

ROLE OF TOUCHSCREEN DEVICES AND MOBILE APPLICATIONS IN EARLY CHILDHOOD EDUCATION: A BIBLIOMETRIC ANALYSIS

O PAPEL DOS DISPOSITIVOS COM TELA TÁTIL E DAS APLICAÇÕES MÓVEIS NA EDUCAÇÃO INFANTIL: UMA ANÁLISE BIBLIOMÉTRICA

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Abstract

This study maps research on touchscreen, mobile, tablet applications in early childhood education between 2012 and 2025, emphasizing their implications for child development and learning. Using the Web of Science Core Collection, 403 articles were analysed with the Bibliometrix R Package, Biblioshiny, and VOSviewer. The analysis identified publishing trends, core journals, leading authors, and emerging topics. Findings show that JMIR mHealth and uHealth, Frontiers in Psychology, and Computers & Education are among the most productive journals, while the United States, the United Kingdom, and China are leading contributors. Keyword analyses highlight terms such as “child,” “early childhood,” “intervention,” “technology,” and “skills,” reflecting a growing focus on behavioural processes, skill acquisition, and developmental outcomes. As the first bibliometric study focusing on touchscreen and mobile applications, this research offers insights into technology-mediated interventions and their links to children’s cognitive, social, and emotional development, while stressing the need for more longitudinal and cross-cultural studies.

Keywords: Early Childhood. Media in Education. Mobile Learning. Mobile Apps. Bibliometric Analysis.

Resumo

Este estudo mapeia pesquisas sobre aplicativos para telas sensíveis ao toque, dispositivos móveis e tablets na educação infantil entre 2012 e 2025, enfatizando suas implicações para o desenvolvimento e a aprendizagem infantil. Utilizando a Web of Science Core Collection, 403 artigos foram analisados com o Bibliometrix R Package, Biblioshiny e VOSviewer. A análise identificou tendências de publicação, principais revistas, autores líderes e tópicos emergentes. Os resultados mostram que JMIR mHealth and uHealth, Frontiers in Psychology e Computers & Education estão entre as revistas mais produtivas, enquanto os Estados Unidos, o Reino Unido e a China são os principais contribuintes. As análises de palavras-chave destacam termos como “criança”, “primeira infância”, “intervenção”, “tecnologia” e “habilidades”, refletindo um foco crescente em processos comportamentais, aquisição de habilidades e resultados de desenvolvimento. Como o primeiro estudo bibliométrico com foco em telas sensíveis ao toque e aplicativos móveis, esta pesquisa oferece insights sobre intervenções mediadas por tecnologia e suas ligações com o desenvolvimento cognitivo, social e emocional das crianças, ao mesmo tempo em que enfatiza a necessidade de mais estudos longitudinais e interculturais.

Palavras-chave: Primeira Infância. Mídia na Educação. Aprendizagem Móvel. Aplicativos Móveis. Análise Bibliométrica.



1 INTRODUCTION

Technology has tremendously transformed human life in recent decades, with the integration of digital devices into everyday routines becoming a common trend. The influence of these devices can be observed even in the lives of very young children, starting from infancy. Specifically, applications on digital media such as mobile phones and tablets have significantly shaped children's daily experiences. Early childhood is regarded as a critical developmental stage for cognitive, emotional, social, and motor skills (Berk, 2013). During this period, children begin constructing their learning processes through environmental stimuli. Recent studies have investigated how technological tools, particularly mobile devices, contribute to these processes (Radesky et al., 2015).

Numerous studies have demonstrated how touchscreen technology supports early learning and highlighted its potential for integration into educational settings (Madigan et al., 2019). The expansion of mobile phones and internet-based learning materials has facilitated children's access to digital technologies (Liu & Hwang, 2023). Touchscreen tablets among young children have grown in early childhood learning settings. Having natural tactile interfaces and finger-based working mechanisms, tablets efficiently facilitate the interactions of preschoolers with software applications of a tablet (Neumann & Neumann, 2014). These devices lower the barriers between young children and digital environments. Such gadgets allow young children to work actively and pleasantly on different applications (Elkind, 2016).

Touchscreen technology offers unique opportunities for experiential and interactive learning by enabling sensorimotor engagements and direct manipulation of screen objects (Wang et al., 2016). However, the effectiveness of using touchscreen mobile devices like tablets and smartphones in early childhood education has been questioned by researchers for decades (Liu & Hwang, 2023). Tablets and mobile applications serve as gateways through which children can access educational content and develop linguistic and intellectual abilities. For instance, rudimentary learning elements such as letters, numbers, shapes, and colors are packaged as activity games to engage children (Wartella et al., 2016).

A growing body of research has examined the pedagogical potential of mobile applications in early childhood. Designed to provide interactive and stimulating content, these applications can enhance language development, numeracy, scientific thinking, and motor skills (Plowman et al., 2012). For instance, tablets and mobile applications help children recognize sounds and words, acquire their vocabulary, and develop early linguistic abilities (Christakis, 2011). Similarly, cognitive growth is facilitated by mobile phones through learning apps and games that enhance problem-solving capacity (DeLoache et al., 2010). Nevertheless, the educational potential of these technologies must be carefully aligned with children's developmental stages and individual needs.

Despite their benefits, several risks are associated with mobile technologies in early childhood education. Excessive screen time has been shown to reduce children's opportunities for environmental interaction, which may lead to developmental delays (Twenge et al., 2017). In the United States, most children below eight years live in a family with one or more mobile devices. Besides, smartphones are prevalent in families that have children, with 95% of households possessing this technology, reports indicate. Tablets are also prevalent, with 78% of households having one or more, and 42% of children having a tablet. Children under eight spend on average more than two hours daily on screen-based media (Rideout, 2021). Such patterns raise concerns regarding possible negative consequences for school performance (Kross et al., 2013), as well as sleep quality and socio-emotional development (Taherian Kalati & Kim, 2022). Scholars emphasize that the impact of mobile technologies in early education is not determined solely by the technology itself but by how it is integrated into pedagogical practices (Zhao, 2020). Building on these discussions, it becomes evident that while a growing number of empirical and review studies have examined the educational potential and risks of touchscreen technologies, a systematic overview of how this body of research has developed over time is still lacking. Previous literature reviews have synthesized findings on learning outcomes, health effects, or parental mediation, yet none have mapped the broader scientific landscape in terms of publication trends, influential outlets, or evolving themes in this domain.

Against this backdrop, the present study aims to provide a bibliometric overview of scholarly work on touchscreen, mobile, and tablet applications in early childhood education published between 2012 and 2025. Despite the growing body of scholarship on the role of mobile and touchscreen technologies in early childhood, the field still lacks a bibliometric analysis that systematically charts its publication trends, core outlets, and evolving themes. Therefore, the purpose of this research is (a) to determine general trends in research on the use of touchscreen, mobile, and tablet apps in early childhood education; (b) to analyze such research in aspects such as subjects, articles, journals, and countries; and (c) to determine trend subjects and lacunae in the corpus of research. By adopting this approach, the study not only highlights current knowledge structures but also points to areas where research remains fragmented or underexplored. In doing so, it provides valuable insights for researchers, practitioners, and policymakers interested in the intersection of technology and early childhood education.

2 METHOD

2.1 Data collection

The data for this study were drawn from the Web of Science (WoS) Core Collection, chosen for its comprehensive coverage of peer-reviewed international research. The search focused on studies addressing the use of touchscreen, mobile, and tablet apps in early childhood education published between 2012 and January 2025. To capture the breadth of the field, a combination of keywords was employed, including variations of TS= ("mobile app*" or "smartphone application*" or "smartphone app*" or "tablet application*" or "tablet app*" or "touchscreen application*" or "touchscreen app*") and ("preschool*" or "kindergarten*" or "young child*" or "early child*" or "pre-k*" or "childcare" or "child care" or "day care" or "pre-primary education*"). Only research articles and review papers were included, while duplicates and irrelevant records were manually removed. This process resulted in a final dataset of 403 publications. Biblioshiny was utilized as the bibliometric tool for science mapping and performance evaluation.

2.2 Data analyses

WoS articles were analyzed using Biblioshiny and VOSviewer, which are part of the Bibliometric R package. The bibliometric method is a most significant means of systematic reviewing of scientific literature. Software packages specifically designed for bibliometric analyses have enabled researchers to handle large datasets effectively and precisely.

Biblioshiny, a web-based tool developed using Bibliometrix, simplifies data analysis due to its intuitive graphical user interface. The program enables researchers to generate interactive reports and visualizations, thereby simplifying the investigation of bibliometric data (Aria & Cuccurullo, 2017). Biblioshiny is most powerful in the aspect that its dynamic interfaces enhance data visualization as well as allow real-time analysis of bibliometric datasets.

Another useful resource is VOSviewer, computer program specialized in bibliometric visualization. It is widely used to depict relationships, networks, and clusters within the literature (van Eck & Waltman, 2010). VOSviewer is particularly suited to constructing citation networks, geographical mappings, and topic network visualizations. Its interactive visual capabilities enable researchers to more easily identify trends and relationships within the literature.

Bibliometrics is a highly ranked software in this area that offers a comprehensive set of tools to perform bibliometric analyses (Aria & Cuccurullo, 2017). It is particularly good at citation analysis, co-authorship, and detection of trends in literature evolution. Bibliometrix includes data management, visualization, and analysis tools integrated into it, primarily benefiting large-scale data researchers. Bibliometric analysis was selected as it offers a systematic and replicable means of reviewing large bodies of literature. Unlike narrative or systematic reviews, bibliometrics allows researchers to uncover publication dynamics, identify the most influential authors and journals, and detect emerging research fronts over time. By combining descriptive statistics with network visualizations, this method provides both a macro-level overview of the field and fine-grained insights into its development.

3 RESULTS

3.1 Main data statistics

Between 2012 and early 2025, a total of 403 publications focusing on the use of touchscreen, mobile, and tablet applications in early childhood education were identified across 266 different sources.

Table 1

Main Statistics

Description	Results
Timespan	2012-2025
Sources (Journals, Books, etc)	266
Documents	403
Annual Growth Rate %	5.48
Document Average Age	4.29
Average citations per doc	11.95
Total References Cited	17036
Keywords Plus (ID)	929
Author's Keywords (DE)	1373
Authors	2106
Authors of single-authored docs	17
Single-authored docs	18
Co-Authors per Doc	5.8
International co-authorships %	22.08

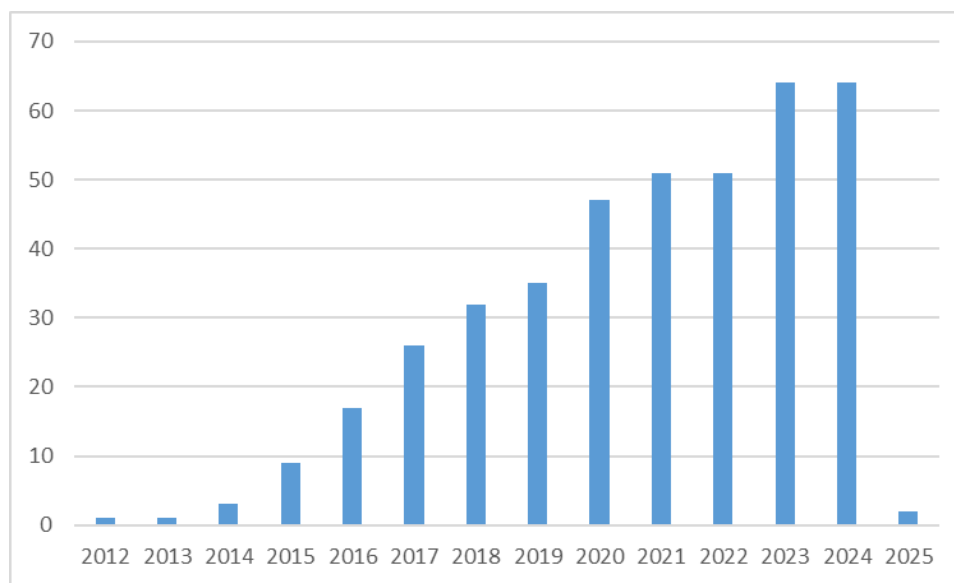
Table 1 presents the descriptive statistics of the dataset. The findings indicate that research on touchscreen, mobile, and tablet applications in early childhood education has steadily expanded over the period 2012–2025, with an annual growth rate of 5.48%. On average, each article is cited nearly 12 times and involves approximately six co-authors, suggesting a strong tendency toward collaborative work. Notably, 22.08% of publications resulted from international collaborations, highlighting the global relevance of this research area. Although 17 authors produced single-authored studies, the presence of 18 single-authored publications implies that a small number of individuals may have contributed more than one such study.

3.1.1 Publication output and growth trend

The query using the keywords given in the Web of Science database resulted in 517 research studies.

Figure 1

Annual Distribution of Articles on the Use of Touchscreen, Mobile, and Tablet Applications in Early Childhood Education



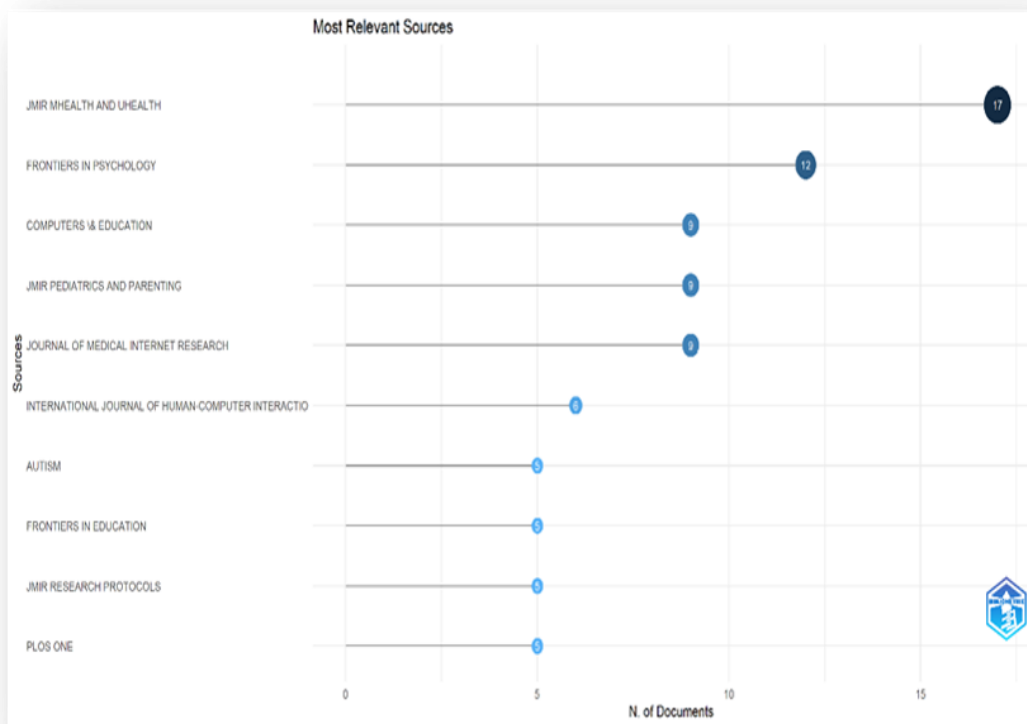
After applying inclusion and exclusion criteria, 403 articles were retained for analysis. Figure 1 presents the yearly distribution of publications between 2012 and January 2025. Given the limited number of studies published at the beginning of 2025, the focus was primarily on the 2012–2024 period. Research in this area gained momentum particularly after 2014. While only one article was recorded in 2012 and 2013, publication numbers increased steadily and reached 47 in 2020. The upward trajectory continued thereafter, indicating a sustained scholarly interest in touchscreen and mobile technologies in early childhood education. The presence of two publications already in the first week of January 2025 suggests that the trend is likely to continue.

3.1.2 Journals publishing articles

There were 403 studies appeared in 266 unique journals. Among these, 26 journals published at least three relevant articles.

Figure 2

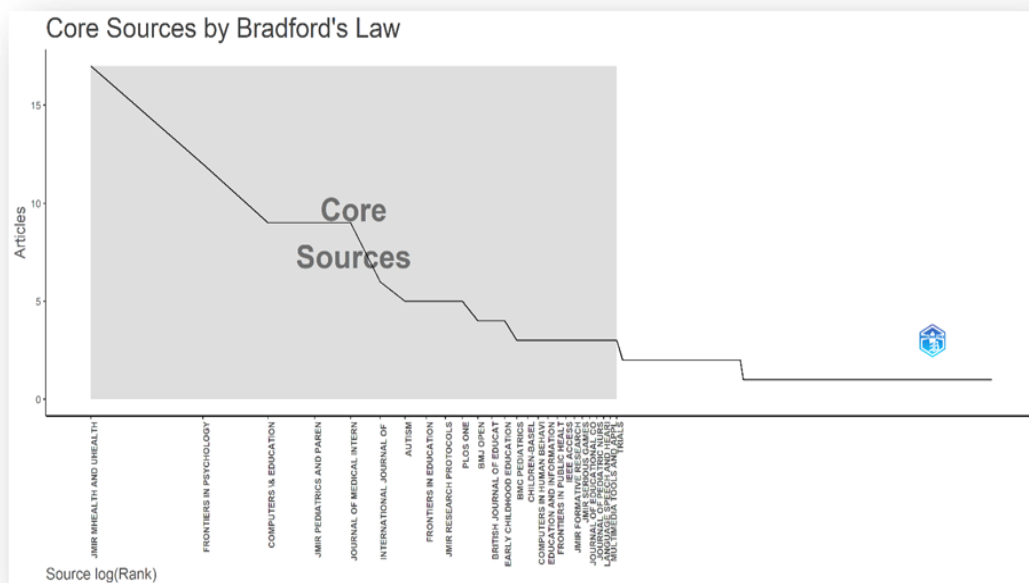
Journals publishing articles on the use of touchscreen, mobile, and tablet applications in Early Childhood Education



The most prolific sources included JMIR mHealth and uHealth (n=17), Frontiers in Psychology (n=12), Computers & Education (n=9), JMIR Pediatrics and Parenting (n=9), Journal of Medical Internet Research (n=9), International Journal of Human-Computer Interaction (n=6), Autism (n=5), Frontiers in Education (n=5), JMIR Research Protocols (n=5), and PLOS ONE (n=5).

Based on Bradford's Law, there are 266 productive journals in touchscreen, mobile, and tablet applications applied to early childhood education.

Figure 3
Core sources identified by Bradford's Law



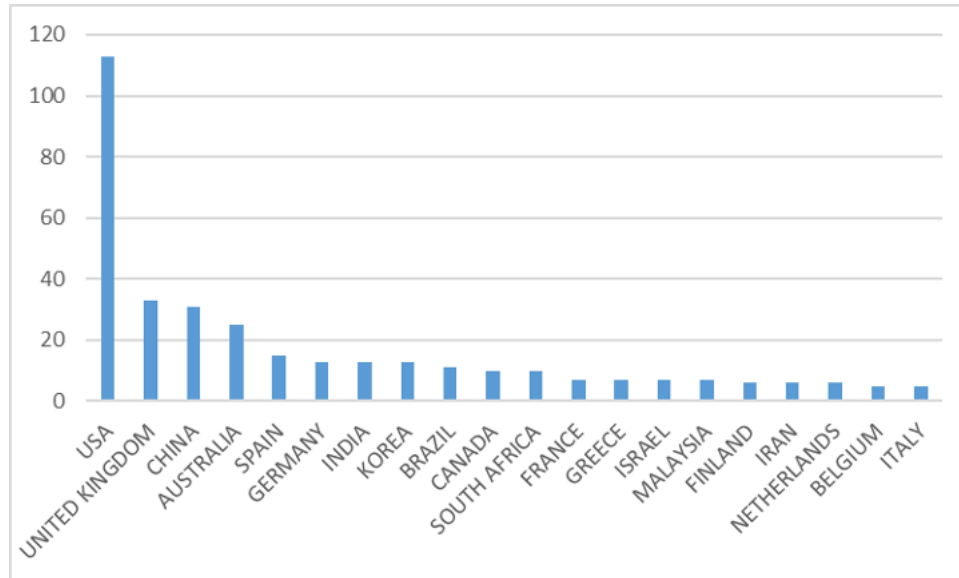
Applying Bradford's Law, the sources were classified into three zones: 26 journals in the first core zone, 108 in the second, and 132 in the third. This distribution illustrates the concentration of productivity within a relatively small set of journals.

3.1.3 Geographical, disciplinary, and institutional distribution

The data analysis reveals that articles discussing touchscreen, mobile, and tablet use in early childhood education account for 63 countries.

Figure 4

Articles on the use of touchscreen, mobile, and tablet applications in early childhood education by country

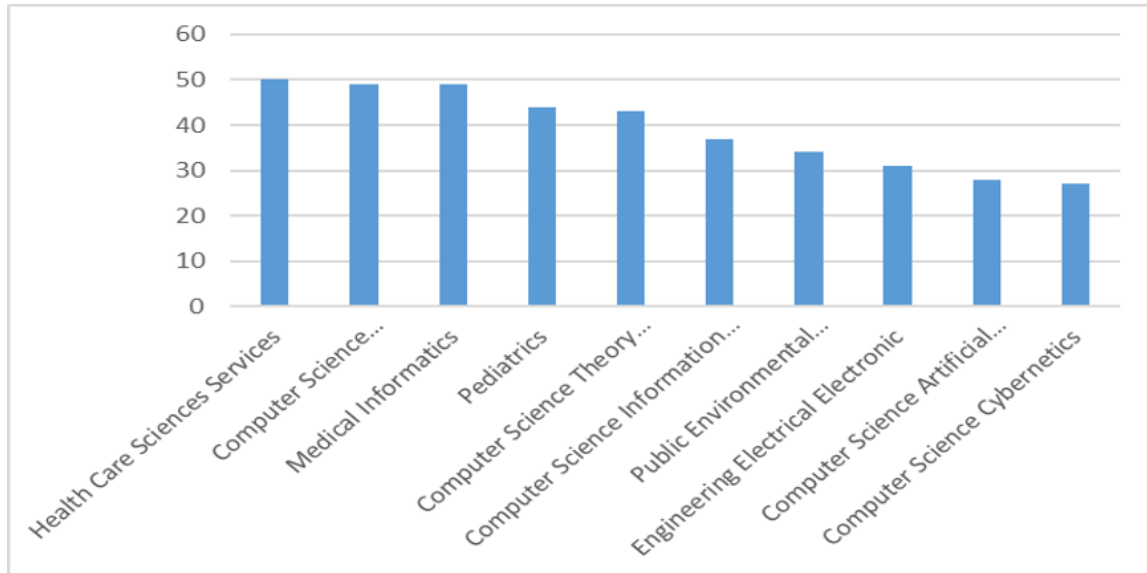


Of the top 20 countries based on publication number, the United States was the leading contributor (n=113), followed by the United Kingdom (n=33), China (n=31), Australia (n=25), Spain (n=15), Germany (n=13), India (n=13), South Korea (n=13), Brazil (n=11), and Canada (n=10).

The studies were distributed across diverse subject categories, including education, educational research, health care sciences services, computer science interdisciplinary applications, medical informatics, pediatrics, computer science theory methods, computer science information systems, public environmental, occupational health, engineering electrical electronic, computer science artificial intelligence, computer science cybernetics, psychology developmental, psychology multidisciplinary, computer science software engineering, education scientific disciplines, rehabilitation, telecommunications, ergonomics, medicine general internal, nursing, nutrition dietetics, multidisciplinary sciences, audiology speech-language pathology, linguistics, and psychology experimental.

Figure 5

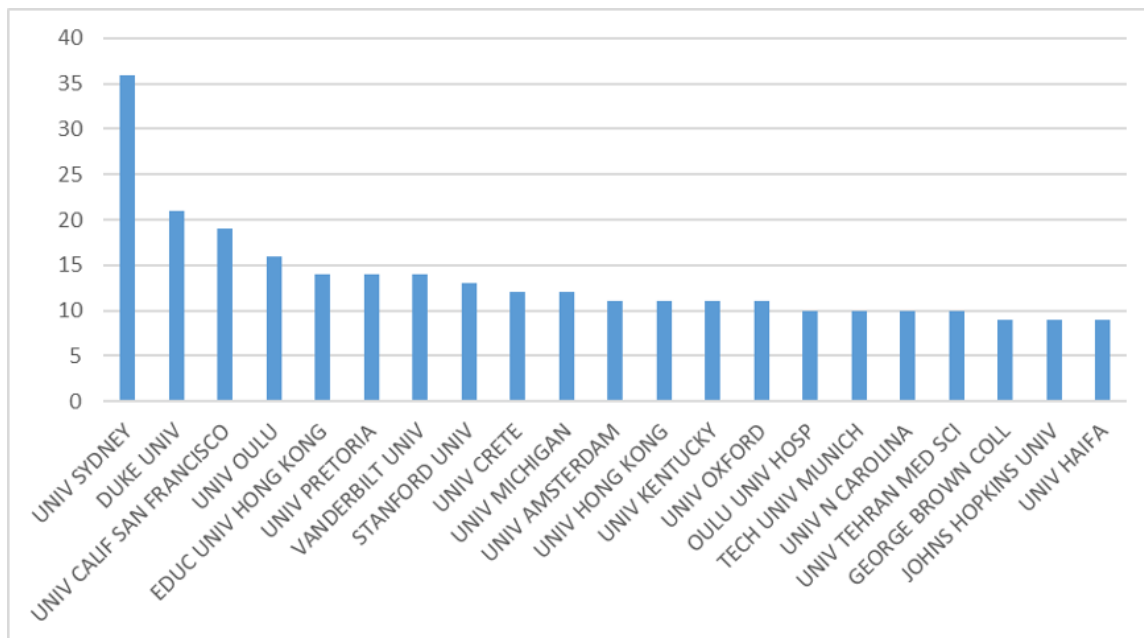
Articles on the use of touchscreen, mobile, and tablet applications in early childhood education by research area



The leading fields by publication count were Education and Educational Research (n=98), Health Care Sciences Services (n=50), Computer Science Interdisciplinary Applications (n=49), Medical Informatics (n=49), and Pediatrics (n=44).

Figure 6

Institutional distribution of articles on the use of touchscreen, mobile, and tablet applications in early childhood education

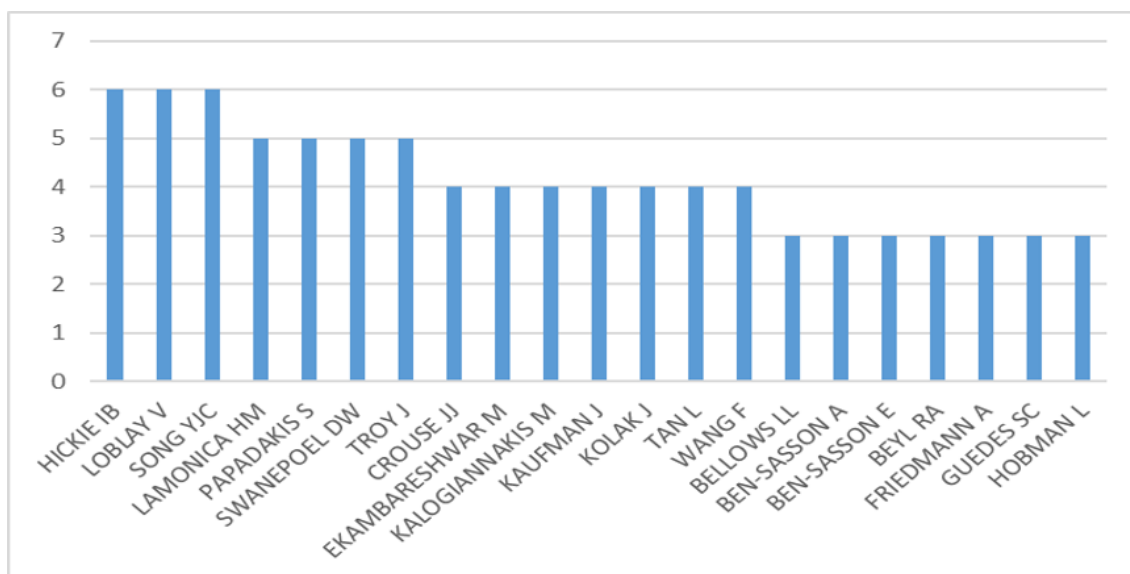


Institutional analysis revealed that the University of Sydney was the most productive (n=36), followed by Duke University (n=21), the University of California, San Francisco (n=19), the University of Oulu (n=16), and the Education University of Hong Kong (n=14). This summary indicates the breakdown of institutions who carried out studies on utilizing touchscreen, mobile, and tablet apps in early childhood education.

Figure 7 provides authors publishing research on touchscreen, mobile, and tablet app use in early childhood education.

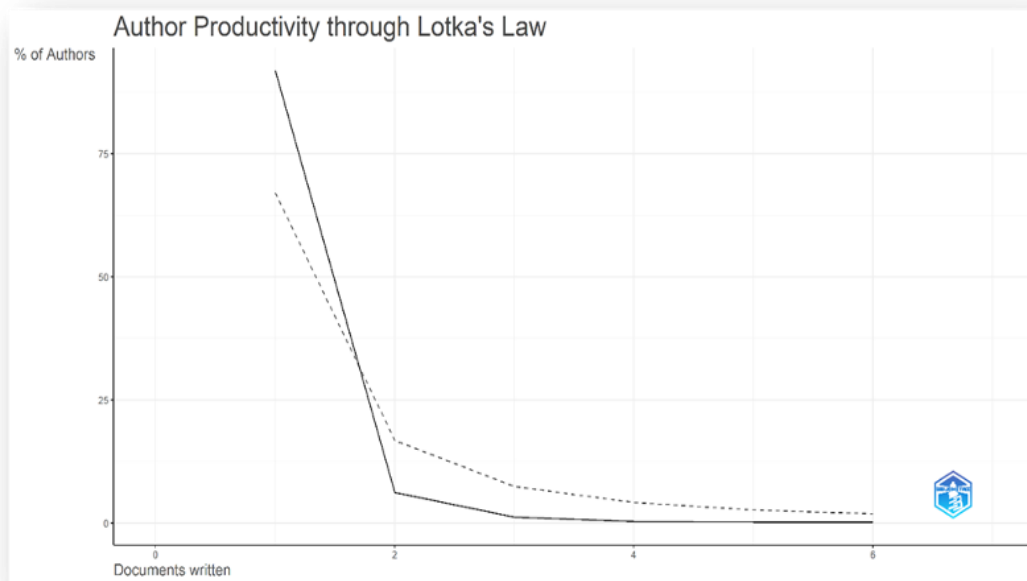
Figure 7

Distribution of articles on the use of touchscreen, mobile, and tablet applications in early childhood education by author



Among the 20 most cited authors, publications range from 3 to 6. Leading authors with the highest number of publications are Hickie, I.B. (n=6), Loblay, V. (n=6), Song, Y.J.C. (n=6), Lamonica, H.M. (n=5), and Papadakis, H.M. (n=5). These figures provide an overview of key contributors for this research study.

Author productivity was further examined through Lotka's Law.

Figure 8*Author productivity analyzed through Lotka's Law*

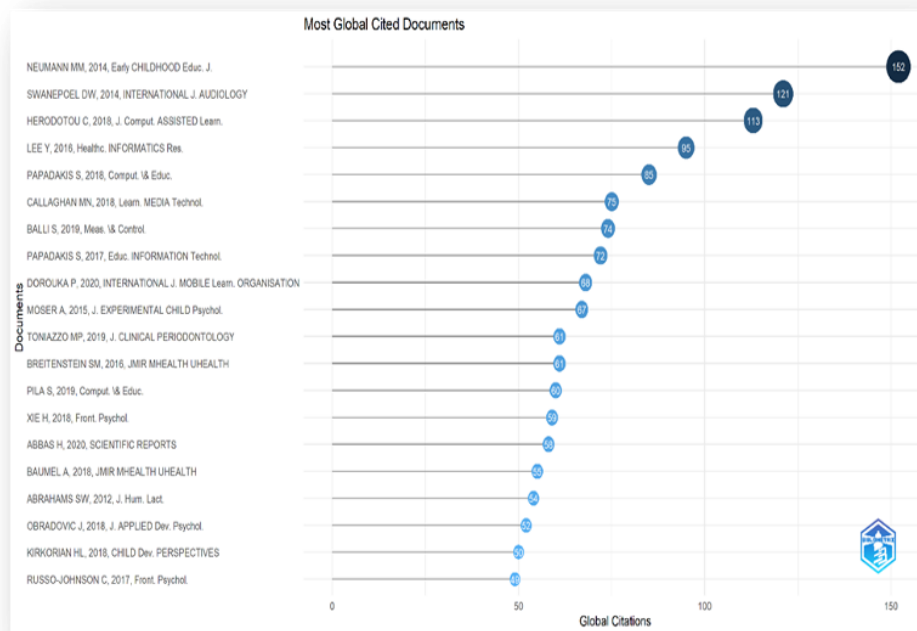
According to Lotka's Law, 60% of authors should publish a single paper, 15% two papers, and 7% three papers (Sudhier, 2013). However, the present dataset diverged from this model: 91.9% of authors (n=1936) produced only one publication, 6% (n=131) had two, and 1% (n=25) had three. This is contrary to the pattern in Lotka's Law.

3.1.4 Most global cited articles

The 20 most cited papers on the use of touchscreen, mobile, and tablet in early childhood education are presented in Figure 9.

Figure 9

Most-cited articles on the use of touchscreen, mobile, and tablet applications in early childhood education



The most frequently cited publication was Neumann and Neumann's (2014) study on touchscreen tablets and emergent literacy (152 citations, annual citation rate = 12.67, normalized TC = 1.44). The second most cited paper is "Smartphone Hearing Screening with Integrated Quality Control and Data Management" by Swanepoel et al. (2014), cited 121 times, with an annual TC of 10.18 and a normalized TC of 1.15.

The systematic review "Young Children and Tablets: A Systematic Review of Effects on Learning and Development" by Herodotou in the year 2018 was referenced 113 times with an annual TC of 14.13 and a normalized TC of 3.96. Lee and Moon's (2016) "Utilization and Content Evaluation of Mobile Applications for Pregnancy, Birth, and Child Care," received 95 citations with an annual TC of 9.50 and a normalized TC of 4.02. Papadakis et al.'s paper, "Educational apps from the Android Google Play for Greek preschoolers: A systematic review," received 85 citations with an annual TC of 10.63 and a normalized TC of 2.98.

3.1.5 Keywords and trending topics

In bibliometric analysis, the size of a word in a Treemap increases with the frequency of use in studies so that it is simple to identify prominent keywords.

Figure 10

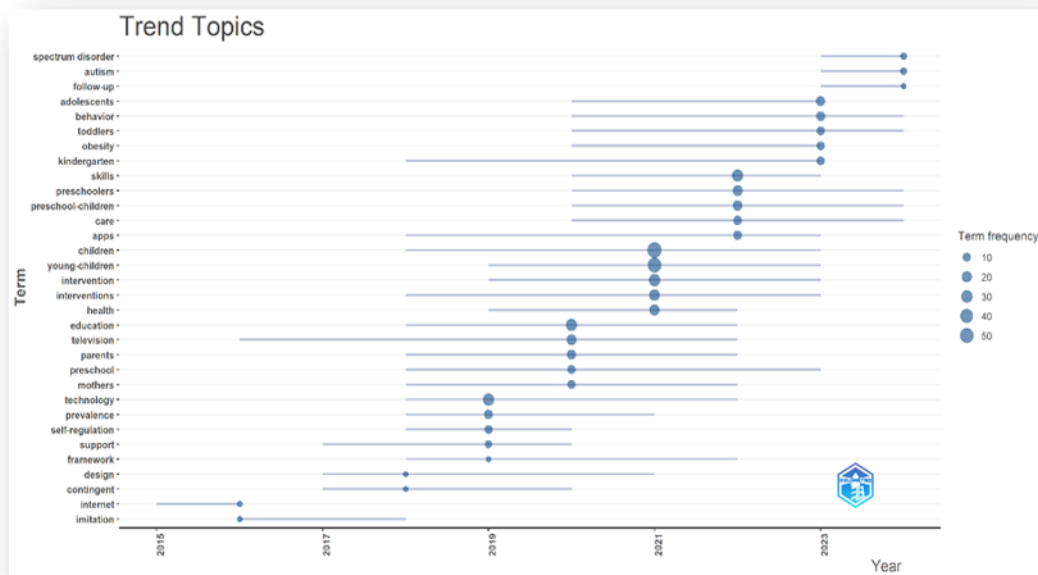
Tree map of keywords in research on the use of touchscreen, mobile, and tablet applications in early childhood education



Figure 10 shows the most frequent keywords that occur in touchscreen, mobile, and tablet application use on early childhood education articles. Keyword analysis revealed children (n=57), young children (n=51), intervention (n=30), technology (n=30), skills (n=28), education (n=27), interventions (n=23), health (n=20), preschoolers (n=18), television (n=18), knowledge (n=17), preschool-children (n=17), risk (n=16), parents (n=15), adolescents (n=14), impact (n=14), language (n=14), students (n=14), behaviour (n=13), and apps (n=12) among the most frequent terms.

Figure 11

Trending topics in research on the use of touchscreen, mobile, and tablet applications in early childhood education



The most frequent topics in these articles are children (n=57), young children (n=51), and technology (n=30), which were extremely popular between 2018-2023. In earlier years, terms like internet, imitation, and contingent were prevalent. At the same time, interest slowly shifted away from skills, behaviour, follow-up, autism, and spectrum disorder, which reflects concern for skill acquisition, behavioral processes, and psychopathologies.

This study used VOSviewer to examine keywords in touchscreen, mobile, and tablet app publications regarding early childhood education.

4 DISCUSSION

Bibliometric analysis is a method used to evaluate bibliographic information from various sources of literature, such as articles and journals. It has been recognized by researchers as an essential reference tool, especially for examining and interpreting research trends in academic communities (Ninkov et al., 2022). This study aimed to map articles on the use of touchscreen, mobile, and tablet applications in early childhood education from a bibliometric perspective, identifying frequent patterns related to topics, articles, journals, countries, and research trends. The goal was to identify dominant themes and gaps in the literature, analyze articles over the past 13 years, and establish a basis for future research while informing scholars, educators, and practitioners in the field.

This study conducted a bibliometric examination of 403 articles published between 2012 and 2025 on touchscreen, mobile, and tablet application usage in early childhood education. The analysis identified a significant growth in research effort and publication on this topic, with an annual growth rate of 5.48%. The mean age of the publications was 4.29 years, indicating that the articles are relatively recent. With 17,036 citations and an average of 11.95 citations per article, the findings suggest that the journals are highly valued within academic circles (Table 1). The first two studies on this topic were published in 2012 and 2013, respectively, with yearly publication counts continuing to rise (Figure 1).

The study applied Bradford's Law, an empirical model providing analytical data on journal productivity (Venable et al., 2016), to quantitatively assess publishing in journals related to touchscreen, mobile, and tablet applications in early childhood education. Bradford's Law establishes a mathematical relationship between publications and journals, dividing scientific output into three zones based on productivity: Zone 1 (most productive), Zone 2 (moderately productive), and Zone 3 (least productive) (Garfield, 2004).

The most productive journals were JMIR mHealth and uHealth (n=17), Frontiers in Psychology (n=12), Computers & Education (n=9), JMIR Pediatrics and Parenting (n=9), and the Journal of Medical Internet Research (n=9). According to Bradford's Law, 266 journals were productive in this field, distributed as 26 in Zone 1, 108 in Zone 2, and

132 in Zone 3 (Figure 3). These journals publish multidisciplinary articles on how technology, including mobile devices and applications, can support children, parents, healthcare settings, and educational environments. Authors contributing to these journals are often experts in psychology, child development, education, and health.

Citation count is the crucial indicator of an article's impact and reflects the quality, methodology, innovation, and impact factor of the journal (Tahamtan et al., 2016). Leading authors in the field include Hickie, I.B. (n=6), Loblay, V. (n=6), Song, Y.J.C. (n=6), Lamonica, H.M. (n=5), and Papadakis, H.M. (n=5).

The distribution of publications does not fully adhere to Lotka's Law, which predicts that 60% of authors in a field will have one publication, 15% two publications, and 7% three publications (Sudhier, 2013). Lotka's Law suggests that most publications are produced by a small proportion of authors. As the number of publications increases, there is a drastic decline in the proportion of authors (Esh & Ghosh, 2025). In this study, 91.9% of authors had one publication, 6% had two publications, and 1% had three publications, indicating that many authors have contributed only a single article on touchscreen, mobile, and tablet applications in early childhood education. These results show that many authors have written a single article on how to use touchscreen, mobile, and tablet software in early childhood education.

Author-selected keywords describe the study's area, approach, or main concept, reflecting both content and the researcher's perspective. Keywords plus, derived from reference titles, are more descriptive than the first two keywords, possibly with wider terms surrounding the research topic. However, they do not necessarily appear in the title of the article or chosen keywords (Wei et al., 2024). The most frequently used keywords in this study were children, intervention, technology, skills, health, and risk.

Living in a technologically oriented society, children are increasingly exposed to digital technologies from early childhood. Given that early childhood forms the foundation for later development, preparing children for a technology-rich environment is crucial (Su et al., 2024). Earlier debates questioned whether technology should be integrated into early childhood education, whereas current discussions focus on how technology can support children's learning, development, and well-being (Zomer & Kay, 2016). This perspective aligns with Piaget's cognitive developmental theory (1952), which emphasizes that young children in the preoperational and concrete operational

stages learn best through hands-on interaction and symbolic play. Touchscreen applications can provide such interactive opportunities. Similarly, Vygotsky's sociocultural theory highlights the importance of social interaction and scaffolding in learning (Vygotsky, 1978). Mobile technologies can serve as tools for guided participation, allowing parents and teachers to scaffold learning experiences in children's zone of proximal development.

Recent empirical evidence supports these theoretical perspectives. For instance, Wirth et al. (2024) reported systematic differences between expert and child/parent app ratings: apps judged higher on educational criteria by experts were often less preferred by children, indicating a potential mismatch between pedagogical quality and child engagement, rather than direct evidence of superior learning outcomes. Similarly, Tenenbaum and Van Herwegen (2023) demonstrated that preschool children can acquire scientific concepts from a well-structured touchscreen app, extending evidence of educational apps beyond literacy and numeracy.

Research has demonstrated that computer and tablet interventions can enhance early numeracy skills if aligned with developmentally appropriate programs (Papadakis et al., 2018). Touchscreen tablet interventions have improved fine motor skills in children with cerebral palsy (Abd-Elfattah et al., 2024). Early numeracy skills were supported with the use of tablet-based mathematics game interventions early in life (Lee & Choi, 2020). Touchscreen tablet and app usage affecting emergent literacy skills was researched within an intervention study and provided evidence of how tablets could benefit letter knowledge, phonemic awareness, and other emergent literacy development (Neumann, 2018). Studies using parent-guided interventions also found that touchscreen devices make learning engaging and enjoyable (Wood et al., 2016). Rapid acquisition of touchscreen skills has been associated with improvements in numeracy and literacy (Furman et al., 2019). However, excessive use of these technologies may negatively affect social skills and attention (Radesky et al., 2016). These contrasting outcomes are consistent with Bandura's (1977) social learning theory, which posits that children acquire behaviors by observing and imitating models. While digital media can provide positive role models, overexposure may limit face-to-face interactions, thus reducing opportunities for social learning. From an ecological perspective, Bronfenbrenner's (1979) ecological systems theory suggests that increased screen time can alter the balance

of children's microsystem interactions (family, peers, school), leading to potential developmental risks. Moreover, Van Herwegen (2024) synthesized neuroscience and behavioral findings and emphasized that the impact of digital technologies on learning outcomes depends heavily on app quality and adult mediation, underlining the critical role of scaffolding in children's digital experiences.

Touchscreen, tablet, and mobile app use has also been associated with musculoskeletal risks and prolonged periods of sedentary behavior in early childhood. Hence, surveillance of tablet usage in early childhood has been emphasized (Howie et al., 2017). In a study on the relationship between touchscreen activity and sleep in infants and toddlers (6–36 months), there were significant relationships between night sleep, day sleep, and sleep onset with touchscreen activity (Cheung et al., 2017). These findings resonate with Erikson's (1963) psychosocial theory, which stresses that during early childhood, children need opportunities to develop autonomy and initiative. Technology and mobile apps are useful instruments for promoting learning and development if used consciously and at the right time. Excessive or unstructured use of digital technologies may undermine these developmental needs. Conscious use requires that teachers, parents, and early childhood professionals possess knowledge and strategies to ensure that technology use aligns with developmental appropriateness (Donohue & Schomburg, 2017; Blevins et al., 2017). Zuo et al. (2025) conducted a meta-analysis to systematically synthesize and evaluate findings from 30 recently published studies on the use of Information and Communication Technology (ICT) in early childhood and primary education. The meta-analytic evidence suggests that ICT interventions in early childhood education generally have a positive impact on learning outcomes. In particular, touchscreen-based applications and programs targeting subject knowledge appear to be especially effective. Moreover, longer intervention durations are associated with greater improvements, highlighting that the effectiveness of technology depends not only on access but also on its sustained and pedagogically integrated use.

When exploring the trending topics of touchscreen, mobile, and tablet application use in early childhood education, spectrum, autism, follow-up, adolescence, and behaviour research have emerged in recent years at the forefront (Figure 11). Mobile learning was found to have numerous advantages, most prominently in such fields as the development of fundamental arithmetic and literacy, the development of fundamental

cognitive and emotional competencies, as well as the support of collaboration, with a special mention of preschool special education. Use of mobile apps and learning activities provided by them, aided by multimedia capabilities in the app, has been shown to facilitate children's learning processes in terms of accessibility, portability, and compactness (Kokkalia & Drigas, 2016). These findings are consistent with the information-processing theory, which conceptualizes learning as the acquisition, storage, and retrieval of information (Atkinson & Shiffrin, 1968).

Finally, application design also matters for creativity and engagement. Booton et al. (2023) evaluated commercial apps and found that many lacked pedagogical depth; however, apps with open-ended, exploratory affordances were more effective in supporting creativity and child-led learning compared to rigid, drill-based designs. This highlights that future app development for early childhood should prioritize creativity, problem-solving, and social-emotional learning alongside academic skills. Mobile technologies, through multimedia affordances, can strengthen attention, memory, and problem-solving processes, particularly when tailored to individual learning needs.

5 CONCLUSION

This study provides a comprehensive bibliometric perspective on research conducted over the past 13 years regarding the use of touchscreen, mobile, and tablet applications in early childhood education. The analyzed articles indicate a steady increase in publications, reflecting growing scholarly interest in this area.

Based on Bradford's Law, 9.9% of journals were categorized in Zone 1, publishing articles in the fields of psychology, child development, education, and health. Author productivity did not conform to Lotka's Law, indicating that more focused and repeated research efforts are needed to build in-depth knowledge on this topic.

The majority of publications originated from developed countries, particularly the United States, the United Kingdom, and China, suggesting that research on early childhood technology interventions is concentrated in regions with advanced educational and research infrastructure. The literature primarily emphasizes children, early childhood, intervention, technology, skills, health, and risk, with recent years showing a shift toward behavioral processes, skill acquisition, and developmental outcomes.

The findings highlight the necessity for more longitudinal, cross-cultural, and developmentally informed studies on touchscreen, mobile, and tablet applications in early childhood education. These studies should evaluate both the benefits and potential risks of technology use, including cognitive, social, and emotional development.

This study has both strengths and weaknesses. Strengths of the study include its novelty and the growing body of analyzed literature, which demonstrates the topic's relevance and scientific potential. This study makes a significant contribution by being the first bibliometric analysis focused on touchscreen, mobile, and tablet applications in early childhood education, offering a valuable guide for researchers, educators, and policymakers interested in technology-mediated interventions. Despite being a relatively new topic and working with a specific age group, like early childhood, the increasing number of studies indicates the strength of the topic. One of the study's strengths is its potential to serve as a guide for researchers interested in researching this subject. Limitations include the exclusive use of the Web of Science database, suggesting that future research could incorporate additional databases, such as Scopus or ERIC, to provide a more comprehensive overview. Overall, this study provides a foundation for future research and practical applications by clarifying trends, identifying gaps, and informing the design of interventions that support children's learning, development, and well-being in the context of technology use.

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The study has not been published in any form previously. The study is not under review elsewhere.

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ETHICS STATEMENTS

This study is based on secondary data obtained from previously published studies. Since no human participants or animals were involved, ethical approval was not required.

CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

INFORMED CONSENT

Not applicable, as this study is based on secondary data from previously published studies and does not involve human participants.

DATA AVAILABILITY

Data will be available upon reasonable request.

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Authors' Contribution

All authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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