



Mapping the prevalence of mixed methods research in educational technology journals

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ABSTRACT

Advancing knowledge in educational technology requires a diverse array of research designs, methodologies, and data sources. Mixed methods research, particularly valuable for studying intricate issues, remains scarce in educational technology. The purpose of this study is to examine the prevalence of mixed methods research studies published in the top 10 educational technology journals between 2018 and 2022. By examining $n = 2380$ articles from top educational technology journals, this study aims to enhance awareness of mixed methodologies among educational technology researchers, highlighting common approaches and identifying gaps. Adhering to best practices for prevalence studies and utilizing methods from evidence synthesis, three authors screened and coded articles for quantitative, qualitative, mixed methods, or non-empirical studies through three stages of data analysis. Results indicate that mixed methods research is underrepresented, constituting only 12% of all published articles, the smallest proportion compared to other types. Furthermore, 64% of these mixed methods studies did not self-identify as such despite employing mixed methods approaches, revealing a gap in methodological understanding. Among those that did self-identify, 68% failed to specify the type of core mixed methods approach used, indicating further gaps. The prevalence of mixed methods research published in the top 10 educational technology journals in a 5-year period ranged between 5% and 15% and is low compared to other types of published studies in the field. Addressing the underrepresentation and improving the specificity of methodological reporting can enhance the overall quality of research in educational technology.

1. Introduction

There is an increased public interest and scholarly scrutiny regarding the impact of educational technology at all stages of education and learning, along with a critical examination of the quality and rigor of research in the field (Peters & Fabregues, 2023). The field of educational technology necessitates a diverse array of research designs, methodologies, and data sources to advance the current state of knowledge (Krumsvik, 2020). Mixed methods research allows the combination of the strengths of both quantitative and qualitative research to offset the limitations of both and increase the breadth and depth of research (Fetters, 2020) and offers an opportunity to investigate complex problems that cannot be studied using a single method (Creswell & Plano Clark, 2018). In the rapidly evolving field of educational technology, where new tools and approaches impact learning environments in multifaceted ways,

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mixed methods research allows to capture both broad trends and deeper contextual insights, uncovering the intricate ways technology influences learning outcomes. It is particularly valuable and suited for studying multidimensional types of complex problems prevalent in the field of educational technology (Krumsvik, 2020; Ngulube & Ukwoma, 2022; Peters et al., 2022; Peters & Fàbregues, 2023; Poth, 2018). Several good examples of mixed methods research studies are present in the educational technology literature. For example, Sumuer and Kasikci (2022) used a sequential explanatory mixed methods design to examine the relationship between college students' smartphone addiction and mind-wondering during learning. The quantitative phase identified relationships using multiple regression analysis, while the qualitative phase used semi-structured interviews to provide richer explanations of how smartphone use contributed to mind-wandering during learning. Another study conducted by Han (2020) employed a convergent mixed methods design to investigate the impact of immersive virtual field trips on elementary school students' sense of presence and perceived learning. By collecting quantitative data on students' perceived presence through questionnaires and qualitative data on students' perceptions via reflective papers, the study was able to measure students' perceived virtual presence and provide a nuanced understanding of their perceptions using virtual field trips for learning.

Prevalence studies can provide guidance for researchers and journals on how to better conduct and represent underutilized methodologies in a field. While some studies have explored mixed methods prevalence across multiple disciplines (e.g., Alise & Teddlie, 2010; Ivankova & Kawamura, 2010), other studies examined one-discipline mixed methods prevalence such as health (McManamny et al., 2015), special education (e.g., Conroy et al., 2023) and juvenile justice (Marsh et al., 2022). Few studies examine the types of articles published in educational technology (Baydas et al., 2015; Lai & Bower, 2019; Perez-Sanagustin et al., 2017; Twining et al., 2017) and of these, most report a strong emphasis on quantitative methodologies. The literature advocates for the use of diverse methodologies in the educational technology field, mixed methods research being one of them. For example, in a meta-systematic review of research in artificial intelligence in higher education, Bond et al. (2024) reviewed 66 evidence synthesis studies and called for "enhanced rigor and methodological robustness" (p. 34). The authors highlighted the importance of undertaking mixed methods approaches to strengthen future research in the educational technology field.

The clear benefits of mixed methods research combined with the calls for increased rigor in mixed methods research and the lack of a recent investigation of the prevalence of mixed methods research in the educational technology field necessitate an updated exploration of mixed methods research in top educational technology journals. This study aims to fill the gap by investigating the prevalence of mixed methods research published in the top 10 educational technology journals between 2018 and 2022. The following research questions guided the study:

1. What are the publication trends in methodological approaches (quantitative, qualitative, non-empirical, and mixed methods) in top educational technology journals between 2018 and 2022?
2. How prevalent is mixed methods research in top educational technology journals between 2018 and 2022?
3. How frequently is mixed methods research self-identified in top educational technology journals between 2018 and 2022?
4. How are core mixed methods research designs represented in top educational technology journals between 2018 and 2022?

2. Literature review

2.1. Mixed methods research as a method of inquiry

Mixed methods research involves integrating quantitative and qualitative research techniques within a single study (Johnson & Onwuegbuzie, 2004) and is preferred when "combining quantitative and qualitative approaches is likely to provide more comprehensive research findings and outcomes" (Powell et al., 2008, p. 292). Numerous studies across various fields praise the advantages of using mixed methods research, emphasizing its potential to lead to a deeper understanding of the research problem and complex issues that require multiple types of data (Bazeley, 2019; Creamer, 2018; Creswell & Plano Clark, 2018; Fetters & Molina-Azorin, 2017; Greene, 2007; Johnson & Onwuegbuzie, 2004; Teddlie & Tashakkori, 2009). Methodological reviews in different disciplines also consistently highlight the advantages of mixed methods research for addressing intricate research inquiries (Howell Smith & Shanahan Bazis, 2021).

The mixed methods approach leverages the strengths of qualitative and quantitative research and deepens the research results as scholars can employ a wide array of data collection tools rather than being constrained by the tools associated with either type of research. Through mixed methods research, scholars thoughtfully integrate qualitative and quantitative approaches to generate novel insights that allow exploring convergent and divergent findings (Creswell & Plano Clark, 2018; Fetters, 2020; Fetters & Freshwater, 2015). Given the clear benefits of mixed methods research, it is important to understand its prevalence in educational technology.

2.2. Trends in mixed methods research in educational technology

The field of educational technology necessitates a diverse array of research designs, methodologies, and data sources to advance the current state of knowledge (Krumsvik, 2020). The choice between research approaches should be guided by the research questions and the problem under investigation (Hesse-Biber & Johnson, 2015). Mixed methods research can enhance knowledge and address intricate issues within educational technology (Krumsvik, 2020; Peters et al., 2022) and provide answers to questions that would otherwise remain unattainable through a singular methodological approach (Poth, 2018).

Scholars have examined the representation of various research methodologies in publications within educational technology (e.g., Lopez et al., 2015; Perez-Sanagustin et al., 2017; Twinning et al., 2017). For instance, between 2010 and 2015, Perez-Sanagustin et al.

(2017) identified an uneven distribution of empirical quantitative and qualitative research articles in *Computers and Education*, prompting a call for rebalancing the utilization of these research approaches. Between 2015 and 2017, Lai and Bower (2019) similarly observed an imbalance in the publication of quantitative and qualitative studies in *Computers and Education*. Baydas et al. (2015) reported a prevalence of quantitative studies in educational technology journals from 2002 to 2014. Perez-Sanagustin et al. (2017) found that 34% of articles in *Computers and Education* published between 2011 and 2015 employed mixed methods, whereas Lai and Bower (2019) reported a much lower proportion of 5.5% in articles published in *Computers and Education* but in a later and shorter timeframe of 2015–2017. Baydas et al. (2015) identified a mixed methods prevalence rate of 12.7% in the journals they reviewed. Bond et al. (2019) called for exploring methodological representation in the *British Journal of Educational Technology* by analyzing article types and research methods. While some researchers have investigated the prevalence of quantitative and qualitative research approaches, others have focused on specific journals, and some have examined historical trends. However, no research has studied the prevalence of mixed methods empirical research articles across top-ranked journals in educational technology in recent years, an issue examined in this study.

2.3. Methods used in mixed methods prevalence studies

To explore the prevalence of mixed methods research in the educational technology field, we analyzed the types of studies conducted to investigate similar issues. Two types of methodological studies have been conducted: prevalence studies and evidence synthesis methods. Prevalence studies seek to understand the frequency of a methodology within a specific discipline, journals, or set of articles (Molina-Azorin & Fettes, 2016). Several studies have looked at the prevalence of mixed methods in different fields, such as the social sciences (Alise & Teddlie, 2010; Collins et al., 2006), educational technology (Baydas et al., 2015; Pérez-Sanagustín et al., 2017), or school psychology (Powell et al., 2008). In 2016, Molina-Azorin and Fettes published recommended guidelines for conducting prevalence studies. These guidelines included justifying the disciplinary focus, defining the mixed methods used in the study, selecting relevant journals, determining the time period, and outlining the search methods for article identification.

Other studies have applied evidence synthesis methods such as systematic reviews (e.g., McManamany et al., 2015; Merchant et al., 2021) or systematic maps (e.g., Bond et al., 2020) to investigate the quality of research questions used in mixed methods research. Evidence synthesis methods have strong guidance for documenting search strategies (Rethlefsen et al., 2021) and anonymous screening processes for selecting articles (Lefebvre et al., 2023; Polanin et al., 2019), often with the use of software designed for this purpose (Zhang & Neitzel, 2023). Borrowing from evidence synthesis methods can increase the rigor of prevalence studies.

3. Methodology

We adhered to the recommended guidelines for rigorous mixed methods research prevalence studies outlined by Molina-Azorin and Fettes (2016) and borrowed some processes from the field of evidence synthesis (Lefebvre et al., 2023) to further improve the reproducibility and transparency of this study. The research procedures employed in this study comprised three distinct phases.

3.1. Phase 1. Time period, journal, and article period selection

3.1.1. Time period selection

We deliberately chose a 5-year timeframe, spanning from 2018 to 2022, with the primary objectives of ensuring the inclusion of recent data, achieving comprehensive coverage, and facilitating a manageable data analysis process. We also acknowledge that researchers may have had limited access to students in classrooms during the pandemic, which might have influenced the types of studies published in these years. That said, by adopting this specific temporal scope, we aimed to offer an up-to-date perspective on emerging trends in the evolving landscape within the field of educational technology. Consequently, our study provides an accurate portrayal of the contemporary landscape concerning the application of mixed methods designs in the realm of educational technology.

3.1.2. Journal selection

Two methods are used to identify articles for a prevalence study. Some prevalence studies use database search strategies designed to find articles employing mixed methods designs (Bond et al., 2020; Hayman & Smith, 2020; McManamny et al., 2015), and others have reviewed all articles published in specific journals (Alise & Teddlie, 2010; Baydas et al., 2015; Powell et al., 2008). This study reviews articles published in top journals in educational technology for two reasons. First, not all articles that employ mixed methods approaches report their use in the title, abstract, or keywords (Molina-Azorin & Fettes, 2016), which are the fields that databases search most consistently. Second, it would be challenging to differentiate articles in the field of educational technology from other subfields of education with a search strategy approach.

With no pre-defined list of top journals in the field of educational technology, we determined prominent journals in the field based on 2022 CiteScores provided by Scopus in the Education Subject Area. Scopus was selected since it has a single category for all journals in Education compared to four sub-categories of journals that overlap with educational technology from the Web of Science (Clarivate Analytics, 2023). To form the journal selection, two authors (XX and XX) independently reviewed the Aims & Scope webpages of the top 50 journals with the highest 2022 CiteScores in Scopus's Education Subject Area for their focus on the field of educational technology. After the initial votes, the two authors discussed any conflicts and identified the top 10 educational technology journals used in this study (Table 1). By selecting ten journals, this study provided a more expansive view of mixed methods research than previous studies that have looked at mixed methods prevalence in educational technology in one or two journals (Baydas et al., 2015;

Lai & Bower, 2019; Perez-Sanagustin et al., 2017).

3.1.3. Article selection

After identifying the top ten educational technology journals, we selected the articles from each journal to be included for review. First, we compiled a Saved List in Scopus of all Articles (excluding other Document Types) for the time period selected, totaling 3694 articles. It is possible that Scopus may have missed indexing some articles from the time period and we acknowledge this limitation. Articles from three journals (*Computers and Education*, *Interactive Learning Environments*, and *British Journal of Educational Technology*) accounted for 65% of the article sample. To avoid skewing the research towards these three journals, we limited the number of articles from these journals to 350 using a simple random sample technique (Alise & Teddlie, 2010). The final number of articles from each journal is listed in Table 1.

3.2. Phase 2. Screening for types of articles

In the second phase of our study, three authors screened articles for inclusion of mixed methods research using Rayyan (<https://www.rayyan.ai/>), a collaborative online software tool used in evidence synthesis projects to facilitate the screening and assessment of articles.

Following a process used in evidence synthesis projects (Lefebvre et al., 2023), the authors first completed an anonymous title-abstract screening of $n = 2380$ articles, then retrieved full text of $n = 466$ articles and completed secondary anonymous screening. Both title-abstract and full-text screening were piloted with various selections of articles until intercoder reliability reached at least 75%. During both the title-abstract and full-text screening phases, two researchers (OK + SQ or AD + SQ) anonymously evaluated each study, bringing in a third researcher (OK or AD) to decide in any case of disagreement to reach a consensus.

Articles were screened for inclusion in the study by categorizing the type of method used, such as non-empirical, qualitative, quantitative studies or mixed methods. Only mixed methods research (MMR) studies were advanced to phase 3 of the analysis. The inclusion criteria for mixed methods articles were based on Creswell and Plano Clark's (2018) core characteristics of mixed methods research. Molina-Azorin and Fetter's (2016) underscored the criticality of adopting a clear definition of mixed methods research within the context of conducting prevalence studies. Over the years, numerous definitions of mixed methods research have emerged from the scholarly community, encompassing diverse facets of research methods, procedural steps, overarching objectives, and philosophical underpinnings (Creswell & Plano Clark, 2018). In our present study, we have adopted the definition of mixed methods research delineated by Creswell and Plano Clark (2018). Using this definition, each article was screened for inclusion in the study based on four core characteristics discussed by Creswell and Plano Clark (2018): 1) the rigorous collection and analysis of both quantitative and qualitative data; 2) the integration or merging of both forms of data in the results; and 3) organizing the procedures into a research design; and 4) grounding the research procedures within a framework of theoretical and philosophical orientations. Note that we did not distinguish between the depth of quality in mixed methods studies. Identifying a study as mixed methods did not indicate how well mixed methods research was executed in the study.

Many articles failed to clearly articulate their methodology in the abstract, and some failed to communicate the types of data collected in a clear manner in full text, which made screening for article types challenging and required discussion between all three authors to determine an article type. To enhance the transparency of our selection process, following the recommendation of Boeije et al. (2013) and based on PRISMA guidelines (Haddaway et al., 2022; Page et al., 2021), we have incorporated a flow chart delineating the stepwise inclusion and exclusion of studies (Fig. 1).

3.3. Phase 3. In-depth analysis of mixed methods research articles

In the third phase of our study, three authors coded articles classified as mixed methods research ($n = 290$) in separate private spreadsheets which were later combined and compared. Each article was coded by two researchers (OK & SQ or AD & SQ) with tie-breaking votes by a third researcher (OK or AD) where there were coding conflicts. After piloting the coding scheme on 20 articles with

Table 1
Top ten educational technology journals and selected articles (2018–2022).

| Journal | All articles | | Selected articles | |
|---|--------------|------------|-------------------|------------|
| | Articles (n) | Sample (%) | Articles (n) | Sample (%) |
| Computers and Education | 1001 | 27 | 350 | 15 |
| Interactive Learning Environments | 757 | 20 | 350 | 15 |
| British Journal of Educational Technology | 606 | 16 | 350 | 15 |
| Journal of Educational Computing Research | 335 | 9 | 335 | 13 |
| International Journal of Educational Technology in Higher Education | 233 | 6 | 233 | 10 |
| Learning, Media and Technology | 192 | 5 | 192 | 8 |
| Journal of Computing in Higher Education | 181 | 5 | 181 | 8 |
| Distance Education | 153 | 4 | 153 | 7 |
| Internet and Higher Education | 120 | 3 | 120 | 5 |
| Journal of Computers in Education | 116 | 3 | 116 | 5 |
| Total | 3694 | | 2380 | |

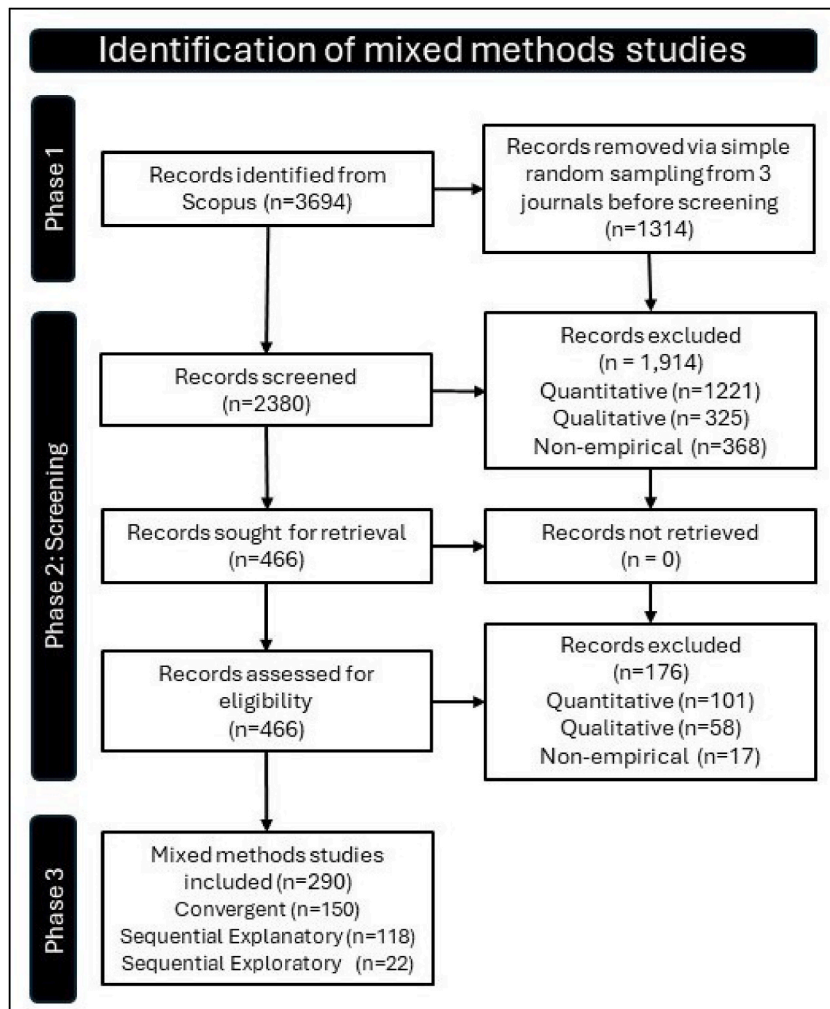


Fig. 1. Flow diagram of articles selected for this study.

all team members and intercoder reliability of 80%, we analyzed these articles to determine the specific mixed methods research design employed. We relied on a three-dimensional typology of mixed methods research. We examined the mixing, time orientation, and emphasis level when determining the type of mixed methods design utilized in the articles (Leech & Onwuegbuzie, 2009), conducted a content analysis of the articles (Krippendorff, 2009), and classified them into three core mixed methods designs: convergent, explanatory sequential, and exploratory sequential (Creswell & Plano Clark, 2018).

We conducted two additional levels of coding which analyzed how authors described their research methodology. Many prevalence studies locate mixed methods articles using keyword-based database searches (Bond et al., 2020; Hayman & Smith, 2020; McManamny et al., 2015). As a result, they tend to find articles that self-identify as mixed methods research. By looking at most published articles by journals in a timeframe, we were able to see that many articles that adhere to the definition of mixed methods posed by Creswell and Plano Clark (2018) failed to self-identify as mixed methods research. To our knowledge, no other prevalence study has analyzed the discrepancy between the use of a mixed methods approach and the choice to self-identify as mixed methods research. This approach allowed us to contribute an additional dimension to mixed methods research in educational technology.

The first round of coding ascertained whether the authors of $n = 290$ mixed methods articles explicitly self-identified their research as mixed methods (SI MMR) or whether the articles were not self-identified as mixed methods research (NSI MMR) despite employing mixed methods design in adherence to Creswell and Plano Clark's (2018) definition used in Phase 2 of the study. The second round of coding was inductive and examined if the type of mixed methods design in the articles was specified (Specified MMR) or not specified (Non-Specified MMR). During this round of coding, we also examined how authors labeled their studies when they employed a mixed methods design but did not explicitly call their study mixed methods.

4. Results

4.1. Publication trends in methodological approaches in educational technology journals

To answer the first research question, “What are the publication trends in methodological approaches (quantitative, qualitative, non-empirical, and mixed methods) in top educational technology journals between 2018 and 2022,” we screened $n = 2380$ articles. The articles were classified as quantitative, qualitative, mixed methods, or non-empirical. The largest percentage of articles represented quantitative empirical research articles ($n = 1322$; 56%), followed by non-empirical articles ($n = 385$; 16%) and qualitative empirical research articles ($n = 383$; 16%). Mixed methods empirical research articles constituted the smallest percentage ($n = 290$; 12%) of all published articles and were underrepresented. Fig. 2 and Table 2 show the summaries of these results.

The percentage of quantitative articles shows a generally increasing trend from 2018 to 2022, with minor fluctuations. The trend for qualitative research articles is more variable and indicates fluctuations in qualitative research publications over the five years. The trend in the percentage of mixed methods research shows an initial decrease followed by a slow but consistent increase. The percentage of mixed methods articles saw a consistent upward trend from 10% in 2019 to 14% in 2022, indicating a slow-growing acceptance and use of mixed methods research in academic educational technology publications. Comparative analysis (Fig. 3) shows that while quantitative and mixed methods research have generally increasing trends, quantitative research remains the most prevalent.

4.2. Prevalence of mixed methods research in educational technology journals

By answering the second research question, “How prevalent is mixed methods research in top educational technology journals between 2018 and 2022,” we concluded that mixed methods studies were underrepresented. The highest percentage of mixed methods studies was published in the *Journal of Computing in Higher Education* and *Internet and Higher Education* (15%), while the lowest percentage was found in *Learning, Media, and Technology* (6%). Top educational technology journals published mixed methods research at relatively similar rates. Table 2 summarizes the prevalence of mixed methods studies in each journal.

This analysis shows that while mixed methods research is present in top educational technology journals, it constitutes a smaller proportion of the published articles compared to other research methodologies.

4.3. Self-identification of mixed methods designs in educational technology journals

To address research question three, “How frequently is mixed methods research self-identified in top educational technology journals between 2018 and 2022,” we examined self-identification of mixed methods studies. Out of a total of $n = 290$ articles which adhered to Creswell and Plano Clark’s (2018) definition of mixed methods research, 186 (64%) self-identified as mixed methods (SI MMR), while 104 (36%) did not self-identify as mixed methods (NSI MMR).

We closely analyzed mixed methods studies that did not explicitly identify themselves as such (NSI MMR) yet still implemented mixed methods designs. Out of a total of $n = 104$ articles that fell into this category, the majority did not indicate the type of design they utilized nor discuss any particular design typology ($n = 60$). Others described their design as either experimental or quasi-experimental ($n = 33$), a few labeled their design as a case study ($n = 7$), and a handful identified it as design-based research ($n = 4$). This finding highlights a gap in methodological understanding as researchers employ mixed methods procedures but call their

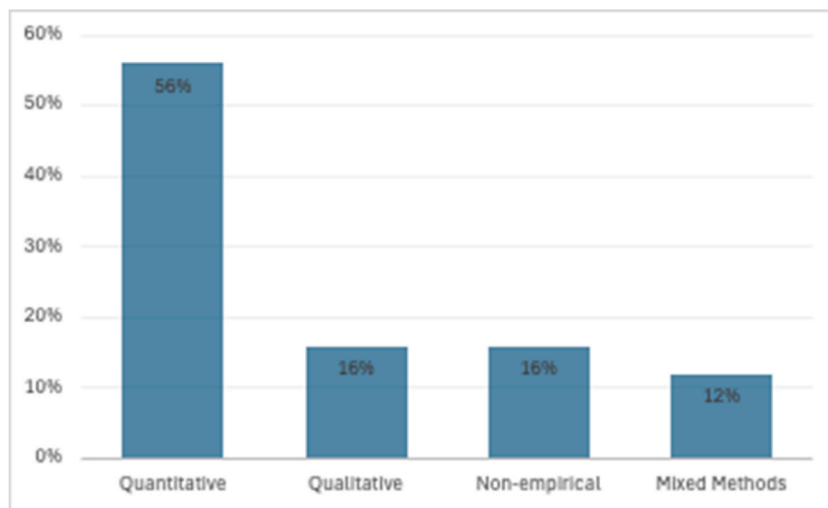


Fig. 2. Percentage of articles per type published in top educational technology journals between 2018; 2022.

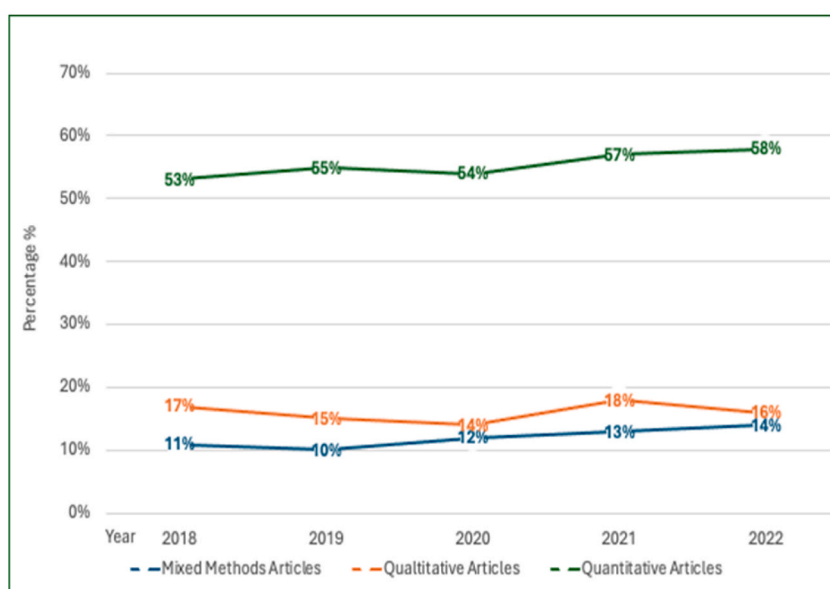
*Note. Percentages are rounded.

Table 2

Prevalence of mixed methods studies in top ten educational technology journals published between 2018; 2022.

| Journal | Mixed Methods n (% of journal) | Non-empirical n (% of journal) | Qualitative n (% of journal) | Quantitative n (% of journal) | Total articles in journal (n) |
|---|--------------------------------|--------------------------------|------------------------------|-------------------------------|-------------------------------|
| Journal of Computing in Higher Education | 28 (15%) | 17 (9%) | 32 (18%) | 104 (57%) | 181 |
| Internet and Higher Education | 18 (15%) | 11 (9%) | 25 (21%) | 66 (55%) | 120 |
| British Journal of Educational Technology | 50 (14%) | 59 (17%) | 61 (17%) | 180 (51%) | 350 |
| International Journal of Educational Technology in Higher Education | 33 (14%) | 30 (13%) | 47 (20%) | 123 (53%) | 233 |
| Interactive Learning Environments | 45 (13%) | 27 (8%) | 37 (11%) | 241 (69%) | 350 |
| Computers and Education | 41 (12%) | 50 (14%) | 29 (8%) | 230 (66%) | 350 |
| Journal of Educational Computing Research | 41 (12%) | 39 (12%) | 17 (5%) | 238 (71%) | 335 |
| Journal of Computers in Education | 10 (9%) | 28 (24%) | 8 (7%) | 70 (60%) | 116 |
| Distance Education | 13 (8%) | 46 (30%) | 40 (26%) | 54 (35%) | 153 |
| Learning, Media and Technology | 11 (6%) | 78 (41%) | 87 (45%) | 16 (8%) | 192 |

*Note. Percentages are rounded.

**Fig. 3.** Trends in research design between 2018; 2022.

*Note. Percentages are rounded.

studies quantitative or qualitative.

Among the studies ($n = 186$) that self-identified as mixed methods research (SI MMR), the majority did not specify the particular type of core mixed methods approach they employed. Specifically, $n = 126$ (68%) labeled themselves as mixed methods research in general without specifying a particular type of mixed methods approach used (Non-Specified MMR), with only $n = 60$ (32%) specifying a core mixed methods approach (Specified MMR), indicating a lack of comprehensive understanding of the discussed core mixed methods approaches in educational technology. Creswell and Plano Clark (2018) emphasized the importance of researchers carefully selecting a core mixed methods design that aligns with their research problem and reasons for mixing data sets. Choosing a typology-based core mixed methods design ensures that the resulting study design is rigorous high-quality, and facilitates a

Table 3

Core mixed methods research designs in educational technology journals.

| Core mixed methods research design | Published articles (n) | Published articles (%) |
|------------------------------------|------------------------|------------------------|
| Convergent | 150 | 52 |
| Sequential Explanatory | 118 | 41 |
| Sequential Exploratory | 22 | 8 |
| Total | 290 | 100 |

*Note. Percentages are rounded.

manageable and straightforward implementation and description of the study.

We examined the prevalence of three core mixed methods research designs, convergent, sequential explanatory, and sequential exploratory, across different identification types: self-identified as mixed methods research (SI MMR), self-identified as a specific mixed methods research (Specified MMR), and not self-identified as mixed methods research (NSI MMR). Table 4 illustrates this prevalence.

When the convergent mixed methods research design was used, $n = 69$ studies self-identified as mixed methods research, $n = 53$ did not, and only $n = 28$ explicitly stated the use of convergent mixed methods research. A similar pattern emerged with the application of the sequential explanatory mixed methods research design. For sequential explanatory mixed methods research, $n = 49$ studies self-identified as mixed methods research, $n = 47$ did not, and only $n = 22$ explicitly mentioned using the sequential explanatory mixed methods design. This finding suggests that while there is an understanding of core mixed methods research designs in the educational technology field, more attention is needed as only a small number of studies employing convergent and sequential explanatory designs named them and followed procedures consistent with the design typology.

Interestingly, the opposite trend was observed when the sequential exploratory mixed methods research design was implemented. In this case, the majority ($n = 10$) of self-identified specified MMR studies applied this design and explicitly stated it in the article, $n = 8$ SI MMR did, and only $n = 4$ NSI MMR used exploratory sequential mixed methods design. These findings suggest that although the sequential exploratory type of design is less frequently employed in the educational technology field, it appears to be more often self-identified.

We did not observe any significant changes that indicate a consistent trend over time in the prevalence of studies self-identifying as mixed methods research. The percentage of studies self-identifying as mixed methods research ranged from as low as 56% in 2019 to as high as 70% in 2020, with no clear increasing or decreasing trend over the years. Conversely, the percentage of mixed methods research studies that did not self-identify was relatively high, fluctuating from as low as 30% in 2020 to as high as 44% in 2019. Despite utilizing mixed methods procedures, and adhering to Creswell and Plano-Clark's (2018) definition of mixed methods research, many scholars who published the studies in this dataset appear unaware of mixed methods research as a distinct research methodology. They did not frame or refer to their studies as mixed methods research. Unfortunately, this trend does not seem to be improving over time. Fig. 4 shows this data.

4.4. Core mixed methods designs in educational technology journals

To address the fourth research question, "How are core mixed methods research designs represented in top educational technology journals between 2018 and 2022," we referred to Creswell and Plano Clark's (2018) mixed methods typology to analyze articles, outlining three core mixed methods designs: convergent, sequential explanatory, and sequential exploratory. The literature emphasized the significance of indicating a particular type of mixed methods design in studies. Creswell and Plano Clark (2018) highlighted this significance, stating that selecting a design based on typology provides researchers with a structured framework and logic to guide their research methods.

We examined $n = 290$ empirical mixed methods research articles published in the top 10 educational technology journals during the five years (Table 3). The convergent mixed methods design, a type of design that implies that both quantitative and qualitative data are collected and analyzed simultaneously and mixed during the interpretation phase (Creswell & Plano Clark, 2018), was the most common, appearing in $n = 150$ (52%) of empirical mixed methods articles. According to Creswell and Plano Clark (2018), convergent mixed methods design emphasizes equal weight for both data types (QUAN + QUAL). It can also vary in emphasis, with one data type being more prominent (QUAN + qual or QUAL + quan).

Following convergent design in prevalence, the sequential explanatory mixed methods design was used in $n = 118$ articles (41%). This approach entails a sequential data collection and analysis, usually beginning with an emphasis on quantitative methods and followed by qualitative methods to explain quantitative results (QUAN— > qual). Emphasis on the second qualitative data strand (quan— > QUAL) can also be possible but less common (Creswell & Plano Clark, 2018).

While convergent and sequential explanatory mixed methods designs were relatively similar in prevalence, the sequential exploratory mixed methods design was less common, appearing in only 22 (8%) of the studies. This approach involves sequentially implementing two strands of data collection and analysis, starting with a qualitative strand that holds greater weight and followed by the quantitative strand with lesser weight to generalize findings (QUAL— > quan). Emphasis on the second quantitative strand (qual— > QUAN) is also possible (Creswell & Plano Clark, 2018).

Convergent design is often chosen by researchers new to mixed methods and is considered efficient due to its simultaneous use of

Table 4
Prevalence of core mixed methods research per identification type.

| Self-identification (SI) | Convergent mixed methods research (n) | Sequential explanatory mixed methods research (n) | Sequential exploratory mixed methods research (n) |
|-------------------------------------|---------------------------------------|---|---|
| SI mixed methods research | 69 | 49 | 8 |
| NSI mixed methods research | 53 | 47 | 4 |
| SI specified mixed methods research | 28 | 22 | 10 |
| Total | 150 | 118 | 22 |

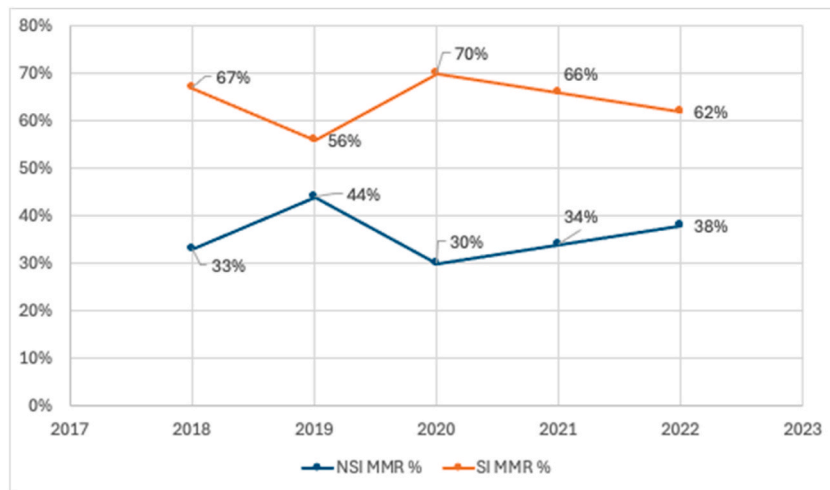


Fig. 4. Annual percentage of studies self-identified (SI MMR) and not self-identified (NSI MMR) as mixed methods research.

*Note. Percentages are rounded.

both data types (Creswell & Plano Clark, 2018). Additionally, it has historical precedence as the first mixed methods design discussed in the literature (Jick, 1979). This efficiency and convenience likely contribute to its frequent use in the educational technology field.

5. Discussion

Our comprehensive analysis of $n = 2380$ articles from the top 10 educational technology journals between 2018 and 2022 highlights trends in research methodologies. Quantitative studies dominated the landscape (56%), reflecting a strong preference for numerical data and statistical analysis in addressing problems within the educational technology field. Non-empirical articles and qualitative research, which offers deep insights into individual experiences and contextual nuances, maintained a substantial presence and each accounted for 16% each of all published articles during the time frame. However, mixed methods research, which combines the strengths of both quantitative and qualitative approaches and leverages both types of data to answer complex research questions and provide comprehensive insights (Creswell & Plano Clark, 2018; Leech & Onwuegbuzie, 2009; Tashakkori, 2009), was notably underrepresented in the top educational technology journals (12%). The integration of quantitative and qualitative data in mixed methods designs can uncover nuanced findings that might be overlooked by collecting quantitative or qualitative data alone (Clark, 2019; Creamer, 2018; Fetters et al., 2013; Fetters & Molina-Azorin, 2017; Hitchcock & Onwuegbuzie, 2022). Mixed methods research provides rich, contextualized data that can better inform educational technology practice and policy. Its underrepresentation limits the availability of comprehensive evidence needed to understand complex educational technology problems.

Despite implementing a mixed methods design adhering to Creswell and Plano Clark's (2018) definition of mixed methods research, a significant proportion of mixed methods studies (32%) did not explicitly self-identify as mixed methods research. This is a major finding for educational technology and prevalence studies of mixed methods research and hints at larger issues of education, understanding, and application of mixed methods research design in the field of educational technology and possibly beyond. Even the studies that did identify as mixed methods research (64%) often failed to clearly articulate their mixed methods approach. It was common to see the term "mixed methods" mentioned only once in the abstract or the methodology section, or to see the use of mixed methods terminology interchangeably with other approaches. From this we can infer that scholars were often aware of mixed methods as an approach distinct from quantitative or qualitative research and saw the value of collecting and integrating quantitative and qualitative data to answer research questions in their study; however, they were often unable to frame the study as mixed methods or explain and apply mixed methods design thoroughly. The analysis of self-identification of mixed methods articles adds complexity to prevalence studies and highlights challenges in the quality and appropriate identification of mixed methods articles in educational technology. Among the studies which self-identified as mixed methods (64%), the term "mixed methods" was often used generically, and a specific type of mixed methods design was not identified. This generic labeling suggests a further lack of depth in understanding mixed methods designs. Mixed methods research has a typology of designs, each with distinct methodological procedures (Creswell & Plano Clark, 2018; Tashakkori & Teddlie, 1998, 2010). Sequential explanatory mixed methods design was most commonly specified, while convergent mixed methods design was rarely named despite being most frequently used. Sequential exploratory mixed method design was the least common but was frequently specified.

Specifying the type of mixed methods approach enhances methodological rigor and clarity. It allows for better evaluation of the study's validity and reliability and facilitates replication and building on previous findings (Tashakkori, 2009). Generic identification of mixed methods designs can indicate inadequate integration of data sets, essential for drawing strong conclusions about the problem under study (Clark, 2019; Creamer, 2018; Fetters et al., 2013; Fetters & Molina-Azorin, 2017; Hitchcock & Onwuegbuzie, 2022). The lack of specificity may also indicate missed opportunities to use the most appropriate research design, as each type of mixed methods

design serves different research purposes (Creswell & Plano Clark, 2018). Exposure to and understanding distinct mixed methods approaches is crucial for training future educational technology researchers. Underrepresentation limits these training opportunities, leading to gaps in methodological education. To increase the quantity and quality of mixed methods research in educational technology, training for graduate students in the field should include coverage of mixed methods approaches as a distinct methodological approach with clear benefits to the field.

The proportion of published mixed methods studies varied across journals, with the highest percentage published in the *Journal of Computing in Higher Education* and the lowest in *Learning, Media, and Technology*. Other journals showed relatively similar mixed methods research publication rates. A slow but growing acceptance and use of mixed methods research is evident from the data analysis. Even though the overall representation of mixed methods studies remains relatively low, the upward trend seems promising.

Our findings are consistent with the findings of multiple prevalence studies that reported mixed methods prevalence rates across various academic fields. Creamer (2018) in her text “*An Introduction to Fully Integrated Mixed Methods Research*” described prevalence rates in mixed methods as found in studies conducted in fields of education, business, health sciences, family science, school psychology, sports management etc. Mixed methods research accounted for as low as 0.9% in family science, as found in the prevalence study conducted by Plano Clark et al. (2008) for studies published between 1996 and 2005, and as high as 31% in math education, as reported by Ross and Onwuegbuzie (2012) for studies published between 2002 and 2006.

The prevalence rate of 12% found in our study, while falling within the range of prevalence rates reported in previous studies across other disciplines, is relatively low, particularly given the later timeframe of our research. Furthermore, our study found that only 64% of the mixed methods studies self-identified as using mixed methods designs. Variations in prevalence rates across fields may be attributed to differences in methodological traditions (some fields favoring quantitative or qualitative methods more strongly), the nature of research questions (some disciplines tackling issues better suited for certain methodologies), and differing standards in methodological rigor.

Educational technology, with its emphasis on measurable outcomes such as, for example, student performance or technology effectiveness, has traditionally leaned more heavily toward quantitative research. This focus may explain the lower prevalence of mixed methods in the field. However, mixed methods approaches offer the potential for deeper insights, especially when examining complex technology topics such as artificial intelligence (AI) and learning analytics (LA), increasingly relevant in educational technology research. Recent discourse within AI and LA subfields of educational technology has recognized the need for mixed methods approaches to complement the predominantly quantitative research frameworks. The LA community as well as AI in education scholars have emphasized the importance of integrating qualitative data to understand the complexities behind student interactions with technology, moving beyond purely numerical data. For example, Ouhaichi et al. (2023) conducted a systematic mapping review to examine research trends in learning analytics and found that studies in this area applied predominantly experimental approaches and did not mention that any studies implemented mixed methods approaches.

Previous studies have also observed an uneven distribution of empirical scholarship in educational technology journals, which calls for a rebalancing. For instance, Perez-Sanagustin et al. (2017) reported an uneven mix of qualitative and quantitative research in *Computers and Education* between 2010 and 2015. Similarly, Lai and Bower (2019) found a similar imbalance between 2015 and 2017, while Baydas et al. (2015) noted a dominance of quantitative studies in educational technology journals between 2002 and 2014.

When looking specifically at mixed methods research, previous studies have reported highly variable rates. Perez-Sanagustin et al. (2017) found a relatively high prevalence of 34% in *Computers and Education* from 2011 to 2015, whereas Lai and Bower (2019) reported a much lower prevalence of 5.5%. In contrast, our findings are more consistent with Baydas et al. (2015), who reported a prevalence rate of 12.7%, closely aligning with the 12% found in our study.

The observed differences in mixed methods prevalence across studies could be due to several factors. Variations in methodologies, coding processes, journal selection, and the criteria used to classify mixed methods studies may all contribute to the discrepancies. Furthermore, the definition of mixed methods and the timeframes selected for review may also influence prevalence rates. In our study, over the five-year period we examined, prevalence rates remained relatively stable, ranging between 10% and 14%. Similarly, across the top ten journals, prevalence fluctuated from as low as 6% in *Learning, Media and Technology* to 15% in *Journal of Computing in Higher Education*. These variations suggest that journal-specific factors may also influence the publication of mixed methods research, with some journals more likely to publish such studies than others.

Top educational technology journals set trends and standards in the field, and when mixed methods research is underrepresented in educational technology journals, researchers may become discouraged from conducting mixed methods studies due to perceived lower chances of publication. To increase the visibility of mixed methods research and other research methodologies, journals in the educational technology field could require authors to identify their methodology in the abstract, perhaps using structured abstracts (Hartley, 2004). Further, editors should consider publishing an editorial on how to conduct and report mixed methods research. An editorial can underscore the importance of integrating both qualitative and quantitative approaches for a more comprehensive understanding of educational technology issues, outline the value of mixed methods research, offer specific guidelines on how to conduct and present mixed methods research and provide exemplary mixed methods studies. Consequently, editorials can pave the way for special issues further increasing the visibility and publication of mixed methods studies.

6. Conclusions and implications

The study contributes to understanding current trends in research methodologies in the educational technology field and examines how mixed methods research is represented in top educational technology journals. Our study concluded that mixed methods research approaches are underrepresented and often misnamed in top educational technology journals. Addressing the underrepresentation of

mixed methods research and improving the clarity and specificity of methodological reporting can enhance the overall quality of research in educational technology. The study has implications for educational technology researchers, program administrators, journal editors, reviewers, and publishers.

Implications for Educational Technology Researchers This study can encourage educational technology researchers to adopt mixed methods approaches, which allow for comprehensive data collection and richer insights, especially valuable in complex educational technology contexts. To help researchers build the necessary skill sets, we recommend resources like the Mixed Methods Program at the University of Michigan which provides education, training, consulting, and mentoring for students, postdoctoral fellows, and faculty interested in conducting mixed methods research and Qualitative and Mixed Methods Learning Lab (QMMLL) within the program offering peer feedback and advocacy to improve researchers' mixed methods skills. Researchers can also benefit from foundational texts like Creswell and Plano Clark's *Designing and Conducting Mixed Methods Research* (2018) and Tashakkori and Teddlie's *Handbook of Mixed Methods in Social & Behavioral Research* (2010) and resources and texts specifically focused on different aspects of mixed methods such as [Creamer \(2018\)](#) text on *An Introduction to Fully Integrated Mixed Methods Research* among others. These resources offer practical guidance for designing and implementing mixed methods studies.

6.1. Implications for educational technology programs

Highlighting the need for mixed methods research can encourage educational technology programs to offer more comprehensive training. This training could include specialized courses on mixed methods research, drawing on well-regarded works of mixed methods experts, and professional development opportunities through organizations like the American Educational Research Association (AERA) and the Mixed Methods International Research Association (MMIRA). Such initiatives can help equip future researchers with the skills to conduct and evaluate mixed methods studies, further promoting rigorous, diverse methodologies within the field.

6.2. Implications for journals in educational technology

Editors, reviewers, and publishers of educational technology journals can use these findings to evaluate the current state of mixed methods research in their publications. Journals might adopt editorial policies that encourage more diverse research methodologies and ensure that the use of mixed methods is clear in abstracts, keywords, and methodology sections of the articles. Additionally, journals could publish editorials on the design and implementation of mixed methods and promote the publication of special issues or call for papers that feature mixed methods studies, tackling complex educational technology problems with the depth and rigor that these approaches offer. For editorial guidance, journals could also draw upon published examples of high-quality mixed methods studies in educational technology.

Encouraging and supporting mixed methods research in top journals is essential for advancing the field and addressing complex educational technology issues with the required rigor and depth. By ensuring mixed methods research is adequately represented and accurately reported, the educational technology field can benefit from richer, more nuanced understandings, ultimately leading to better-informed practices and policies. We hope this study will encourage more researchers to conduct mixed methods studies that contribute to a more robust body of literature in the educational technology field.

7. Limitations

Our study is comprehensive but has several limitations. The study examined only the top ten educational technology journals, which may not represent the entire field. The prevalence of mixed methods articles published in other educational technology journals, books, or conference proceedings may differ. Articles from three of the ten journals included in this study represent 42% of the sample articles. While this may overrepresent some journals, we do not think it detracts from the study's findings. It is possible that Scopus may have missed indexing some articles from the time period and we acknowledge this limitation. Our study examined a 5-year time frame, including pandemic years. Changes in educational technology publication trends might happen after the study's data collection period, and the study might not have captured long-term trends.

Our study categorized articles by methodology based on abstracts and, where applicable, the full text of the article itself. Unfortunately, many abstracts did not clearly articulate the methodology used in an article. Moreover, many mixed methods articles did not self-identify as mixed methods. Therefore, our categorization for articles screened at the title-abstract level may rest on what authors called their method in the abstract, which may not reflect the true methods in the full text of an article.

The misnaming of mixed methods articles was part of a larger challenge in this study, making screening for article types challenging. Even when the full text of an article was used during the screening process, some articles failed to articulate the types of collected data.

The typologies and criteria to classify studies as mixed methods might vary, potentially leading to inconsistent categorization. Although we coded publications into multiple categories, mixed methods being one of them, we did not distinguish between the depth of quality in mixed methods studies. Identifying a study as mixed methods does not indicate how well mixed methods research was executed in the study. Moreover, our study may overrepresent convergent mixed methods articles. In some cases, mixed methods articles did not have a sequential organization to their quantitative and qualitative methods, meaning that convergent was the only mixed method typology that could apply to them.

We used content analysis with two independent coders, coding the same articles, and the third coder acted as a tiebreaker when disagreement occurred. However, some biases might persist despite efforts to standardize and validate coding procedures.

8. Future research

Based on the conclusions of our study, we suggest the following areas for future research. Researchers may consider broadening the scope of the study by including a more comprehensive range of educational technology journals other than the top ten. For example, including other journal and publication types to provide a more comprehensive view of methodological trends may offer a different picture. Future research should consider a longitudinal analysis and explore changes in the prevalence of mixed methods in educational technology over an extended period. In addition, future research should consider determining not only the presence of mixed methods but also evaluating methodological depth and integration between quantitative and qualitative data. Future research could explore the specific ways mixed methods have been employed in subfields like learning analytics and AI, potentially providing insights that can inform broader trends in the field. Finally, cross-disciplinary comparison should be considered to compare trends and prevalence of mixed methods in educational technology with those in other academic disciplines to better contextualize findings.

CRedit authorship contribution statement

Olha Ketsman: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Conceptualization. **Alissa Droog:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation. **Sumaiya Qazi:** Investigation.

Declaration of competing interest

No potential conflict of interest had been reported by the authors.

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Data availability

The data that support the findings of this study are openly available in Huskie Commons at <https://huskiecommons.lib.niu.edu/allfaculty-datasets/7/>.

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