E-ISSN: 2502-3519 P-ISSN: 2798-3234
JGA, Vol. 10(2), June 2025 (243-261)
DOI: https://doi.org/10.14421/jga.2025.102.04

Golden Age
Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini

OPEN ACCESS

Home-School Communication in Digital Era: A Bibliometric Analysis of Publications on Technology Supporting Parental Involvement in Early Childhood Education

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Keywords:
Parental Involvement, Early childhood education, Digital technology, Home-school communication, Bibliometric analysis

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Received 24 11 2024
Revised 20 04 2025
Accepted 23 05 2025
Published Online First 28 06 2025

Check for updates

Abstract
Despite the increasing integration of digital technologies in early childhood education, there remains a significant gap in comprehensive, trend-based understanding of how these technologies support parental involvement. Existing studies often lack a systematic exploration of publication patterns, thematic focuses, and emerging innovations in this field. This study addresses that gap by analysing the scope and trajectory of research on technology that supports parental involvement in early childhood education using bibliometric review and data mapping techniques. This study examined relevant publications from 2014 to 2023 through computational mapping using VOSviewer software. Bibliometric data from 101 scholarly articles were retrieved via Harzing's Publish or Perish software and analyzed to generate visualization maps that categorize research themes and trends. Findings indicate fluctuating but overall increasing trends in research output, with notable peaks after 2020, suggesting renewed interest in this domain, particularly following the COVID-19 pandemic. The visualization maps revealed core research themes centered around digital communication tools, parental engagement, and home-school collaboration. These findings have significant implications for future educational practices and policy development. They provide a foundation for enhancing digital strategies that foster equitable and meaningful parent-educator partnerships in early childhood education. Furthermore, they highlight the importance of addressing digital literacy gaps and promoting inclusive approaches in the design and implementation of technology-mediated parental involvement programs.

To cite: Mashudi, E. A., Hendriawan, D., Sundari, N., Nuroniah, P., & Arzaqi, R. N. (2025). Home-school communication in digital era: A bibliometric analysis of publications on technology supporting parental involvement in early childhood education. *Golden Age: Jurnal Ilmiah Tumbuh Kembang Anak Usia Dini, 10*(2), 243-261. *https://doi.org/10.14421/jga.2025.102-04*

Introduction

The digital era is characterized by the pervasive integration of digital technologies across various domains, fundamentally altering how information is accessed, shared, and utilized. In education, this era has seen the rise of Information and Communication Technologies (ICT) that reshape teaching, learning, and communication dynamics. Digital tools such as artificial intelligence, touch-screen devices, and online learning platforms enable personalized, interactive, and efficient educational experiences, facilitating learning beyond traditional boundaries (Arnott, 2016; Su & Yang, 2022; Yang & Hong, 2024). In the context of early childhood education, digital technologies are increasingly adopted to support children's learning and development. Tools like interactive tablets, educational apps, and even AI-driven robots have been introduced to stimulate cognitive, emotional, and social growth (Yi et al., 2024; Su & Yang, 2022).

Digital technology not only facilitates children's learning processes but also enhances communication between parents and teachers regarding children's education (Farooq et al., 2024). This communication underscores the interdependence between two key contexts of children's education: home and school. Such interdependence forms the foundation for effective family-school partnerships. Strengthening this partnership can be achieved through

well-structured parental involvement programs, which serve as a bridge to integrate efforts between educators and families in supporting children's holistic development (Devlieghere et al., 2020; Nzuruba, 2024).

Various studies report the positive influence of the level of parental involvement in early childhood care and education on various positive characteristics in children, including the ability to adapt and social adjustment (Gurzbuzturk et al., 2010, Fisher, 2018); school readiness (Sime & Sheridan, 2014; Petridou & Karagiorgi, 2018); discipline (Mbaluka et al., 2021); academic performance and achievement (Ebuta & Ekpo-Eloma, 2013; Wilder, 2014; Jaiswal & Chouduri, 2017; Li et al, 2020; Devlieghere et al., 2020; Wanjala et al.; 2024); positive attitude towards school (Wilder, 2014) ; self-confidence (Giallo et al., 2013; Yildirim et al., 2019); and social-emotional skills (Van Voorhis et al., 2013; Valdez et al., 2013).

Technology has fundamentally reshaped parental engagement practices by enhancing accessibility, communication efficiency, and the ways parents can participate in their children's education. Numerous studies have highlighted the transformative impact of technology on enhancing parental involvement in educational initiatives, including provide real-time updates and monitoring of children academic performance and schooling activities (Farooq et al., 2024); improving communication and accessibility (Erdem & Avci, 2020; Wilke et al., 2024; Farooq et al., 2024); support for learning at home (Knopik et al., 2021; Wilke et al., 2024); empowerment through information sharing (Erdem & Avci, 2020); and facilitate community building (Erdem & Avci, 2020; Farooq et al., 2024).

However, technology has redefined parental engagement by enabling more flexible, frequent, and data-driven interactions. It has transitioned parental involvement from occasional face-to-face meetings to a continuous and integrated role in supporting children's educational experiences. Digital tools have significantly enhanced the ways parents can engage in their children's education. Notable examples include communication apps like ClassDojo (Erdem & Avci, 2020), Lillio (Wilke et al., 2024), Remind (Khaleel & Mohammed, 2024); virtual meetings platform like Zoom (Nizam et al., 2024; Wanjala et al., 2024), Microsoft Teams (Fadda et al., 2020); digital portfolio tools like Seesaw (Farooq et al., 2024; Nzuruba, 2024; Wanjala et al., 2024), Google Classroom (Erdem & Avci, 2020; Nizam et al., 2024); and social media apps like WhatsApp (Amini, 2018; Fadda et al., 2020; Peled et al., 2021), Facebook (Stratigos & Fenech, 2020).

Existing studies often highlight the use of specific tools, without a broader examination of how these tools fit into larger educational goals or how they impact parental attitudes and long-term involvement (Amini, 2018; Peled et al., 2021; Farooq et al., 2024). Thus, the digital divide and varying levels of digital literacy among parents are often mentioned but not deeply explored in research on technology's role in ECE parental engagement. This oversight limits the ability to create inclusive strategies for leveraging technology.

The inconsistencies and gaps in understanding the effectiveness of digital tools in fostering home-school connections arise from various challenges, include diverse perceptions of digital tool's effectiveness (Amini, 2018; Erdem & Avci, 2020), limited empirical evidence (Farooq et al., 2024; Solichah et al., 2024), variability in implementation (Jeynes, 2012; Amini, 2018), unaddressed privacy concerns (Amini, 2018; Peled et al., 2021), minimal evaluation of long term impact (Erdem & Avci, 2020; Solichah et al., 2024), cultural and contextual variability (Jeynes, 2012; Solichah et al., 2024).

These inconsistencies and gaps highlight the need for more targeted, comprehensive, and contextually relevant studies on how technology supports parental involvement in ECE. Future research should address these limitations to maximize the potential of digital tools in fostering meaningful and equitable parent-educator partnerships, while considering several factors to develop inclusive and effective strategies for parental engagement through digital platforms.

A comprehensive review of research trends focusing on technology that support parental involvement in early childhood education through bibliometric analysis has never been carried out, especially in the last ten years. Bibliometric analysis techniques can be used to

systematically explore research trends, publication patterns, and intellectual structures within a specific academic domain (Al Husaeni & Nandiyanto, 2022; Mashudi et al., 2023). It is highly relevant for understanding the trajectory of publications in the context of how technology supports parental involvement in early childhood education.

Bibliometric analysis quantifies the growth of literature in a specific field over time, offering insights into how a domain evolves (Al Husaeni & Nandiyanto, 2022; Zakariyya et al., 2023). Co-authorship networks reveal influential authors and institutions, indicating where collaboration is strong or lacking. This supports strategic partnerships for advancing research (Al Husaeni & Nandiyanto, 2022; Salido et al., 2024). In addition, keyword analysis function in bibliometric analysis helps uncover prevalent themes, such as communication apps, digital portfolios, or equity challenges. It also highlights underexplored areas, like longitudinal studies on digital tools' impact in early childhood education (Castelli & Pepe, 2008).

Among the various tools available for bibliometric mapping, VOSviewer is a widely utilized software that specializes in the computational mapping and visualization of publication metadata (Nandiyanto & Al Husaeni, 2021; Mashudi et al., 2023). The computational mapping results generated by VOSviewer are presented as detailed visualizations, facilitating enhanced observation and analysis.

This study aims to explore the scope of research on technology that supports parental involvement in early childhood education through computational mapping utilizing VOSviewer. Subsequently, a bibliometric analysis of relevant publications from the past decade is conducted to identify emerging trends and research trajectories, offering valuable insights to guide future investigations in this domain.

The use of computational mapping with VOSviewer to explore research on technology that supports parental involvement in early childhood education addresses the identified research gap by systematically analyzing underexplored areas and emerging innovations, providing a foundation for maximizing the potential of digital tools in fostering meaningful and equitable parent-educator partnerships. By highlighting the factors influencing parental engagement, the study offers actionable insights to develop inclusive and effective strategies for leveraging digital platforms, ensuring that diverse needs are met and equitable access to educational collaboration is achieved.

Methods

Research Design

This study employed a quantitative bibliometric analysis to examine research trends and patterns concerning the use of technology to support parental involvement in early childhood education. The analysis was conducted using VOSviewer, a widely recognized software for bibliometric network visualization. This approach enabled a systematic investigation of the scholarly landscape over the past decade. The chosen method facilitated the identification of dominant themes, research gaps, and emerging areas. As such, this design supported a comprehensive and objective exploration of the academic field.

Research Subject

The unit of analysis consisted of 101 academic journal articles discussing the intersection of digital technology and parental involvement in early childhood education. These articles reflected global academic discourse published between 2014 and 2023. The selection was based on thematic relevance and compliance with defined inclusion criteria. The publications represented a diverse range of scholarly sources across educational and technological disciplines. The focus was on studies emphasizing the role of parents and digital tools in early childhood learning contexts.

Data Collection

Data were gathered using the Publish or Perish software developed by Anne Harzing, with Google Scholar as the primary database. Google Scholar was selected due to its open-access

nature and comprehensive coverage of academic publications. The search strategy involved keywords such as "*technology,*" "*parental involvement*," "*early childhood education,*" and "*home-school communication,*" combined with Boolean operators. Filters were applied to limit the results to journal articles only, within the time frame of 2014 to 2023. This approach ensured the inclusion of recent and relevant publications for analysis.

Article Selection and Data Extraction

An initial set of 588 articles was retrieved, which was narrowed down to 101 relevant studies after applying inclusion and exclusion criteria. Inclusion criteria targeted studies that directly addressed the use of technology to support parental engagement in early childhood education. Articles lacking full-text access, complete metadata, or thematic relevance were excluded. Extracted metadata included title, author names, abstract, year of publication, keywords, journal source, and citation count. These data were exported in RIS and CSV formats for subsequent processing.

Data Processing and Classification

The selected articles were processed using Microsoft Excel to enable preliminary classification and trend analysis. Articles were sorted by year of publication and citation frequency to visualize the progression of research over time. A line chart was created to represent publication growth across the ten-year span. This classification helped identify the most cited works and topical shifts over the years. The processed dataset served as the foundation for bibliometric mapping with VOSviewer.

Research Instruments

Three main tools were used in this study to support data collection and analysis. Publish or Perish was employed to retrieve citation and bibliographic metadata from Google Scholar. Microsoft Excel facilitated data filtering, sorting, and the generation of initial graphs to illustrate trends. VOSviewer software was used to create visual maps of co-authorship networks, keyword co-occurrence, and citation structures. These instruments collectively supported the integrity and depth of the bibliometric analysis.

Data Analysis

Data analysis was carried out in two major phases: preliminary processing and advanced bibliometric mapping. In the first phase, Microsoft Excel was used to organize and visualize publication trends by sorting articles by year and citations. A publication trend graph was created to show the temporal development of the field. The second phase involved detailed network visualization using VOSviewer. This included co-authorship mapping, keyword relationships, and citation network analysis.

Bibliometric Mapping with VOSviewer

Three types of visualizations were produced: network, density, and overlay maps. Network maps showed relationships among authors, journals, and keywords based on co-occurrence. Density maps indicated areas of intensive research activity, while overlay maps displayed changes in research focus over time. A minimum keyword occurrence threshold of eight was applied to ensure analytical relevance. This process identified 17 significant items that were categorized into three distinct clusters.

Focus Areas

Each cluster was examined to identify thematic concentrations, inter-topic relationships, and existing research gaps. The analysis tracked the distribution of publications over time to detect patterns of research growth. Areas such as equity and long-term impact studies were found to be underrepresented. The link between keyword frequency and citation patterns revealed dominant and overlooked research areas. These findings provide a foundation for future research directions and thematic development.

Ethical Considerations

This study utilized publicly accessible bibliographic data and did not involve human participants or personal information. Therefore, ethical approval was not required. All stages of data collection and analysis adhered to principles of research transparency and integrity. The methodological process is presented clearly to enable replication and evaluation. Ethical compliance was ensured to support the reliability and academic rigor of the findings.

Result

Research developments on technology supporting parental involvement in early childhood education

The search conducted using Publish or Perish identified 236 publications from the Google Scholar database that matched the keywords "technology", “parental involvement”, “early childhood education” and "home school communication." The retrieved data were presented as metadata, including details such as authors' names, publication titles, journal names, publication years, publishers, citation counts, article links, and associated URLs. The metadata was subsequently sorted by citation count to highlight publications addressing popular topics. Research developments on technology that supports parental involvement in early childhood education were analyzed across publications from the 2014–2023 period.

Table 1 summarizes publications with 100 or more citations. Collectively, the identified publications garnered a total of 4623 citations, averaging 462,3 citations per year and 45,77 citations per article. Additional metrics reveal an average of 2,27 authors per publication, h-index of 38, g-index of 66, hI-norm of 28, hI-annual of 2,8 and hA-index of 17.

Table 1. List of popular publications on technology supporting parental involvement in early childhood education (google scholar database in 2014-2023 period)

No	Author	Title	Year	Journal	Citation
1	JL Epstein (Epstein, 2018)	School, family, and community partnerships in teachers' professional work	2018	Journal of Education for Teaching	276
2	CI Okeke (Okeke, 2014)	Effective home-school partnership: Some strategies to help strengthen parental involvement	2014	South African Journal of Education	222
3	SA Garbacz, et al. (Garbacz et al., 2017)	Family engagement in education and intervention: Implementation and evaluation to maximize family, school, and student outcomes	2017	Journal of school psychology	199
4	MA Erdener & RC Knoeppel (Erdener & Knoeppel, 2018)	Parents' Perceptions of Their Involvement in Schooling.	2018	International Journal of Research in Education and Science	188
5	Y Latunde & A Clark-Louque (Latunde & Clark-Louque, 2016)	Untapped resources: Black parent engagement that contributes to learning	2016	Journal of Negro Education	175

No	Author	Title	Year	Journal	Citation
6	JS Goodall (Goodal, 2016)	Technology and school–home communication	2016	International Journal of pedagogies and learning	172
7	S Park & S Holloway (Park & Holloway, 2018)	Parental Involvement in Adolescents' Education: An Examination of the Interplay among School Factors, Parental Role Construction, and Family Income.	2018	School Community Journal	171
8	EN Patrikakou (Patrikakou, 2016)	Parent Involvement, Technology, and Media: Now What?.	2016	School Community Journal	169
9	J Szente (Szente, 2020)	Live virtual sessions with toddlers and preschoolers amid COVID-19: Implications for early childhood teacher education	2020	Journal of Technology and Teacher Education	155
10	MA Suizzo, et al. (Suizzo et al., 2014)	Home-based parental involvement in young children's learning across US ethnic groups: Cultural models of academic socialization	2014	Journal of Family Issues	128
11	J Puccioni (Puccioni, 2018)	Parental beliefs about school readiness, home and school-based involvement, and children's academic achievement	2018	Journal of Research in Childhood Education	124
12	S Higgins & M Katsipataki (Higgins & Katsipataki, 2015)	Evidence from meta-analysis about parental involvement in education which supports their children's learning	2015	Journal of children's services	123
13	D Heath, et al. (Heath et al., 2015)	Implications of information and communication technologies (ICT) for school-home communication.	2015	Journal of Information Technology Education: Research	111
14	MA Erdener (Erdener, 2016)	Principals' and Teachers' Practices about Parent Involvement in Schooling.	2016	Universal Journal of Educational Research	109

No	Author	Title	Year	Journal	Citation
15	K Palts & V Kalmus (Palts & Kalmus, 2015)	Digital channels in teacher-parent communication: The case of Estonia	2015	International Journal of Education and Development Using ICT	106
16	L Gu (Gu, 2017)	Using school websites for home–school communication and parental involvement?	2017	Nordic Journal of Studies in Educational Policy	102

Based on Table 1, the article with the highest number of citations is authored by Joyce L. Epstein, titled "School, Family, and Community Partnerships in Teachers' Professional Work." This article has been cited 276 times since its initial publication in 2018. Joyce L. Epstein's contributions have been pivotal in shaping the understanding and practices of parental involvement in education, providing both theoretical frameworks and practical strategies to enhance collaboration among schools, families, and communities. In the past decade, Epstein has continued to contribute to the field by exploring the role of policy in advancing school, family, and community partnerships (Epstein & Sheldon, 2016).

Table 2 below, shows the development of research on technology that supports parental involvement in early childhood education, especially in the last decade (2014-2023). As displayed in table 2, there were 101 publications related to technology that supports parental involvement in early childhood education from 2014 to 2023.

Table 2. The development of research on technology supporting parental involvement in early childhood education.

Year of Publications	Number of Publications
2014	3
2015	6
2016	6
2017	6
2018	16
2019	11
2020	9
2021	16
2022	12
2023	16
Total	**101**
Average	**10,1**

When visualized graphically, the data in Tabel 2 reveals a distinctive pattern, as depicted in the graph of Figure 1 which illustrates a low volume of publications at the start of the decade, followed by a gradual increase toward its conclusion.

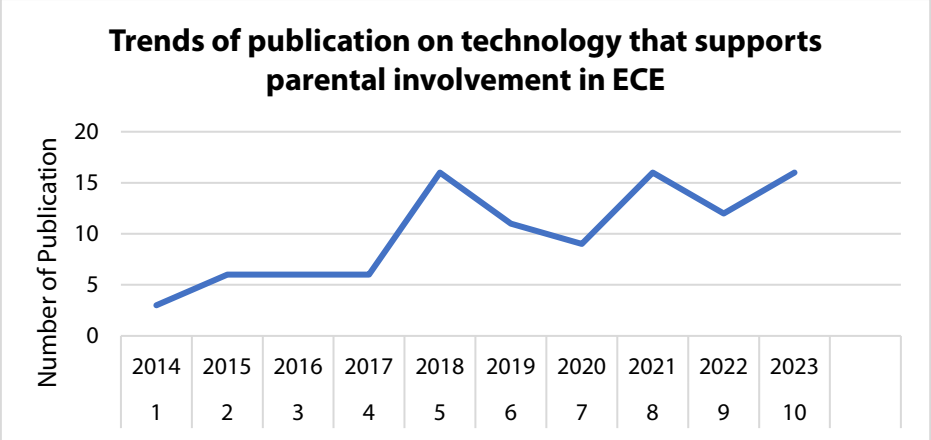

Figure 1. Trends of publications on technology that supports parental involvement in ECE

The provided graph illustrates the trends in the number of publications focusing on technology that supports parental involvement in Early Childhood Education (ECE) from 2014 to 2023. The more detailed description is explained below:

(1) General Trend: The number of publications has shown fluctuating trends over the decade, with notable peaks and declines.
(2) Initial Growth: Starting in 2014, the number of publications was modest, at around 4. There was gradual growth, with a significant rise from 2016 to 2018, reaching a peak of approximately 16 publications in 2018.
(3) Decline and Recovery: After 2018, there was a noticeable decline in publications, hitting a low point around 2019. However, the trend started recovering after 2020, with another peak observed in 2021.
(4) Recent Years: From 2022 to 2023, the trend has shown a steady upward trajectory, indicating renewed interest or focus on the topic.

The graph reflects evolving research interest and efforts in integrating technology to enhance parental involvement in early childhood education, potentially influenced by technological advancements and changing educational practices. Bibliometric analysis is particularly valuable in early childhood education research as it provides a clear picture of how technology adoption supports parental involvement, identifies gaps in theoretical and practical knowledge, and informs future studies to ensure equitable and effective digital solutions.

VOSviewer visualization of bibliometric data on technology that supports parental involvement in early childhood education

VOSviewer was utilized for computational mapping, producing citation-based clusters from the analyzed publications. This process identified 17 terms, which were subsequently categorized into 3 clusters related to technology, parental involvement, early childhood education, and home-school communication as follows:

(1) Cluster 1 (marked in red) consists of 7 items, include: children, communication, development, home school communication, parental engagement, role, and technology.
(2) Cluster 2 (marked in green) consists of 6 items, include: home, home school, parent, parent involvement, study, and use.
(3) Cluster 3 (marked in blue) consists of 4 items, include: covid, engagement, learning, and parental involvement.

The relationships between terms are represented within each cluster, with labels assigned to the corresponding-coloured circles. The size of each circle varies based on the frequency of the term's occurrence; terms appearing more frequently in the titles and abstracts of publications are represented by larger labels. This study analyzed three types of mapping visualizations: network visualization (Figure 2), overlay visualization (Figure 3), and density visualization (Figure 4).

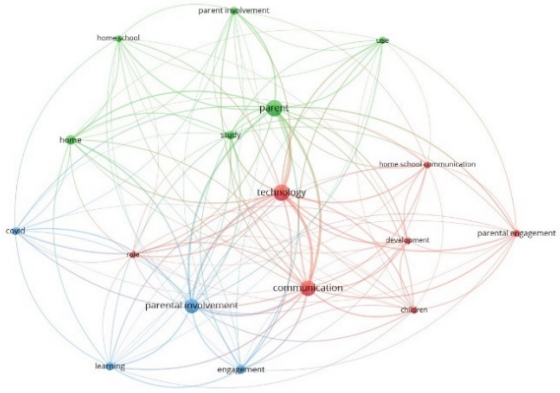

Figure 2. Network Visualization of publications on technology that supports parental involvement in ECE

This network visualization (Figure 1), represents the relationships among key terms extracted from publications related to technology that supports parental involvement in early childhood education (ECE). Each term is represented by a coloured circle, and the relationships between terms are indicated by connecting lines (Al Husaeni & Nandiyanto, 2022).

The terms are grouped into clusters represented by different colours, indicating thematic groupings based on term co-occurrence. For instance, terms such as "technology," "communication," and "parental engagement" may belong to one cluster marked with red colour, emphasizing the role of digital communication tools in fostering parental involvement. Another cluster, marked with green colour, might group terms like "home," "home-school," and "parent involvement," reflecting the interconnected roles of home or family and school or educational institutions.

The size of each circle corresponds to the frequency of the term's appearance in the dataset. Larger circles (e.g., "technology" and "communication") indicate terms with higher occurrences, signifying their centrality to the research topic (Mashudi et al., 2023). Central terms like "technology" and "parental involvement" are prominently positioned, signifying their importance as focal points in the field. Meanwhile, the lines between terms represent co-occurrence relationships, with thicker lines indicating stronger associations between terms. The terms like "home-school communication" may have a strong link to "parental involvement," reflecting their close conceptual relationship in the literature.

Network visualization provides an overview of the intellectual structure of research on this topic, offering insights into prevalent themes, interconnections, and potential gaps for future exploration (Ragadhita & Nandiyanto, 2022). The visualization highlights major research themes, such as the integration of technology in fostering home-school communication, the role of digital tools in engagement, and the importance of partnerships between parents and educators.

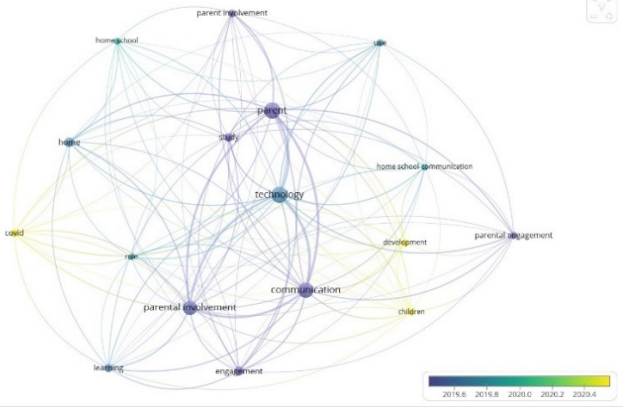

Figure 3. Overlay Visualization of publications on technology that supports parental involvement in ECE

Figure 3 in which shown overlay visualization of publications on technology that supports parental involvement in early childhood education, illustrates the temporal trends of terms associated with publications on technology that supports parental involvement in early childhood education. The terms are represented with colors corresponding to the timeline shown in the legend (2019.6 – 2020.4). Recent terms are highlighted in yellow, while older terms are shaded in blue and green (Al Husaeni & Nandiyanto, 2022).

Central terms such as "technology," "parental involvement," and "communication" appear prominently, indicating their consistent relevance throughout the publication period. Terms like "COVID" and "role," highlighted in yellow, reflect emerging trends linked to the pandemic's influence on technology facilitates parental involvement in early childhood. Terms closer to the yellow spectrum, such as "COVID" and "development," suggest a recent increase in research interest, likely due to the shift to digital tools during and after the pandemic. Established terms like "technology," "communication," and "parental involvement," appearing in blue or green, represent longstanding themes in the field.

The lines between terms indicate co-occurrence relationships. Stronger and more frequent connections, such as those between "parental involvement" and "communication," underline the centrality of these topics to research on technology in early childhood education. Related terms are positioned closer together, revealing thematic groupings (Ragadhita & Nandiyanto, 2022). Terms like "home-school communication," "parental engagement," and "technology" cluster indicate studies focusing on digital tools facilitating partnerships between schools and families. This overlay visualization highlights not only the evolution of research in this field but also the areas of emerging focus, providing valuable insights for future exploration of technology's role in supporting parental involvement in early childhood education.

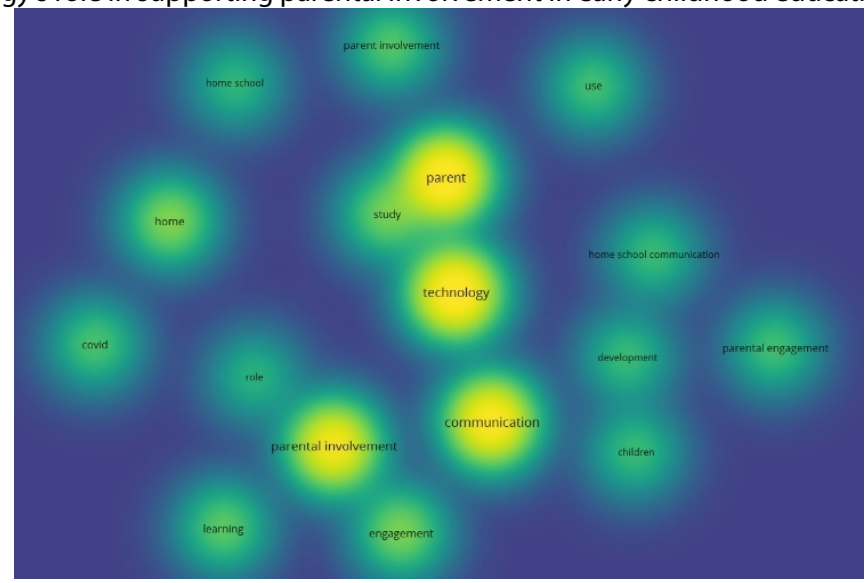

Figure 4. Density Visualization of publications on technology that supports parental involvement in ECE

The picture of density visualization (Figure 4), depicts the prominence and distribution of key terms in publications focused on technology supporting parental involvement in early childhood education. The density of terms is represented by a heatmap using color gradient, where bright yellow areas indicate terms with high frequencies and research activity, while green and blue areas reflect terms with moderate to lower activity (Mashudi et al., 2023; Zakariyya et al., 2023).

Central terms such as "technology," "parent," "parental involvement," and "communication" appear in bright yellow, signifying their frequent mention and central role in the field. Other relevant terms, like "home-school communication," "parental engagement," and "learning," are highlighted in green, showing their growing but comparatively moderate importance. Terms like "technology," "communication," and "parental involvement" are closely

associated, reflecting a core research focus on how technology facilitates parent-teacher communication and partnerships in early childhood education. Meanwhile, emerging terms such as "COVID" suggest a recent shift in research, likely driven by the pandemic's impact on technology adoption for remote communication and engagement.

Terms with lower density (darker areas), such as "children" and "role," may represent areas with less frequent exploration, indicating potential gaps or opportunities for further research. The spatial distribution of terms highlights the interconnectedness of key topics, with closely grouped terms indicating thematic relationships, such as those between "home," "school," and "parental involvement." Therefore, this density visualization provides a comprehensive overview of the research landscape, identifying dominant topics, emerging trends, and potential areas for future investigation in technology-supported parental involvement in early childhood education.

Discussion

This study explored the scope of research on technology that supports parental involvement in early childhood education through computational mapping generated by VOSviewer software. A bibliometric analysis of relevant publications from the past decade is conducted to identify emerging trends and research trajectories, offering valuable insights to guide future investigations in this domain.

The retrieved data were presented as metadata. The metadata was subsequently sorted by citation count to highlight publications addressing popular topics. Research developments on technology that supports parental involvement in early childhood education were analysed across publications from the 2014–2023 period.

The most cited publication was authored by Joyce L. Epstein (2018), whose foundational framework on family-school-community partnerships continues to shape the academic discourse. The prominence of her work in this bibliometric analysis highlights the sustained relevance of structured frameworks in guiding parental involvement practices, even in digitally mediated contexts. The article written by Epstein in 2018 entitled "*School, Family, and Community Partnerships in Teachers' Professional Work*" became the most cited article in the last ten years (276 citations).

Joyce L. Epstein's contributions to the field of family and community engagement in education date back to the 1980s and have since become pivotal in understanding the complex dynamics of parental involvement (Nzuruba, 2024). Her development of the Framework of Six Types of Involvement—parenting, communicating, volunteering, learning at home, decision-making, and collaborating with the community—has provided a comprehensive model for understanding and enhancing family and community partnerships in schools. This framework has been widely adopted by a number of previous researches and serves as a foundational guide for educators and policymakers aiming to foster effective school-family-community collaborations (Newman et al., 2019; Onyango et al., 2024).

The findings on the annual number of publications on technology that supports parental involvement in early childhood education reveal a fluctuating but overall increasing trend over the past decade. This suggests a growing research interest and ongoing efforts to integrate technology into enhancing parental involvement in early childhood education. These developments are likely driven by advancements in technology and evolving educational practices, including curriculum changes and policy shifts.

Research related to parental involvement in children's education began to develop around the 1980s in the Western world (Lau et al., 2012). In the last two decades, research related to parental involvement in children's education has increasingly emerged as various empirical facts from research have been verified which confirm the positive impacts of parental involvement on various aspects of children's development (Mazer & Thompson, 2017).

Parental involvement is not merely a school-driven initiative to encourage parents to pay closer attention to their children's schooling; it also establishes boundaries regarding the extent

and areas of parental engagement in their children's educational journey. This consideration arises because parental involvement has its own proportion, which, as noted in several studies, tends to diminish as children grow older and become more independent (LaRocque et al., 2011; Ule et al., 2015).

The result of bibliometric analysis using visualization maps generated by VOSviewer collectively provide valuable insights into how technology has shaped home-school communication in the digital era with a focus on parental involvement. The visualization highlights major research themes, such as the integration of technology in fostering home-school communication, the role of digital tools in engagement, and the importance of partnerships between parents and educators.

In this partnership context, a number of studies confirm that teachers play an important role in terms of using technology to bridge communication with parents. Kiryakova & Kozhuharova (2024) highlighted that the success of technology in education is highly dependent on the digital competence of teachers, which must be addressed as part of digital parental involvement efforts. Meanwhile, Blau & Hameiri (2016) emphasize how teacher modeling of mobile data use encourages parental engagement and real-time monitoring of children's school experiences.

The network visualization highlights strong connections between the central terms indicate a robust relationship between digital tools and their role in enhancing parental involvement, bridging the gap between home and school. The clustering of terms underscores the holistic impact of technology on children's educational experiences, mediated through improved communication channels.

The findings aligned with the implication of several previous researches that collectively underline technology as a bridge in fostering holistic parental involvement and reshaping home-school connections in the digital age (Hutchison, 2020; Wanjala et al., 2024; Nzuruba, 2024). By providing accessible and dynamic platforms for interaction, technology not only enhances communication but also supports the collaborative effort necessary for children's academic and emotional success (Cheairs, 2015; Amini, 2018; Ahmed et al., 2021; Gross et al., 2022).

The notion of 'digital intimacy' illustrated how technology enables "observant" and "instrumental" forms of parental connection in the preschool setting (Erdreich, 2020). Therefore, computer-mediated communication can strengthen parent–educator relationships when integrated with face-to-face communication, suggesting that hybrid strategies are ideal for early learning contexts (Wilke et al., 2024). Another studies also confirmed that special features in technology related to home-school communication can overcome language and literacy barriers in diverse community while enhancing participation and long-term behavior change in high risk population. Those special features include video-based communication tools (Walsh et al., 2018), gamification (Love et al., 2016), peer sharing column in online parenting forum (Love et al., 2016), tags on parenting related post on social media (Sari et al., 2020; Thorpe et al., 2020).

The overlay visualization shows temporal trends, with terms like "COVID" and "development" appearing more recently (highlighted in yellow), reflecting the pandemic's role in accelerating the adoption of digital technologies for communication. The result corresponded with previous research findings showed that before the pandemic, parental involvement was often supported by traditional means like in-person meetings, printed letters and reports, also occasional use of digital communication tools such as email and school websites (Ribeiro et al., 2021; Panaoura, 2022).

Covid-19 pandemic necessitated a sudden and widespread shift to remote learning, significantly increasing the reliance on technology. Tools like Google Classroom, Microsoft Teams, and Zoom became essential for facilitating online classes and communication (Ribeiro et al., 2021; Knopik et al., 2021; Kisira & Nabasumba, 2023; Farooq at al., 2024). Platforms previously used sporadically became central for real-time updates, task monitoring, and feedback, fostering closer home-school communication (Ribeiro et al., 2021).

Bright yellow areas in the density visualization for terms like "technology," "communication," and "parental involvement" indicate high research activity, reflecting their central role in shaping home-school communication in the digital era. This result strengthened the findings in the previous studies emphasized both parents and schools recognize the importance of technology in enhancing parental involvement. There is a push for more research regarding structured use of digital tools to improve transparency and collaboration (Erdem & Avci, 2020; Knopik et al., 2021; Panaoura, 2022; Kisira & Nabasumba, 2023).

Amid the post-pandemic education landscape, where digital tools have become indispensable, this study offers novel insights into their role in strengthening parent-educator collaboration. Through computational bibliometric analysis of 101 articles, we map a decade of research trends, visually synthesizing evolving scholarly priorities. The findings reveal how the COVID-19 crisis accelerated focus on technology-mediated engagement in early childhood education (ECE), corroborating evidence of heightened digital reliance among families and educators. Furthermore, this study contributes a conceptual expansion by highlighting technologies that foster parents' emotional connections to their child's learning, aligning with theories of 'parental warmth' (Blau & Hameiri, 2016), wherein affective engagement enhances developmental outcomes.

In the context of early childhood education, the demand for parental involvement is notably higher compared to other educational levels (Erdreich, 2020). This is because young children are at the lowest levels of both age and independence compared to students at higher educational stages. Consequently, various empirical efforts have been undertaken to examine the forms of parental involvement in early childhood education, the frequency and intensity of such involvement, and the division of roles between parents and educators (Daniel, 2015).

In the process, technology can greatly assist these empirical efforts by facilitating effective communication, content sharing, real-time feedback, and flexibility in interaction (Erdem & Avci, 2020; Farooq et al., 2024). Hence, integration of technology into parental involvement in early childhood education has enhanced communication, increased the frequency and intensity of interactions, and refined role divisions between parents and educators. While these tools offer significant benefits, challenges such as digital literacy and equitable access need to be addressed to maximize their potential.

The findings of this study carry important implications across policy, practice, and scholarship. For practitioners, the identified tools and themes offer guidance for designing more inclusive, technology-driven parental involvement strategies in early childhood education. For policymakers, the emerging research directions highlight the need for digital policies that promote equitable family-school partnerships. Meanwhile, for scholars, the visualization of research trends and gaps provides a valuable roadmap for advancing future empirical and theoretical work in this field.

Several findings are also considered to have significant implications for practice, policy, and scholarly inquiry related to parental involvement in early childhood education. The implications of this study highlight the need for integrated efforts across practice, policy, and research. In practice, digital communication tools should be accompanied by strategies that enhance digital literacy among both parents and educators, supported by ongoing professional development in pedagogical digital competence. From a policy perspective, investment in inclusive and accessible digital infrastructure is essential to address socioeconomic and linguistic disparities. For future studies, there is a pressing need to move beyond descriptive analyses toward impact-oriented studies that examine outcomes related to family well-being, child development, and digital equity.

Despite the insights of this study, several limitations must be acknowledged, that were related to database bias, regional gaps, and scope of analysis. A mere reliance on Google Scholar database may have led to inconsistencies in article indexing and may not represent the full spectrum of high-quality international research. Regional gaps can carry out language gaps which often coincide with language barriers, leading to the underrepresentation of non-English

sources and context-specific research from areas such as Southeast Asia and Sub-Saharan Africa in the dataset. Finally, regarding scope of analysis, the focus was on bibliometric patterns rather than the pedagogical depth or outcomes of parental involvement programs.

Eventually, future research should expand data sources to include Scopus and Web of Science for greater academic robustness while combining bibliometric and content analysis to deepen theoretical and pedagogical insights. Investigations into the digital divide's impact on equity in home–school partnerships are needed, alongside studies on how culturally specific parenting models shape technology acceptance and usage, particularly among minority and Muslim millennial parents. Additionally, examining co-designed communication platforms with embedded feedback loops and support systems could better align educator and parent needs.

Conclusion

This study seeks to explore the scope of publications on technology that facilitates parental involvement through computational mapping utilizing VOSviewer. The bibliometric data comprises 101 research articles published in various journals, sourced from the Google Scholar database spanning the period from 2014 to 2023. The articles were retrieved using the Publish or Perish software. The findings indicate that research on technology supporting parental involvement has shown a fluctuating yet overall increasing trend over the years. A significant increase occurred from 2017 to 2018. The VOSviewer maps collectively illustrate how technology has redefined home-school communication, enabling more dynamic, frequent, and accessible interactions. The visualizations emphasize the growing reliance on digital tools in fostering parental involvement, particularly in adapting to contemporary educational challenges in the digital era. By addressing these implications, future research can contribute to a more nuanced understanding of how technology facilitates parental involvement, ensuring its effective and equitable use in home-school communication within the digital era.

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