INDONESIAN JOURNAL OF EDUCATIONAL RESEARCH AND REVIEW
Volume 6 Nomor 1 2023, pp 99-110
E-ISSN: 2621-8984; P-ISSN: 2621-4792
DOI: https://doi.org/10.23887/ijerr.v6i1.55648

The Role of Contemporary Pedagogical Technology in ECE: A Systematic Literature Review

Novi Anggraeni[1*], Aan Listiana[2]
[1,2] Early Childhood Education, Universitas Pendidikan Indonesia, Bandung, Indonesia
*Corresponding author: novianggra@upi..edu

Abstrak

Pendidikan Anak Usia Dini (PAUD) merupakan tahap kritis dalam perkembangan anak yang meletakkan dasar untuk belajar seumur hidup dan sukses. Penggunaan teknologi di PAUD efektif untuk meningkatkan hasil belajar dan perkembangan. Teknologi pedagogis kontemporer seperti media interaktif, aplikasi seluler, dan perangkat lunak pendidikan telah diidentifikasi sebagai alat potensial untuk meningkatkan kualitas PAUD. Tinjauan literatur ini bertujuan untuk menganalisis kemanjuran teknologi pendidikan dalam mendorong pembelajaran dan perkembangan anak usia dini. Dalam kajian literatur ini, penulis memilih studi yang relevan dan akurat dari sumber akademik terbatas seperti Scopus dan Crossref untuk mengumpulkan data penelitian, yang kemudian dikategorikan menurut kriteria PRISMA. Pencarian pertama menghasilkan 134 artikel, yang kemudian dipangkas menjadi 20 makalah yang dapat diterima untuk pemeriksaan lebih dekat. Hasil penelitian ini mengungkapkan kurangnya kompetensi instruktur dalam penggunaan teknologi di antara instruktur kelas PAUD, menghalangi pendidik untuk fokus pada penggunaan teknologi dalam pendidikan anak usia dini. Hal ini disebabkan fakta bahwa pendidik anak usia dini kurang dibekali dengan teori dan praktik teknologi pendidikan modern, seperti perangkat lunak pembelajaran, aplikasi seluler, dan media interaktif, yang dapat meningkatkan kapasitas kognitif, linguistik, dan sosial anak usia dini. Sementara itu, teknologi pendidikan dapat membantu menjembatani kesenjangan belajar antara anak berkebutuhan khusus dan mereka yang tidak memiliki akses ke sekolah formal.

Kata kunci: *Technology, Pedadodical, ECE, Systematic Literature Review*

Abstract

Early Childhood Education (PAUD) is a critical stage in a child's development that lays the foundation for lifelong learning and success. The use of technology in PAUD is effective for improving learning and development outcomes. Contemporary pedagogical technologies such as interactive media, mobile applications, and educational software have been identified as potential tools for improving the quality of ECD. This literature review aims to analyze efficacy of educational technology in boosting the learning and development of young children. In this literature review, the writers selected relevant and accurate studies from restricted academic sources such as Scopus and Crossref to gather research data, which were then categorized according to PRISMA criteria. The first search yielded 134 articles, which were then whittled down to 20 papers acceptable for closer examination. This study results reveal a lack of instructor competency in the use of technology among ECE classroom instructors, preventing educators from focusing on the use of technology in early childhood education. This is due to the fact that early childhood educators are less equipped for the theory and practice of modern educational technologies, such as learning software, mobile apps, and interactive media, which may increase the cognitive, linguistic, and social capacities of young children. In the meanwhile, educational technology may assist in bridging the learning gap between children with special needs and those without access to formal schooling.

Keywords: Technology, Pedadodical, ECE, Systematic Literature Review

History:
Received : December 19, 2022
Revised : December 22, 2022
Accepted : March 23, 2023
Published : April 25, 2023

Publisher: Undiksha Press

1. INTRODUCTION

The fourth-generation industrial revolution, also known as the industrial revolution 4.0, steers all aspects of life toward digital technology, artificial intelligence, big data, and robots. When we join the world industrial revolution 4.0, education is not an exception. Education must include technology-enhanced learning. Professionals in the field of education use the term 4.0 to describe the incorporation of cyber technology in the classroom (Daniela, 2021; Gargot et al., 2021). Early childhood education organizations provide instruction and care to children beginning at birth. The majority of IT research in educational institutions is undertaken in classrooms with non-educators. A survey of the literature indicated that few

empirical studies have investigated the obstacles of IT integration inside ECEC businesses (Legaki et al., 2020; Nikolopoulou & Gialamas, 2015). This research also covers studies that focus especially on hurdles to IT integration. According to previous study it is not possible to estimate with certainty" from school-based studies (Hu & Yelland, 2019).

There is a significant disparity between early childhood education teachers. The framework can also lead to a better understanding of existing barriers, how they interact, and how they affect IT integration procedures and work methods of personnel in early childhood education organizations (C. K. Blackwell et al., 2013; Plumb & Kautz, 2016). Early Childhood Education (ECE) is a critical stage in a child's development that lays the foundation for lifelong learning and success. In recent years, there has been a growing interest in the use of technology in ECE to enhance learning and development outcomes (Blackwell, 2013;Mertala, 2019). Contemporary pedagogical technology such as interactive media, mobile applications, and educational software have been identified as potential tools to improve the quality of ECE.

Early childhood education is still developing knowledge of digital games. Early childhood educators and researchers continue to debate whether integrating digital technologies into play-based pedagogy is yet fully established (Mohanty et al., 2021; Pramono et al., 2021). In Kuwait, previous study found there is a contradiction between institutional concerns and individual views and actions about the use of digital technology in early childhood education (Mohanty et al., 2021). The biggest impediments to digital technology being part of game-based pedagogy in this context are current teacher abilities, attitudes, and practices based on the notion that digital technologies are not included in play-based pedagogy (Frolova & Rogach, 2021; Ningsih et al., 2019).

The biggest obstacle to digital technologies reflecting contentment with established techniques and suspicion towards digital technology such as computers and mobile devices is distrust of both. The use of digital technology in the classroom is not caused by a lack of technological resources or equipment; rather, it is a result of the teacher's abilities and attitudes (Dewi & Alam, 2020; Hashim, 2018; Sargent & Calderón, 2021). What appears to be occurring in the classroom is adherence to what is recognized and framed as game-based teaching, rather than the instructor demonstrating technophobia. With this hesitation, using digital technologies in early childhood education. It is necessary to revise the notion of play-based pedagogy in early childhood education. According to previous study both conventional and technology can enhance or harm the attributes we wish to see in children in their early years (Cowan et al., 2021). As a result, it has both theoretical and practical ramifications, and it also encourages us to rethink what it truly means to play and have pleasure in the context of modern technology. As a result, the researcher advises investigating the extent to which technology is employed in early childhood education. As a result, the researchers undertook a systematic review to answer researchers' queries concerning the use of pedagogical technology in early childhood education.

This comprehensive literature study aims to analyze the function of modern pedagogical technology in ECE. The purpose of this study is to present empirical data about the efficacy of technology-based treatments for increasing learning and development outcomes in young children. Particularly, the review will investigate the effect of technology on cognitive, linguistic, and social-emotional development in early childhood education (ECE). The evaluation will also highlight possible problems and constraints related to the use of technology in early childhood education, such as concerns about screen time and potentially harmful impacts on the social and emotional health of children. The assessment will give insights into the best practices for using technology in ECE and identify research gaps. Overall, the purpose of this review is to contribute to the expanding body of literature on the use of technology in early childhood education (ECE) and to inform educators,

parents, and policymakers about the potential benefits and risks of technology-based interventions in promoting learning and development outcomes for young children.

2. METHODS

This article uses the Systematic Literature Review (SLR) research approach to study, locate, assess, and interpret studies on technology in early childhood education (Afsari et al., 2021; Castaneda & Cuellar, 2020). To carry out this systematic literature review, a comprehensive search was carried out in several academic databases, a database search was carried out, through Publish Of Perish using the Scopus and Crossref options. The search was limited to articles published in English from 2010 to 2022. The following search terms were used: "early childhood education", "technology", "pedagogy", "learning" and "development".

The inclusion criteria for the review were as follows: (1) studies investigating the use of technology in ECE, (2) studies examining the impact of technology on cognitive, language, and socio-emotional development in young children, (3) studies using experimental designs or quasi-experimental, and (4) studies published in peer-reviewed journals. After conducting an initial search, the identified titles and abstracts of articles were filtered for relevance. Full-text articles that met the inclusion criteria were then reviewed in detail. Data were extracted from selected studies, including study design, sample size, type of intervention, outcome measure, and outcome. In addition, the author also pays attention to publications that are only published in Indonesian and English.

Reporting standards are used as the basis for reviews under the Preferred Reporting Items for Systematic Review and Meta-Analyzes (PRISMA) guidelines (Boonroungrut et al., 2022). The following five steps were taken: 1) database search, 2) article identification and preliminary abstract assessment, 3) criteria exclusion and inclusion, 4) full-text retrieval, and 5) analysis (Page et al., 2021). The results of selected studies were synthesized using a narrative approach, and findings were organized according to the impact of technology on cognitive, language, and socio-emotional development in ECE. Finally, the review identified potential challenges and limitations associated with the use of technology in ECE, and recommendations for future research were made based on the review's findings.

3. RESULTS AND DISCUSSION

Results

The researchers got 34 publications from the restricted Scopus database and 100 databases from Crossref using the keywords "Technology", "ECE", and "Early Childhood Education", "Childhood" in their search, yielding a total of 134 articles. Then 53 articles were issued since they did not fit the requirements and had duplicate data. As a result, the remaining 81 complete articles are regarded viable. Furthermore, the researcher published 45 complete publications and 16 articles with uninteresting research results. The researcher obtained the following data as a result of data analysis utilizing the PRISMA approach. The PRISMA approach is show in Figure 1.

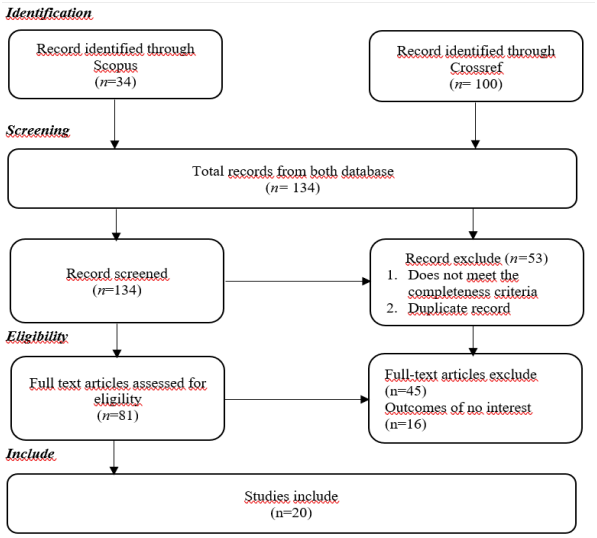

Figure 1. PRISMA

The researcher in the image above receives 20 articles that meet the criteria and are ready for an in-depth review, as shown in Table 1.

Table 1. Summary Table

NO	Title/Author	Research Place	Research Subjects	Research Design	Research Instrument	Research Result
1	Strengthening teaching competencies in early childhood education: A look at classroom activities. (Otero-Mayer et al., 2021)	Spanyol	The research subjects were 31 classes from 21 early childhood education facilities with 340 kids and 58 instructors aged 0-3 years.	Quantitative	Observations and interviews	This study's findings on the actions and dispositions of educational materials and elements in the classroom throughout the first cycle of Early Childhood Education confirm the findings of (Morales-Murillo et al, 2020). Based on the findings of this study, and despite the difficulty of obtaining a representative sample from centers and classrooms in studies of this type, it would be very interesting to continue working on expanding the sample and conducting a detailed analysis of the differences. in the "Activity" subscale by contextual variables such as teaching qualifications, child age, and center type.
2	Experiences of a Tablet-Based Mobile Learning Environment in Family Day Care (Pihlainen et al., 2018)	Finlandia	Five caregivers participated in the study.	Qualitative	Observations and interviews	The study's findings indicate that using Digi bags with young children enhances the educational, creative, and frequent use of digital technology. In addition to professional training in the use of digital technology, the study underlines the necessity of offering chances for peer support and peer learning in natural settings for family daycare professionals.

NO	Title/Author	Research Place	Research Subjects	Research Design	Research Instrument	Research Result
3	Robot programming versus block play in early childhood education: Effects on computational thinking,sequencing ability, and self-regulation. (W. Yang et al., 2022)	Beijing, China	101 preschool children and their parents participated in the study.	Quantitative	Observation	The findings highlight the vital importance of innovative technology-enhanced learning programs in encouraging early development, which is critical for individual and societal well-being.
4	The ECE Pre-service Teachers' Perception of Factors Affecting the Integration of Educational Computer Games in Two Conditions: Selecting versus Redesigning. (Sancar Tokmak & Ozgelen, 2013)	Turkey	The study's participants were 26 early childhood education teacher candidates.	Qualitative	Observations and interviews	The outcomes of the study demonstrated that there were disparities in the educational computer game integration decisions made by pre-service ECE instructors while selecting and redesigning the games. According to pre-service ECE instructors, the impacts of course activities and play features were the explanation for this transformation.
5	Early childhood teachers professional learning about ICT implementation in kindergarten curriculum: A qualitative an exploratory study in China. (T. Yang, 2022)	China	Eleven PAUD teachers participated in the study.	Qualitative	Observations and interviews	The study also looks at the teaching-research atmosphere that encourages participants' professional development. This research has significant ramifications for the evolution of professional learning programs today.
6	STEM starts early: Views and beliefs of early childhood education stakeholders in Tanzania. (Ndijuye & Tandika, 2020)	Tanzania	Two policymakers, three academics, and two ECE students participated in the study.	Qualitative	Interview, observation, and documentation	Although there is consensus among ECE stakeholders that children should be introduced to the STEM environment as early as feasible, the survey findings show that even among ECE practitioners, there is a hazy understanding of what STEM education means in ECE. Furthermore, while instructors are informed and instructed to assist science and mathematics education, there is no explicit policy/instruction outline on how to promote technology and engineering education in ECE. This paper makes recommendations for incorporating STEM into early childhood education, particularly in Tanzania.
7	Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. (Mertala, 2019)	Finlandia	35 Article data	Qualitative	Review method	According to the synthesis, macro and micro contextual elements such as national education policy and personal experiences influence teachers' opinions. The consequences for teacher education are examined.
8	Ready, steady … pause: integrating ICT into Shanghai Preschools. (Dong & Newman, 2016)	Shanghai	4 early childhood education teachers	Qualitative	Observations and interviews	According to the findings of this study, Chinese preschool teachers have an increasing grasp of the social and technological implications of

NO	Title/Author	Research Place	Research Subjects	Research Design	Research Instrument	Research Result
						ICT use in early childhood education (ECE), yet they regard ICT as having limited value for children and themselves. This inhibits young children's active and meaningful use of ICT for early learning and development. We contend that clear ICT policies and curricular standards for ECE systems are required to encourage children's active and creative use of ICT for early learning and development, as well as to better support teacher learning.
9	Technological knowledge in early childhood education: provision by the staff of learning opportunities. (Sundqvist, 2020)	Swedia	35 early childhood educators, 3 early childhood education teachers, and 3 early childhood caregivers	Qualitative	Observations and interviews	Teachers boost children's learning of a range of technical materials, particularly those connected to technology items and creative processes, according to the findings. This varies from basic knowledge of how to use a knife or scissors to a more advanced understanding of how to construct something fit for purpose and how certain equipment or materials are more or less sufficient for a specific activity or design. The findings also imply that how teachers approach these issues has an impact on what talents and skills children are encouraged to acquire.
10	Exploring the adoption of social media in self-paced physical activity in early childhood education: a case in central China. (Lu, 2022)	China	There were 28 participants, including 10 teachers and 18 early childhood parents.	Qualitative	Interviews	The results reveal that the majority of participants knew how to use the scientific method to aid children's physical development; nonetheless, they raised worries about children's health, privacy, and formal learning as a result of overexposure to social media technology. Suggestions and consequences for social media app makers and educators will be included in future study investigations.
11	Development and validation of the STEM Teaching Self-efficacy Scale (STSS) for early childhood teachers. (W. Yang et al., 2021)	Zhejiang, China	There are 418 early childhood education teachers.	Quantitative	Survey	According to the findings of this study, STATUS is a novel measure for measuring early childhood teachers' attitudes toward STEM education in early childhood settings. STEM education and self-efficacy
12	Investigating Pre Service Early Childhood Education Teachers' Technological Pedagogical Content Knowledge (TPACK) Competencies Regarding Digital	Central Anatolia, Turkey	There are 481 early childhood educators.	Quantitative	Survey Cross-Sectional	This study found that prospective teachers' Technology Pedagogical Content Knowledge TPACK competency was connected to their attitude and use of technology, digital literacy abilities, and online reading comprehension methods, with

NO	Title/Author	Research Place	Research Subjects	Research Design	Research Instrument	Research Result
	Literacy Skills and Their Technology Attitudes and Usage. (Altun, 2019)					their characteristics explaining 38% of the variation. However, there was no association between prospective teachers' self-reported TPACK abilities and their grade level or GPA.
13	Digitalization in early childhood education: a domestication theoretical perspective on teachers' experiences. (Lindeman et al., 2021)	Swedia	12 educators from 9 ECE institutions	Qualitative (Study of domesticati on theory)	Interviews	This study found that digital competence, including pedagogical aspects, as well as personal encouragement and professional learning and development, are important factors in the successful domestication of digital tools in ECE.
14	Harnessing the Potential of Storytelling and Mobile Technology in Intangible Cultural Heritage: A Case Study in Early Childhood Education in Sustainability. (Tzima et al., 2020)	Greece	12 children aged 4 to 7, 3 instructors, 2 teachers, and 1 trainee teacher	Qualitative	Observati ons, interviews	This study found that digital competence, including pedagogical aspects, as well as personal encouragement and professional learning and development, are important factors in the successful domestication of digital tools in ECE.
15	Teachers' pedagogical strategies when creating digital stories with young children. (Undheim & Jernes, 2020)	Norway	1 teacher and 6 4-5 year old children	Qualitative (many case studies) (multiple case studies)	Observati on	When making digital tales with young children, several teacher pedagogical approaches are as crucial as methods and products: integrating discourse, explaining the practice, and instructing results. A cheery tone characterizes teacher interactions. By highlighting the pedagogical consequences of employing digital technologies, the findings of this study contribute to our knowledge of how teachers engage groups of children in technology-mediated storytelling.
16	Digital Childhood: The Impact of Using Digital Technology on Children's Health. (Zahra & Alanazi, 2019)	Tabuk (KSA)	300 moms have children under the age of six.	Quantitative	Quesionar e	Technology influences children's physical and psychological health and moms are becoming more conscious of this. This highlights the critical importance of health education in boosting mothers' knowledge of the impacts of technology use on their children's health.
17	Factors Affecting Teacher Readiness for Online Learning (TROL) in Early Childhood Education: TISE and TPACK. (Warmansyah et al., 2022)	Indonesia	105 ECE educators	Quantitative	Survey	Empirical findings show that: 1) there is a direct positive effect of Technology Integration Self-Efficacy on Teacher Readiness in Online Learning; 2) there is a direct positive effect of PACK on Teacher Readiness in Online Learning, and 3) there is a direct positive effect of Technology Integration Self-Efficacy on TPACK.

NO	Title/Author	Research Place	Research Subjects	Research Design	Research Instrument	Research Result
18	Young children and digital technology: Australian early childhood education and care sector adults' perspectives. (Zabatiero et al., 2018)	Australia	There are 528 early childhood instructors.	Cross-sectional quantitative survey	Observation	The findings show that the sector has a diverse set of perspectives, including an appreciation for the learning and teaching opportunities provided by technology, as well as a concern for children's well-being and digital citizenship. The findings also highlight the need for sector-wide support and evidence-based practice in the use of educational tools that promote physical, emotional, and social development and health in children.
19	Enhancing the learning of technology in early childhood setting. (Fox-Turnbull, 2019)	Swedia	2 early childhood educators with 18 and 19 years of teaching experience, respectively	Qualitative	Observations, interviews	This study demonstrates that the framework utilized is useful to both teachers and students. As a result, it provides insight into how and what children learn through technology, as well as instructors' understanding of technology.
20	Augmented reality as a form of digital technology in early childhood education. (Madanipour & Cohrssen, 2020)	ProQuest, Web of Science, and the Resources Information Center (ERIC) database	16 articles were published in 2015-2018.	Literature Review	Peer review in a journal "Augmented reality" and "childhood" are keywords.	According to the Department of Education, Employment, and Workplace Relations, digital technology is playing a significant role in early childhood education in the twenty-first century. It must be investigated whether the use of AR technology in early childhood would increase pedagogical quality and enrich learning.

Discussion

In a thorough review of 134 scientific articles published between 2010 and 2022, the researcher identified only 20 empirical studies that met the inclusion criteria, eight of which were quantitative and twelve qualitative. Although the bulk of the research participants are youngsters, educators and parents are also involved.

This comprehensive literature review aims to investigate the role of contemporary instructional technology in ECE. Technology-based interventions, such as interactive media, mobile apps, and instructional software, have the potential to enhance the cognitive, linguistic, and social-emotional development of young children, according to the review (Pihlainen et al., 2018; W. Yang et al., 2022). The study found that technology-based therapy may aid the cognitive development of young children. Specifically, interventions that target early reading and numeracy skills using interactive games and instructional software have been demonstrated to improve children's cognitive capacities (Warmansyah et al., 2022; Zabatiero et al., 2018). Young children's language development has been shown to be enhanced by technological interventions in language development. It has been established that treatments that provide children with direct access to language-rich activities, such as reading and storytelling, improve their vocabulary, grammar, and comprehension skills (Altun, 2019; Lindeman et al., 2021). Regarding Socio-Emotional Development, there are contradictory accounts of the impact of technology on the socio-emotional development of young children.

Although some studies have shown positive results, such as enhanced social skills and reduced anxiety, others have discovered negative results, such as increased screen usage and decreased physical activity. There are additional difficulties and constraints related with the use of technology in ECE. Worries about screen time, the potential negative effects on children's social and emotional well-being, and the significance of choosing and implementing technology-based solutions with care are among them. Technology-based therapies have the potential to boost cognitive and linguistic development in young children, according to the research. Yet, information regarding the effect of technology on socioemotional development is contradictory, and there are obstacles and constraints involved with the use of technology in early childhood development. The analysis suggests that educators, parents, and policymakers carefully weigh the potential dangers and advantages of technology-based treatments and apply them effectively and responsibly. Future research should concentrate on the long-term effects of technology-based interventions on child learning and development outcomes, the most effective methods of integrating technology into the ECD curriculum, and the potential risks and benefits associated with the various types of technology-based interventions.

This study highlights the significance of teachers' abilities to use technology in early childhood education, and instructors must be able to engage with parents in systematically deploying technology to meet the requirements of children. This study contributes to the range of research on the use of technology in ECD and highlights the relevance of incorporating technology into early childhood education using an evidence-based approach. In this way, we can use the potential advantages of technology to enhance children's learning outcomes and development while building the groundwork for long-term success.

4. CONCLUSION

Reforms in education have provided new qualifications for kindergarten instructors, such as particular curriculum, pedagogical tactics, and ICT educational abilities. In addition to receiving fundamental theoretical and practical training, early childhood educators gain competence via experience and modeling. Global education policies and curriculum emphasize the significance of educational computers in encouraging the development of young children. In order to create a consistent and strong basis for comprehension and application, technology education should begin in the early grades. New requirements have been established for teachers' ICT competence and understanding on how to use ICT to change instruction. In conclusion, this systematic literature review illustrates the possible benefits of technology-based interventions in ECE. Educators, parents, and policymakers must consider the possible risks and advantages of technology-based therapies prior to adopting them effectively and ethically.

5. REFERENCES

Afsari, S., Safitri, I., Harahap, S. K., & Munthe, L. S. (2021). Systematic Literature Review: Efektivitas Pendekatan Pendidikan Matematika Realistik Pada Pembelajaran Matematika. *Indonesian Journal of Intellectual Publication*, *1*(3), 189–197. https://doi.org/10.51577/ijipublication.v1i3.117.

Altun, D. (2019). Investigating Pre-Service Early Childhood Education Teachers' Technological Pedagogical Content Knowledge (TPACK) Competencies Regarding Digital Literacy Skills and Their Technology Attitudes and Usage. *Journal of Education and Learning*, *8*(1), 249–263. https://eric.ed.gov/?id=EJ1203450.

Blackwell, C. (2013). Teacher practices with mobile technology integrating tablet computers into the early childhood classroom. *Journal of Education Research*, *7*(4), 1–25. https://cmhd.northwestern.edu/wp-content/uploads/2014/07/Blackwell-JEDR-Final.pdf.

Blackwell, C. K., Lauricella, A. R., Wartella, E., Robb, M., & Schomburg, R. (2013). Adoption and use of technology in early education: The interplay of extrinsic barriers and teacher attitudes. *Computers and Education*, *69*. https://doi.org/10.1016/j.compedu.2013.07.024.

Boonroungrut, C., Saroinsong, W. P., & Thamdee, N. (2022). Research on Students in COVID-19 Pandemic Outbreaks: A Bibliometric Network Analysis. *International Journal of Instruction*, *15*(1), 457–472. https://eric.ed.gov/?id=EJ1331042.

Castaneda, D. I., & Cuellar, S. (2020). Knowledge sharing and innovation: A systematic review. *Knowledge and Process Management*, *27*(3), 159–173. https://doi.org/10.1002/kpm.1637.

Cowan, K., Potter, J., Olusoga, Y., Bannister, C., Bishop, J. C., Cannon, M., & Signorelli, V. (2021). Children's Digital Play during the COVID-19 Pandemic: insights from the Play Observatory. *Je-LKS: Journal of e-Learning and Knowledge Society*, *17*(3), 8–17. https://eprints.whiterose.ac.uk/184212/.

Daniela, L. (2021). Smart pedagogy as a driving wheel for technology-enhanced learning. *Technology, Knowledge and Learning*, *26*(4), 711–718. https://doi.org/10.1007/s10758-021-09536-z.

Dewi, E. R., & Alam, A. A. (2020). Transformation Model for Character Education of Students. *Cypriot Journal of Educational Sciences*, *15*(5), 1228–1237. https://doi.org/10.18844/CJES.V15I5.5155.

Dong, C., & Newman, L. (2016). Ready, steady… pause: integrating ICT into Shanghai preschools. *International Journal of Early Years Education*, *24*(2), 224–237. https://doi.org/10.1080/09669760.2016.1144048.

Fox-Turnbull, W. (2019). Enhancing the learning of technology in early childhood settings. *Australasian Journal of Early Childhood*, *44*(1), 76–90. https://doi.org/DOI: 10.1177/1836939119841457.

Frolova, E. V., & Rogach, O. V. (2021). Particularities of students perceptions of the digitalization of education: Comprehending the experience of online learning in a pandemic environment. *Perspektivy Nauki i Obrazovania*, *51*(3). https://doi.org/10.32744/pse.2021.3.3.

Gargot, T., Asselborn, T., Zammouri, I., Brunelle, J., & ... (2021). "It Is Not the Robot Who Learns, It Is Me." Treating Severe Dysgraphia Using Child–Robot Interaction. In *Frontiers in …*. frontiersin.org. https://doi.org/10.3389/fpsyt.2021.596055.

Hashim, H. (2018). Application of Technology in the Digital Era Education. *International Journal of Research in Counseling and Education*, *1*(2), 1. https://doi.org/10.24036/002za0002.

Hu, X., & Yelland, N. (2019). Changing learning ecologies in early childhood teacher education: From technology to stem learning. *Beijing International Review of Education*, *1*(2–3), 488–506. https://brill.com/view/journals/bire/1/2-3/article-p488_488.xml.

Legaki, N.-Z., Xi, N., Hamari, J., Karpouzis, K., & Assimakopoulos, V. (2020). The effect of challenge-based gamification on learning: An experiment in the context of statistics education. *International Journal of Human-Computer Studies*, *144*, 102496. https://doi.org/10.1016/j.ijhcs.2020.102496.

Lindeman, S., Svensson, M., & Enochsson, A. B. (2021). Digitalisation in early childhood education: a domestication theoretical perspective on teachers' experiences.

Education and Information Technologies, *26*(4), 4879–4903. https://doi.org/10.1007/s10639-021-10501-7.

Lu, J. (2022). Exploring the adoption of social media in self-paced physical activity in early childhood education: a case in central China. *Educational Technology Research and Development*, *70*(1), 321–338. https://doi.org/10.1007/s11423-021-10059-8.

Madanipour, P., & Cohrssen, C. (2020). Augmented reality as a form of digital technology in early childhood education. *Australasian Journal of Early Childhood*, *45*(1), 5–13. https://doi.org/DOI: 10.1177/1836939119885311.

Mertala, P. (2019). Teachers' beliefs about technology integration in early childhood education: A meta-ethnographical synthesis of qualitative research. *Computers in Human Behavior*, *101*, 334–349. https://doi.org/10.1016/j.chb.2019.08.003.

Mohanty, A., Alam, A., Sarkar, R., & Chaudhury, S. (2021). Design and Development of Digital Game-Based Learning Software for Incorporation into School Syllabus and Curriculum Transaction. *Design Engineering*, *8*, 4864–4900. https://www.researchgate.net/profile/Atasi-Mohanty/publication/367350086_Design_Engineering_Design_and_Development_of_Digital_Game-_Based_Learning_Software_for_Incorporation_into_School_Syllabus_and_Curriculum_Transaction/links/63cebdacd7e5841e0bf01637/Design-Engineering-Design-and-Development-of-Digital-Game-Based-Learning-Software-for-Incorporation-into-School-Syllabus-and-Curriculum-Transaction.pdf.

Ndijuye, L. G., & Tandika, P. B. (2020). STEM starts early: Views and beliefs of early childhood education stakeholders in Tanzania. *Journal of Childhood, Education & Society*, *1*(1), 29–42. https://doi.org/10.37291/2717638X.20201128.

Nikolopoulou, K., & Gialamas, V. (2015). Barriers to the integration of computers in early childhood settings: Teachers' perceptions. *Education and Information Technologies*, *20*, 285–301. https://doi.org/10.1007/s10639-013-9281-9.

Ningsih, I., Winarni, R., & Roemintoyo, R. (2019). *Implementation of Digital Literacy to Achieve 21st Century Skills in The 2013's Curriculum*. https://doi.org/10.4108/eai.27-4-2019.2286855.

Otero-Mayer, A., Vélaz-de-Medrano, C., & Exposito-Casas, E. (2021). Strengthening teaching competencies in Early Childhood Education: an insight into classroom activities Reforzar las competencias docentes en Educación Infantil: una mirada desde las actividades del aula. *Revista de Educación*, *393*, 173–197. https://doi.org/DOI: 10.4438/1988-592X-RE-2021-393-490.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., & Moher, D. (2021). Updating guidance for reporting systematic reviews: development of the PRISMA 2020 statement. *Journal of Clinical Epidemiology*, *134*, 103–112. https://doi.org/10.1016/j.jclinepi.2021.02.003.

Pihlainen, K., Suero Montero, C., & Kärnä, E. (2018). Digi-Bags on the Go: Childminders' Expectations and Experiences of a Tablet-Based Mobile Learning Environment in Family Day Care. *Mobile Information Systems*. https://doi.org/10.1155/2018/6967505.

Plumb, M., & Kautz, K. (2016). Barriers to the integration of information technology within early childhood education and care organisations: A review of the literature. *ArXiv Preprint ArXiv:1606.00748*. https://doi.org/10.48550/arXiv.1606.00748.

Pramono, A., Puspasari, B. D., & Dhanti, N. S. (2021). Character Thematic Education Game" AK@ R" of Society Themes for Children with Malang-Indonesian Visualize. *International Journal of Instruction*, *14*(2), 179–196. https://eric.ed.gov/?id=EJ1291215.

Sancar Tokmak, H., & Ozgelen, S. (2013). The ECE Pre-Service Teachers' Perception on Factors Affecting the Integration of Educational Computer Games in Two Conditions: Selecting versus Redesigning. *Educational Sciences: Theory and Practice*, *13*(2), 1345–1358. https://eric.ed.gov/?id=EJ1017333.

Sargent, J., & Calderón, A. (2021). Technology-Enhanced Learning Physical Education? A Critical Review of the Literature. *Journal of Teaching in Physical Education*, *41*(1), 1–21. https://doi.org/10.1123/jtpe.2021-0136.

Sundqvist, P. (2020). Technological knowledge in early childhood education: Provision by staff of learning opportunities. *International Journal of Technology and Design Education*, *30*(2), 225–242. https://doi.org/10.1007/s10798-019-09500-0.

Tzima, S., Styliaras, G., Bassounas, A., & Tzima, M. (2020). Harnessing the potential of storytelling and mobile technology in intangible cultural heritage: A case study in early childhood education in sustainability. *Sustainability*, *12*(22), 9416. https://doi.org/10.3390/su12229416.

Undheim, M., & Jernes, M. (2020). Teachers' pedagogical strategies when creating digital stories with young children. *European Early Childhood Education Research Journal*, *28*(2), 256–271. https://doi.org/10.1080/1350293X.2020.1735743.

Warmansyah, J., Komalasari, E., & Febriani, E. (2022). Factors Affecting Teacher Readiness for Online Learning (TROL) in Early Childhood Education: TISE and TPACK. *Jurnal Pendidikan Usia Dini*, *16*(1), 32–51. http://journal.unj.ac.id/unj/index.php/jpud/article/view/25056.

Yang, T. (2022). Early childhood teachers' professional learning about ICT implementation in kindergarten curriculum: A qualitative exploratory study in China. *Frontiers in Psychology*, 6532. https://doi.org/doi: 10.3389/fpsyg.2022.1008372.

Yang, W., Ng, D. T. K., & Gao, H. (2022). Robot programming versus block play in early childhood education: Effects on computational thinking, sequencing ability, and self-regulation. *British Journal of Educational Technology*, *53*(6), 1817–1841. https://doi.org/10.1111/bjet.13215.

Yang, W., Wu, R., & Li, J. (2021). Development and validation of the STEM Teaching Self-efficacy Scale (STSS) for early childhood teachers. *Current Psychology*, *42*, 1–9. https://doi.org/10.1007/s12144-021-02074-y.

Zabatiero, J., Straker, L., Mantilla, A., & ... (2018). Young children and digital technology: Australian early childhood education and care sector adults' perspectives. *... Journal of Early ...*. https://doi.org/10.23965/AJEC.43.2.02.

Zahra, N. A. I., & Alanazi, A. A. (2019). Digital Childhood: the Impact of Using Digital Technology on Children's Health. *International Journal of Pharmaceutical Research & Allied Sciences*, *8*(3). https://ijpras.com/storage/models/article/YGfJmxVhSPuEsSm1rKlCSqw8CzdIQJr2S50M0rO7HAXlGCnKFTH1LDkEV3ZH/digital-childhood-the-impact-of-using-digital-technology-on-childrens-health.pdf.