to the fore in the studies conducted around the world. Finally, according to the findings obtained in terms of Abstract field in the same category, *academic, approach, practice, skill* and *support* outshined in the studies of UK origin; on the other hand, the *program* and *system* come forward in the studies conducted around the world.

When the technology category is examined in the Descriptor field, it is concluded that the term *social networks* is used only in publications originating from the UK and not in others. In the Title field, it was concluded that *virtual* use in the studies conducted in the UK and *computer* and *information* stand out in studies conducted worldwide. When the technology category is examined in the Abstract field, while the terms *computer* and *web* were used in general publications, these terms were not used in publications originating from the UK.

Last, studies examined on the basis of the Audience field in terms of target audience also differ from studies conducted in the UK in terms of *community* around the world.

Similarities in descriptor, title, abstract and audience fields

When the findings obtained in terms of the Descriptor field are analyzed under the target audience category, the trends of the studies conducted in the world and the studies conducted in the UK are mostly similar in terms of *higher education.* The term was used in the same years of 2008 and 2013 in both general and UK based studies. However, the results on Title field show the highest similarity for the term *child* in the years of 2010 and 2012. In terms of the Abstract field, the results show similarity for the term *school (2008, 2009, 2010, 2011, 2012, 2014, 2015, 2016, 2017, 2018, 2019)* and for *teacher* (2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019).

Findings for method categories in the Descriptor field show that interviews are used as a common term (2014, 2015, 2016, 2017), but there is no meaningful frequency in the Title and Abstract field.

When the approach category is examined in the Descriptor field, there was the highest similarity in terms of *electronic learning* (2009, 2010, 2013). For Title field, there is highest similarity in *language* (2015, 2016, 2017, 2018, 2019) and *teaching* (2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019). Finally, in terms of the Abstract

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field, there is the highest similarity for *development* (2008, 2009, 2010, 2012, 2014, 2015, 2016, 2017).

Furthermore, when the findings in the technology category in the Descriptor field, the highest similarity was *internet* (2008,2009,2010,2011,2012,2013) and *information technology* (2008,2009,2010,2012); in the Title field, the highest similarity was for *social* (2014); and in the Abstract field, the highest similarity was for *digital* (2018, 2019) and *technology* (2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019).

Last, considering the Audience field, it has been revealed that the studies conducted around the world and the studies of UK origin show the highest degree of similarity in terms of practitioners (2008, 2009, 2010, 2014, 2015, 2017, 2018, 2019).

Discussion

Differences between research trends in the educational technology field in the United Kingdom and over the world

As a result of the examination of the studies indexed in the ERIC database, when the UK-based studies in the field of educational technologies are compared with the studies conducted around the world; it is concluded that UK has provided more research in terms of target audience, method, approach, technology and audience. There are some bibliometric studies in the literature that confirm this deduction. For example, Chen et al. (2020) reported that the UK is the most influential country among the educational technology field.

According to the findings, studies of UK origin tend to be more specific in terms of target audience. This situation is also supported in terms of method, when compared with the studies conducted in the field of educational technology worldwide. In fact, the studies of UK origin has provided more research related to case studies. Furthermore Chen et al. (2020) also found that case study was one of the most frequently used terms in their bibliometric analysis of BJET publications. In this respect, it is suggested that studies on educational technologies around the world will contribute to the literature by addressing different cases on the basis of case studies method.

However, when UK-based studies are examined under the category of approach, they differ in terms of *technology literacy, e-learning, interactive, perception, practice, skill, academic, approach, skill* and *support*. It is also emphasized in the literature that the researchers in the field should focus more on skill-oriented studies (Tight, 2020; Umachandran et al., 2019; Horizon Report, 2017).

Accordingly, the differentiating studies of UK origin have caught the trend by showing a tendency on the basis of skill-oriented and directed works around the world. According to Horizon Report (2017), students need guidance and coaching as they work to solve complex problems to discover new knowledge and gain concrete skills. Social and economic factors are redefining what skills are required in today's workforce, so colleges and universities are forced to rethink how to define, measure and demonstrate skills (Horizon & Report, 2017). Nesta (2020) has reported on new developments, such as the New Model at the University of Technology and Engineering, launched in the UK in 2018, utilizing interdisciplinary and problem-based approaches to teaching and learning through collaboration with industry and academic partners. At this point, it can be deduced that the UK is leading

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the studies that will support the academic, social and cultural development of individuals by guiding the developments in the field of educational technologies.

When the studies of UK origin are examined according to the Descriptor field, *social network* comes forward in the technology category; and according to the Title field, *virtual* comes to the fore. Concepts related to virtual are increasingly included in the literature as well (i.e. Horizon Report). Virtual technologies and virtual learning environments are increasingly being integrated into education and their potential to transform education is discussed. (Horizon Report, 2020). Additionally, it is reported in Horizon Report (2021) that virtual technologies "encourages students to adapt to the reality that their learning and most extracurricular activities will be online, while providing resources to ensure virtual student success" (p.17).

When the studies are examined in terms of the Audience field, while the *community* as the target audience is addressed only in studies around the world, it has not been addressed in the studies conducted in the UK. In addition, *administrators, parents, support staff* did not find a place in UK based studies. Also, UK-based studies mostly address *practitioners* rather than *communities* on the basis of a relevant approach in terms of specific groups and methods. However, with the introduction of distance education at all levels at the K-12 level, especially with the Covid pandemic, it has emerged that the roles of this target audience have become more important (Author, 2020). This situation brings along the importance of working more on the specified audience. Studies that include findings in line with the expectations of the target audience in the studies can be associated with the existence of known and highly recognized communities. At this point, it may be suggested to differentiate the target audience of the UK-based works towards the community in line with the needs and expectations.

Similarities between research trends in the educational technology field in the United Kingdom and over the world

Although, in terms of the Descriptor field, the trends in the target audience category were *higher* on higher education, and in terms of the Title field, the trends in the target group area were high on the *child*; the similarity in showing parallelism in terms of years remains weak.

On the other hand, according to the Abstract field, the *school* and *teacher* are continuous terms both in the UK and in the world in terms of intensity and years of study. This finding reveals that in the field of educational technologies, different fields and target groups should be addressed rather than *school* and *teacher*. Especially, the emphasis of skill-oriented studies on the basis of the approach in the field of educational technologies reveal that all kinds of learning ecology should be employed not only in the school but also in different environments and out-of-school environments, and in a way that students can take an active role and support the formation of a learning culture. As a matter of fact, (Authors, 2021) stated that pedagogical approaches towards theory and practice, learning ecology and the dynamics of this ecology are important in terms of supporting the learning culture and environment based on the concepts of openness in education and learning culture.

Furthermore, the term *interview* is the most similar term for both UK and the worldwide studies in terms of method, and it can be integrated with other data collection methods so studies from around the world and UK can show parallelism. Considering the leadership position of the UK, which stands out in the case studies, diversifies the method in these studies, it is recommended to include other methods for worldwide studies.

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Similarly, although in terms of the Descriptor, Title, and Abstract field, it was found that the tendency of trends in the approach category were higher on *electronic learning*, and in terms of the title variable, the trends in the target group area were high on the *language*; the similarity in showing parallelism in terms of years remains weak.

On the other hand, both in the UK and in the world, *teacher* from the Title field and *development* from the Abstract field have been continuing for many years in terms of both the intensity and the years of study. This suggests that educational technologies have developed on a basis that focuses on teaching. However, at this point, it is not only teaching on the basis of changing paradigms; it can be suggested to work intensively with an understanding based on the structure of educational technologies that enable learning and the development in learning.

Finally, in terms of the Audience field, similarity between the studies of UK origin and the world-wide in terms of *practitioners* also provide a road map for the practitioners of educational technology research. Because the results of the studies in the field should be meaningful for the practitioners. In fact, it may be important for the practitioners to report the results of their practice that they find different from the study results in terms of developing models and theories based on the dynamics of the new world order in the future.

Chen et al. (2020) states that the case studies that stand out in his study may also be related to the practices that teachers carry out in the classroom. This situation makes the stated suggestion meaningful because the teachers, who are practitioners as audiences, are in a position to apply and evaluate the results of the study. Finally, in terms of the audience variable, future studies where the target audience is *community* will be important in strengthening the trend of studies in the field of educational technologies.

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Limitations and recommendations

In this section, recommendations for the analysis and findings obtained in the study are presented. This study is limited to the studies conducted in the field of educational technologies in the ERIC database between 1965 and 2020. Accordingly, it is thought that examining other databases in which the studies in the field of educational technologies are indexed and studies with similar methods will be useful for future studies in terms of revealing and comparing trends in the field of educational technologies. In addition to the analysis carried out, recommendations were made for the findings obtained in the study.

It is predicted that the studies to be carried out on educational technologies around the world can contribute to the literature with a more specific target audience by addressing different cases on the basis of case studies method that stands out in UK-based studies. As a matter of fact, when the common trends in educational technologies are examined on the basis of approach in studies conducted worldwide and in the UK, the findings of *computer uses in education* and *technology uses in education* can be addressed with the target audience and with a specific approach and can feed the literature at the point of technology integration.

At this point, it can be investigated which technologies are subject to which methods and target audience and educational technologies in the studies. Thus, the result of the limited number of studies on *technology integration* obtained among the common tendencies examined can be addressed. In future studies, the case study method of integration studies carried out at the point of effective use of educational technologies can be used with other

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mixed, experimental, etc. Thus, it can contribute to the strengthening of the literature in terms of increasing the generalizability of the results and increasing the impact factor.

In the studies to be carried out, the results obtained regarding the target audience, method and technology integration can be examined together with their limitations and recommendations. In addition, it is recommended that the studies conducted in the field of educational technologies around the world focus more on skills within the framework of new approaches in terms of individual differences. For UK-based studies, it is recommended to integrate the subjects in the field of educational technology with the specific target audience and method, while it is recommended to show a tendency to focus on the prominent issues for the studies conducted around the world. Finally, it is clear that there is a need for scientific studies that analyze and meet the expectations and needs of communities in the field of educational technology in future studies. Otherwise, the studies and applications may not go beyond the use of technology and at this point there may be an imbalance in the investment-expectation scale between decision makers and implementers.

Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

Research involving human and animal participants This article does not contain any studies involving human participants performed by any of the authors.

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