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Mobile applications in early intervention: a systematic review

Aplicaciones móviles en la Atención temprana: una revisión sistemática

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ABSTRACT

Mobile applications in early intervention are emerging as a key tool for diagnosis, intervention, and professional-family communication in the development of children aged 0 to 6 with Specific Educational Support Needs. This systematic review, following the PRISMA method, analyses mobile applications published in scientific journals over the past five years, using the databases WoS, Scopus, and ERIC. Twelve relevant studies were selected and evaluated. The results show that most applications focus on early diagnosis using technologies such as computer vision and deep learning. Other applications are oriented towards educational intervention and promoting communication and support for families, encouraging their participation in the child development process. The applications demonstrated benefits in risk detection, educational intervention, and personalized interventions. However, challenges were identified regarding external validity, cultural diversity, data privacy, and technological accessibility. It is concluded that mobile applications have great potential to enhance early intervention, although it is necessary to address these challenges through research exploring their applicability in diverse contexts and promoting equitable access to these technologies.

RESUMEN

Las aplicaciones móviles en la atención temprana emergen como herramienta clave para el diagnóstico, intervención y comunicación profesional-familia en el desarrollo de niños y niñas de 0 a 6 años con Necesidades Específicas de Apoyo Educativo. Esta revisión sistemática, siguiendo el método PRISMA, analiza aplicaciones móviles publicadas en revistas científicas en los últimos cinco años, utilizando las bases de datos WoS, Scopus y ERIC. Se seleccionaron y evaluaron 12 estudios relevantes. Los resultados muestran que la mayoría de las aplicaciones se enfocan en el diagnóstico temprano utilizando tecnologías como visión computacional y deep learning. Otras aplicaciones se orientan a la intervención educativa

y a promover la comunicación y apoyo a las familias, fomentando su participación en el proceso de desarrollo infantil. Las aplicaciones demostraron beneficios en la detección de riesgos, intervención educativa y personalización de las intervenciones. No obstante, se identificaron desafíos en la validez externa, diversidad cultural, privacidad de datos y accesibilidad tecnológica. Se concluye que las aplicaciones móviles tienen un gran potencial para mejorar la atención temprana, aunque es necesario abordar estos desafíos mediante investigaciones que exploren su aplicabilidad en contextos diversos y promuevan un acceso equitativo a estas tecnologías.

PALABRAS CLAVES · KEYWORDS

Keywords: Early Intervention, Childhood, Educational needs, Mobile Applications.

Palabras clave: Atención Temprana, Infancia, Necesidades educacionales, Aplicaciones Móviles.

1. Introduction

Early childhood intervention is defined as the set of actions and interventions aimed at children aged 0–6 who present developmental disorders or are at risk of developing them, either permanently or temporarily. Its objective is to contribute to comprehensive child development through early responses and from different dimensions, such as the motor, social, cognitive, adaptive and language domains (GAT, 2000).

Neuroscience has demonstrated that during the first years of life, brain plasticity is especially high; therefore, intervention at this stage is essential, as it takes advantage of this plasticity to reduce difficulties and foster global and balanced development (Ordoñez et al., 2023; Ibáñez & Mudarra, 2014; García, 2006). For this reason, early childhood intervention programmes are fundamental in various contexts, ranging from the educational to the clinical and social spheres. However, traditional approaches to early intervention may present certain limitations, as challenges are observed in the diagnostic and assessment process, since this usually takes place in controlled environments that do not reflect the real conditions in which children interact and develop. This may delay the identification of their specific needs (Lee et al., 2015). The consequence is that there is a risk of offering late intervention instead of providing early and personalised experiences, accompanied by professionals specialised in child development (Perera, 2011).

In recent years, the use of digital resources in child development has increased substantially, leaving behind more traditional interventions and using approaches linked to Information and Communication Technologies (ICT) (Ansoborlo et al., 2024; Sáiz-Manzanares et al., 2024). These tools present characteristics that have a positive impact on early intervention, for example by presenting content in an appealing way, allowing the personalisation of learning, and providing educational experiences that benefit the early

development of cognitive skills (Flewitt et al., 2014; Avalos & Pico, 2024; Morales et al., 2022; Sáiz-Manzanares et al., 2022). Through applications, it is possible to capture children's attention more effectively, motivating them to participate and enhancing their progress in multiple areas (Orellana & García, 2023). This implies that mobile applications acquire particular relevance when intervening in holistic child development (Hirsh-Pasek et al., 2015).

Likewise, among the objectives of early childhood intervention, understood as a process of integrated support, is the promotion of learning within the environment in which the child develops and the improvement of their quality of life and that of their family. When families are empowered, it is possible to promote experiences that benefit comprehensive child development (PAINNE, 2017). This implies that a key factor for ensuring success in early intervention is the family, as it is the child's first learning environment, and their involvement in the diagnostic and intervention process is essential (Oke et al., 2021; Bagur & Verguer, 2020; Subiñas et al., 2022). From home, families must collaborate actively with professionals, providing information on the behaviour, abilities, needs or difficulties of their sons and daughters in different contexts. This will result in more detailed assessment and in planning intervention adapted to the specific needs that the child may present, both in specialised centres and at home (Cañadas, 2012; Outhwaite, 2023).

Thus, mobile applications stand out as innovative tools that promote family participation, by facilitating access to specialised information and allowing continuous monitoring by families. Likewise, they strengthen communication with professionals involved in the diagnosis and development of their sons and daughters (Oke et al., 2021), which may make a significant difference in children's development by fostering comprehensive development and greater complexity in their learning.

However, although the use of ICT, and specifically mobile applications, offers numerous advantages in the field of early childhood intervention, there are also certain challenges to take into account. One of these is the need to train both professionals and families so that they acquire the necessary digital competences, enabling them to make better use of applications and digital resources (Area, 2008). In this way, the potential benefits in early intervention could be maximised. Furthermore, it is necessary to consider the possible inappropriate uses of ICT, such as excessive screen time, which may have harmful effects, such as reduced offline interactions or less time devoted to analogue games (Molina, 2024). Moreover, ethical and professional dilemmas arise when using digital platforms to document children's learning, which requires critical reflection on the implications regarding privacy and data management (Restiglian et al., 2023).

In conclusion, interest in integrating technologies into early childhood intervention has increased, highlighting the use of mobile applications to improve the impact of such intervention on child development, while placing the family at the centre of the process. In this context, a systematic review is presented with the aim of identifying and analysing studies that demonstrate the benefits of early childhood intervention mediated by ICT.

2. Methodology

A systematic review was carried out with the aim of identifying and analysing the use of digital applications in early childhood intervention. Specifically, mobile applications that have contributed to diagnosis, intervention assessment, or communication between professionals and families. To this end, the guidelines established by PRISMA 2020 for conducting systematic reviews and meta-analyses were followed (Page et al., 2021).

2.1 Search strategies

With the aim of understanding the construct and adequately defining the search terms and eligibility criteria, a preliminary exploration was conducted on the use of digital applications in early childhood intervention. Subsequently, a search was carried out in several databases by combining the selected terms and incorporating Boolean operators. Three databases (WoS, Scopus and ERIC) were used due to their relevance in the field of study, as they contain a wide range of scientific journals on Education and Psychology. As shown in Table 1, the search was adapted to each database, making use of a truncated-term strategy: “early childhood intervention” OR “early intervention” OR “early care” AND applications OR apps.

Table 1

Search terms for each database

Database	Search terms
Web of Science (WOS)	TS=("early childhood intervention" OR "early intervention" OR "early care") AND TS=(apps OR applications)
Scopus	TITLE-ABS-KEY ("early childhood intervention" OR "early intervention" OR "early care") AND TITLE-ABS-KEY (apps OR applications) AND PUBYEAR > 2020 AND PUBYEAR < 2026 AND (LIMIT-TO (DOCTYPE , "ar") AND (LIMIT-TO (LANGUAGE , "English") OR LIMIT-TO (LANGUAGE , "Spanish"))

Education Resources Information Center (ERIC)	SU Descriptors= ("early childhood intervention" OR "early intervention" OR "early care") AND SU Descriptors= (apps OR applications)

2.2 Eligibility criteria

A series of criteria were selected for the identification and selection of the studies to be analysed in this systematic review. To do so, the PICoS strategy was applied (Landa-Ramírez & Arredondo-Pantaleón, 2014; Moreno & Jurado, 2021), defining the following criteria:

- Participants: studies aimed at children aged 0–6 with Special Educational Needs (NEAE), families and professionals were included. Studies aimed at working with children over 6 years of age were excluded.

- Topic of interest: studies addressing the use of mobile applications for diagnosis, intervention or another topic related to early childhood intervention were included. Studies that did not use mobile applications and instead employed traditional methods or other types of digital resources were excluded.

- Context: studies in which these applications were used in educational, therapeutic or family environments were included, which comprises schools, homes or early childhood intervention centres. Studies conducted in specialised clinical contexts without the participation of families or educators were excluded.

- Study design: experimental articles evaluating the impact of the applications on early childhood intervention were included. Studies without a scientific basis, conference abstracts, books and documents in which the use of the applications was not implemented and the results derived from their implementation were not detailed were excluded.

Other criteria such as language were taken into account, including only articles written in English and Spanish. Only peer-reviewed scientific articles published between 2021 and 2025 were selected. Studies that did not meet these criteria were also excluded.

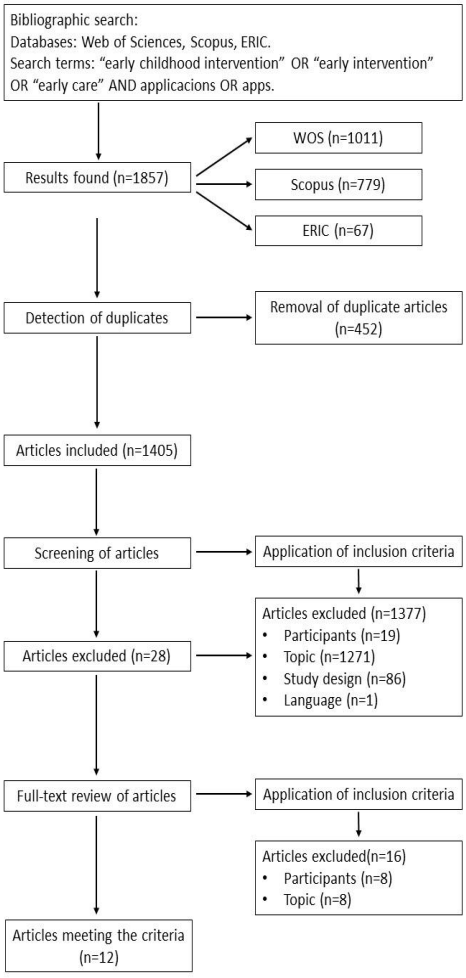
2.3 Selection process

The following steps were followed for the selection of the articles: 1) a preliminary reading was carried out to determine the search terms and eligibility criteria; 2) the database search

was conducted and the results were exported to the online systematic review tool Rayyan (Ouzzani et al., 2016); 3) duplicate records were identified and removed; 4) the articles were selected based on their title and abstract. Each of the authors independently carried out a process of excluding those articles that did not match the previously established eligibility criteria; 5) the conflicting articles were reviewed using the Rayyan tool, discussing whether the articles should be included or excluded based on a second joint reading; 6) a full-text reading of the selected articles was conducted and those that did not meet the eligibility criteria were discarded; and 7) the articles finally selected were analysed. These steps are reflected in Figure 1, which shows the records found and the selection process conducted until reaching the articles that form this study.

Figure 1

Flowchart of the study selection process



3. Analysis and results

3.1 Main characteristics of the studies analysed

A total of 12 articles were obtained after the selection process was carried out for their subsequent analysis. Table 2 shows the main characteristics of the records analysed.

Table 2

Main characteristics of the studies analysed

Author	Age	Name of the app	Description of the app	Purpose	Use of the app	Area of intervention	Type of SEN	App user	Main results
Adhe et al. (2024)	Preschool	KIDOPA	Augmented reality app for visual letter recognition	Improve visual identification and pronunciation of letters	Educational intervention	Cognitive	Literacy difficulties	Children, educators	Improved ability to recognise and pronounce letters
Ben-Sasson et al. (2022)	Avg. 9.3 months	babyTRACKS	Crowdsourcing app for tracking developmental milestones	Early detection of developmental delays	Diagnosis and monitoring	Cognitive, motor, language, social, emotional	Developmental delay	Families	Discovery of new non-traditional milestones
Bharat et al. (2023)	2 to 6 years	Not specified	Apps for early intervention in ASD	Support families in early ASD intervention	Intervention	Social, communicative	Autism Spectrum Disorder	Families	Identified gaps in app development; need for high-quality evidence
Brown et al. (2024)	Infants	Not specified	App for recording videos for early assessment of	Early assessment of cerebral palsy risk	Diagnosis	Motor	Cerebral palsy (risk)	Families	Provided control and active participation for families

			cerebral palsy						
Chang et al. (2021)	16 to 38 months	Not specified	Computer vision app for measuring gaze patterns	Differentiate gaze patterns in ASD vs TD	Diagnosis	Cognitive, social	Autism Spectrum Disorder	Children	Identified visual biomarkers of ASD with high accuracy
Dennis & Whalon (2021)	Preschool	Not specified	App to improve expressive vocabulary in children at risk of language delays	Improve expressive vocabulary	Educational intervention	Communicative	Language delay	Children, teachers	Significant vocabulary gains compared to traditional instruction
Elliott et al. (2021)	Newborns	Baby Moves	App for recording general movements to assess cognitive disability risk	Early detection of cognitive disability	Early diagnosis	Cognitive, motor	Cognitive disability	Families	High accuracy predicting disabilities at age 2
Iniutina (2024)	1.5 to 6 years	KiDD	App for early developmental and autism risk diagnosis	Early diagnosis of autism	Diagnosis	Cognitive, social, communicative, motor	Autism Spectrum Disorder	Families, professionals	High accuracy identifying risks
Kim (2021)	Preschool	DoBrain	App for cognitive and motor development in	Early detection of developmental	Diagnosis	Cognitive, motor	Developmental disabilities	Children	High accuracy in identifying disabilities

			preschoolers	disabilities					
Sawyer et al. (2022)	Preschool	Parents Plus	Parent-implemented app to support language development in DLD	Improve language development	Intervention	Communicative	Developmental Language Disorder	Families	Improvements in language development
Swadi & Croock (2024)	3 to 6 years	Not specified	Intelligent app using deep learning for early ASD diagnosis	Early diagnosis and ASD level classification	Diagnosis	Cognitive, social	Autism Spectrum Disorder	Families, therapists	High accuracy in diagnosing and classifying ASD levels
Wagner et al. (2023)	Under 3 years	Family on Track	App facilitating communication between families	Improve family engagement in EI	Educational management	Social, communicative	Neurodevelopmental disorders	Families	Improved family engagement and communication

3.2 Areas of intervention

A total of 58.33% of the studies focused on the cognitive area (Adhe et al., 2024; Ben-Sasson et al., 2022; Chang et al., 2021; Elliott et al., 2021; Iniutina, 2024; Kim, 2021; Swadi & Croock, 2024). These applications facilitate early cognitive skills through interactive and personalised activities. With respect to the social area, 50% of the studies addressed this domain (Ben-Sasson et al., 2022; Chang et al., 2021; Iniutina, 2024; Swadi & Croock, 2024; Wagner et al., 2023). These applications prioritise fostering social development through monitoring and communication between families and professionals. In the case of the motor area, 41.66% of the studies addressed this domain (Ben-Sasson et al., 2022; Brown et al., 2024; Elliott et al., 2021; Kim, 2021; Iniutina, 2024). These applications allow for the early assessment of motor skills and the diagnosis of neuromotor disorders. As for the communicative area, 33.33% of the studies addressed communication (Dennis & Whalon, 2021; Sawyer et al., 2022; Wagner et al., 2023; Iniutina, 2024). These applications are

oriented towards improving expressive vocabulary and communication in children with language delays or communicative difficulties. Finally, in the emotional area, 8.33% of the studies addressed emotional development (Ben-Sasson et al., 2022).

3.3 Purpose of app use

A total of 41.66% of the studies had diagnosis as their main objective (Brown et al., 2024; Chang et al., 2021; Elliott et al., 2021; Iniutina, 2024; Swadi & Croock, 2024). These applications were used for the early identification of developmental disorders such as ASD, cerebral palsy and cognitive disabilities. Additionally, it was observed that some employed computer vision and deep learning for the early identification of ASD (Chang et al., 2021; Swadi & Croock, 2024), while others used video recordings and analysis of movement patterns for the early assessment of cerebral palsy (Brown et al., 2024; Elliott et al., 2021).

A total of 8.33% combined diagnosis and monitoring (Ben-Sasson et al., 2022). These applications used technologies for remote monitoring of child development and health. A total of 33.33% of the studies focused on educational intervention (Adhe et al., 2024; Bharat et al., 2023; Dennis & Whalon, 2021; Sawyer et al., 2022). These applications were designed to improve specific skills through playful and interactive activities. Finally, 8.33% focused on educational management (Wagner et al., 2023), facilitating communication and family engagement in early intervention through *Family on Track*.

3.4 Types of Special Educational Needs (SEN)

A total of 33.33% of the studies addressed ASD (Bharat et al., 2023; Chang et al., 2021; Iniutina, 2024; Swadi & Croock, 2024). These studies employed emerging technologies such as computer vision, deep learning and behavioural pattern analysis for the early diagnosis of ASD. On the other hand, 58.33% focused exclusively on one specific type of need. These included literacy difficulties (Adhe et al., 2024), developmental delay (Ben-Sasson et al., 2022), cerebral palsy (risk) (Brown et al., 2024), language delay (Dennis & Whalon, 2021), cognitive disability (Elliott et al., 2021), Developmental Language Disorder (DLD) (Sawyer et al., 2022), and Neurodevelopmental Disorders (Wagner et al., 2023).

3.5 Main findings and benefits of apps for early childhood intervention

The use of apps in early childhood intervention has demonstrated benefits in diagnosis and risk detection, educational support and intervention, and family and professional

engagement. In the field of early diagnosis, several applications such as *BabyTRACKS* (Ben-Sasson et al., 2022), *KiDD* (Iniutina, 2024) and *DoBrain* (Kim, 2021) showed high levels of accuracy in identifying disabilities or difficulties in cognitive and motor developmental regulation, or detecting autism risk factors. Similarly, computer vision-based applications for measuring gaze patterns (Chang et al., 2021) or deep learning-based models (Swadi & Croock, 2024) were found to identify different levels of ASD in the early years of life. *Baby Moves* (Elliott et al., 2021) demonstrated high accuracy in predicting cognitive disabilities using movement recordings to assess risk, while the app developed by Brown et al. (2024) showed utility for the early assessment of cerebral palsy through recordings of infant movements.

In the area of educational intervention, applications focused on communication were particularly notable. Various applications aimed at stimulating language development were identified. *KIDOPA* (Adhe et al., 2024) and *Parents Plus* (Sawyer et al., 2022) showed effectiveness in promoting language acquisition and designing strategies to support communicative development. Likewise, apps were found that aimed to improve expressive vocabulary in children at risk of language delay (Dennis & Whalon, 2021).

Finally, another recognised use of apps for early childhood intervention is the promotion of family involvement in diagnostic and intervention processes. The *Family on Track* application (Wagner et al., 2023) has shown its effectiveness in increasing communication between professionals and families. In addition, the involvement of families in diagnosis was highlighted through the use of apps for recording infant movements, enabling early assessment of cerebral palsy (Brown et al., 2024) and detection of children at risk of cognitive disability (Elliott et al., 2021). There are apps aimed at families and designed to recognise early signs of ASD (Bharat et al., 2023; Iniutina, 2024; Swadi & Croock, 2024) or to identify problems in the regulation of oral-motor development (Ben-Sasson et al., 2022). In the context of intervention, there are also family-focused applications designed to improve communication and language development (Sawyer et al., 2022).

It was found that, in 7 of the 12 studies—particularly those using digital biomarkers and deep learning—apps served for early detection and diagnosis. In 6 studies, the apps were interactive learning tools used for educational intervention and skill development. In another 6 studies, a positive impact on parental self-efficacy was reported. In 7 studies, machine learning and individual adaptations were used for personalised interventions. Finally, 5 studies reported improved communication between families and professionals.

3.6 Main challenges in the use of apps for early childhood intervention

The studies analysed reveal important challenges in terms of external validity, limited samples, technological accessibility and ethical considerations that affect the generalisation of results. In several studies (Adhe et al., 2024; Dennis & Whalon, 2021; Sawyer et al., 2022), small and homogeneous samples were used, thus affecting external validity and limiting comparison with more traditional methods. On the other hand, Elliott et al. (2021) and Kim (2021) used digital biomarkers for early diagnosis, but without direct comparison with traditional methods, which raises questions about the validity of the conclusions regarding diagnostic accuracy. Likewise, Iniutina (2024) and Chang et al. (2021) used culturally homogeneous samples, limiting the applicability of the results to diverse cultural contexts. In this sense, the lack of cultural diversity is a recurring problem in the studies analysed. Chang et al. (2021), Iniutina (2024) and Bharat et al. (2023) used samples homogeneous in cultural and socioeconomic terms, thus affecting the generalisation of results in multicultural contexts and cross-cultural validation.

Studies such as Ben-Sasson et al. (2022) and Brown et al. (2024) based their analyses on self-reported family data, introducing possible information biases and affecting the reliability of results. This approach may generate subjective outcomes, limiting the objectivity of the conclusions. Similarly, Bharat et al. (2023) used family perceptions to assess the effectiveness of mHealth apps in ASD, potentially influenced by prior expectations or confirmation bias. Ethical dilemmas regarding data privacy emerged in the use of Artificial Intelligence (AI) and deep learning. In Swadi & Croock (2024), facial images were used for ASD diagnosis, raising concerns about children's privacy and the storage of sensitive data. In the studies by Swadi & Croock (2024) and Kim (2021), information and transparency regarding the algorithms used were lacking, which may lead to algorithmic biases and interpretation problems.

Finally, a significant challenge identified was technological dependence, affecting accessibility in disadvantaged communities. In Wagner et al. (2023) and Sawyer et al. (2022), the apps required advanced digital devices and constant connectivity, which limits equitable access in diverse social contexts. Dennis & Whalon (2021) and Kim (2021) faced implementation difficulties due to a lack of technological infrastructure, affecting adoption and continuity in rural communities.

The challenges identified in these studies highlight the need for future research to address these limitations and improve the validity, accessibility and ethical transparency of apps for early childhood intervention. The potential of these applications to detect Special Educational Needs early and support families in educational and therapeutic settings is unquestionable, provided the methodological and ethical challenges identified are

overcome. Thus, the implementation of rigorous methodological approaches and inclusive, accessible designs will enhance their effectiveness across diverse contexts.

4. Discussion

The aim of the present review was to identify and analyse studies that demonstrate the benefits of early childhood intervention mediated by ICT. A total of 12 articles met the eligibility criteria. These were analysed to identify the apps and their main benefits in early childhood intervention. This article highlights the growing use of mobile applications in early childhood intervention for diagnosis, intervention and communication between professionals and families. Their potential to enhance the holistic development of children with SEN is also emphasised. However, challenges were also observed regarding external validity, cultural diversity, data privacy and technological accessibility.

Regarding the benefits, apps were identified whose main focus was early diagnosis, making use of technologies such as computer vision and deep learning. These technologies have been examined and their potential identified in previous studies (Flewitt et al., 2014; Sáiz-Manzanares, Marticorena-Sánchez & Arnaiz-González, 2022), where their ability to personalise learning and capture children's attention more effectively stands out. In addition, the studies analysed show the accuracy of these apps in identifying developmental disorders such as ASD and cognitive disabilities, demonstrating technological advancement and its positive impact on early intervention (Swadi & Croock, 2024; Chang et al., 2021). Other apps were oriented towards educational intervention and/or promoted communication and family support, facilitating their involvement in the process of holistic child development. The importance of family involvement in early childhood intervention is evident, generating multiple benefits that have been demonstrated in existing literature (Oke et al., 2021; Bagur & Verguer, 2020; Subiñas et al., 2022). Family participation not only optimises intervention but also strengthens parental self-efficacy and promotes a continuous learning environment.

However, this review highlights important methodological and ethical challenges. On the one hand, external validity is affected by the use of samples that are culturally homogeneous and limited in size, restricting the generalisation of findings (Chang et al., 2021; Iniutina, 2024; Bharat et al., 2023). Some studies base their results on self-reports provided by families, introducing potential biases in the information collected and limiting the objectivity of the results (Ben-Sasson et al., 2022; Brown et al., 2024). These limitations regarding the applicability and validity of mobile applications have already been identified in previous studies (Lee et al., 2015). On the other hand, an ethical dilemma emerges regarding data privacy and transparency in the use of algorithms based on deep learning. For example, the use of facial images and sensitive data poses potential risks to children's

privacy and to the secure storage of information (Swadi & Croock, 2024; Kim, 2021). These ethical and professional concerns regarding the use of apps in educational settings are considered one of the major challenges in early childhood intervention (Restiglian et al., 2023).

Practical implications and future prospects

These findings highlight the need to develop more inclusive and adapted applications to ensure their applicability in different educational and therapeutic contexts. It is essential to promote digital literacy among both professionals and families in order to maximise the use of these resources in early childhood intervention. This requires improving algorithmic transparency and ensuring the protection of users' personal and digital data. Future apps should address both the potential and the methodological and ethical challenges they face in order to offer safe and optimal use.

5. Conclusions

In short, mobile applications aimed at early childhood intervention have great potential for diagnosis, intervention and communication between families and professionals. They allow for the promotion of parental involvement in supporting their sons and daughters with SEN, helping to ensure special attention during early childhood. Although this use is not exempt from challenges that must be analysed and minimised, mobile applications offer a valuable means of reaching families who most require support and monitoring for their children.

6. Author contribution

Conceptualisation – CNAR - Methodology – CNAR - Article review – ASP and CNAR - Full-text review – YGD and CNAR - Writing – original draft – YGD, ASP and CNAR - Writing – review and editing – YGD, ASP and CNAR.

References

Adhe, K. R., Mustaji, Suprapto, N., Suryanti, & Ling, L. Y. (2024). Difficulty of Visual Recognition: Identifying the Direction Confusion of Reading Letters in Young Children. *International Journal of Education in Mathematics, Science and Technology*, *12*(2), 334–344. https://doi.org/10.46328/ijemst.3888

Area, M. (2008). La innovación pedagógica con TIC y el desarrollo de las competencias informacionales y digitales. *Investigación en la Escuela, 64*, 5–17. https://doi.org/10.12795/IE.2008.i64.01

Avalos, A. de L. Ángeles, & Pico, J. F. (2024). El Impacto de las TIC en el Desarrollo Cognitivo Infantil. *Dominio De Las Ciencias, 10*(3), 392–400. https://doi.org/10.23857/dc.v10i3.3930

Ben-Sasson, A., Jacobs, K., & Ben-Sasson, E. (2022). The feasibility of a crowd-based early developmental milestone tracking application. *PLoS ONE*, *17*(5). https://doi.org/10.1371/journal.pone.0268548

Bharat, R., Uzaina, Yadav, T., Niranjan, S., & Kurade, P. (2023). mHealth Apps Delivering Early Intervention to Support Parents of Children with Autism Spectrum Disorder: A Scoping Review. *Indian Pediatrics*, *60*(3), 224–230. https://doi.org/10.1007/s13312-023-2840-1

Brown, A., Tornberg, Å. B., & Kristensson, I. (2024). Parents' lived experience of early risk assessment for cerebral palsy in their young child using a mobile application after discharge from hospital in the newborn period. *Annals of Medicine*, *56*(1). https://doi.org/10.1080/07853890.2024.2309606

Cañadas, M (2012). La familia, principal protagonista de los centros de desarrollo infantil y atención temprana. *EDETANIA, 41*, 129-141.

Chang, Z., Di Martino, J. M., Aiello, R., Baker, J., Carpenter, K., Compton, S., Davis, N., Eichner, B., Espinosa, S., Flowers, J., Franz, L., Harris, A., Howard, J., Perochon, S., Perrin, E. M., Krishnappa Babu, P. R., Spanos, M., Sullivan, C., Walter, B. K., … Sapiro, G. (2021). Computational Methods to Measure Patterns of Gaze in Toddlers with Autism Spectrum Disorder. *JAMA Pediatrics*, *175*(8), 827–836. https://doi.org/10.1001/jamapediatrics.2021.0530

Dennis, L. R., & Whalon, K. J. (2021). Effects of Teacher- Versus Application-Delivered Instruction on the Expressive Vocabulary of At-Risk Preschool Children. *Remedial and Special Education*, *42*(4), 195–206. https://doi.org/10.1177/0741932519900991

Elliott, C., Alexander, C., Salt, A., Spittle, A. J., Boyd, R. N., Badawi, N., Morgan, C., Silva, D., Geelhoed, E., Ware, R. S., Ali, A., McKenzie, A., Bloom, D., Sharp, M., Ward, R., Bora, S., Prescott, S., Woolfenden, S., Le, V., … Valentine, J. (2021). Early Moves: A Protocol for A Population-Based Prospective Cohort Study to Establish General Movements as an Early Biomarker of Cognitive Impairment in Infants. *BMJ Open*, *11*(4). https://doi.org/10.1136/bmjopen-2020-041695

Federación Estatal de Asociaciones de Profesionales de Atención Temprana (GAT). (2000). *Libro Blanco de la Atención Temprana*. Real Patronato sobre Discapacidad.

Flewitt, R., Messer, D. & Kucirkova, N. (2014). New Directions for Early Literacy in a Digital Age: The iPad. *Journal of Early Childhood Literacy, 15(3).* https://doi.org/10.1177/1468798414533560

García, P. (2006). *Guía de orientación y sensibilización sobre el desarrollo infantil y la atención temprana para pediatría*. FEAPS.

Grupo de Trabajo del Proceso de Atención Integrada a Niños y Niñas con Necesidades Especiales [PAINNE]. (2017). *Proceso de Atención Integrada a Niños y Niñas con Necesidades Especiales. Guía de práctica clínica.* Osakidetza. ser

Hirsh-Pasek, K., Zosh J. M., Golinkoff, R. M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting education in "educational" apps: lessons from the science of learning. *Psychol Sci Public Interest,* 16(1), 3-34. https://doi.org/10.1177/1529100615569721

Hutabarat, D. P., Wijaya, W., & Wijaya, W. D. (2024). Internet of things-based digital scale to detect stunting symptoms in babies under two years of age. *International Journal of Electrical and Computer Engineering*, *14*(3), 3467–3474. https://doi.org/10.11591/ijece.v14i3.pp3467-3474

Ibañez, P., & Mudarra, M. J. (2014). *Atención Temprana. Diagnostico e Intervención Psicopedagógica. UNED.*

Iniutina, O. (2024). Key principles of the KiDD (kids' development diagnosis and determining the risk of autism for children from 1.5 to 6 years) methodology development and comparison of results with other methods. *Cambridge Prisms-Global Mental Health*, *11*. https://doi.org/10.1017/gmh.2024.85

Kim, H. H., An, J. I., & Park, Y. R. (2021). A prediction model for detecting developmental disabilities in preschool-age children through digital biomarker-driven deep learning in serious games: Development study. *JMIR Serious Games*, *9*(2). https://doi.org/10.2196/23130

Landa-Ramírez, E., & Arredondo-Pantaleón, A. (2014). Herramienta PICO para la formulación y búsqueda de preguntas clínicamente relevantes en la psicooncología basada en la evidencia. *Psicooncología,* *11*(2-3), 259-270. http://dx.doi.org/10.5209/rev_PSIC.2014.v11.n2-3.47387

Lee, D. D., Bagnato, S. J., & Pretti-Frontczak, K. (2015). Utility and validity of authentic assessments and conventional tests for international early childhood intervention purposes: Evidence from US national social validity research. *Journal of Intellectual Disability-Diagnosis and Treatment, 3*(4), 164-176. https://doi.org/10.6000/2292-2598.2015.03.04.2

Molina, J. J. (2024). Análisis del mundo virtual con relación a la Educación 4.0. *Revista Ingenio global, 2*(1), 24-34. https://doi.org/10.62943/rig.v3n1.2024.73

Morales, S. J., Rodríguez, J. T., & Benavides, M. A. (2022). Influencia de las TIC en el desarrollo de habilidades cognitivas en niños de 3 a 7 años. *Revista de Investigación en Educación*, *21*(2), 123-137. https://doi.org/10.47606/acven/ph0256

Moreno, A. & Jurado, M.M. (2021). Una revisión sistemática sobre las variables relacionadas con las habilidades sociales y la creatividad en el periodo de la adolescencia. *Apuntes de Psicología, 39*(3), 159-170. https://doi.org/10.55414/ap.v39i3.907

Oke, A., Butler, J. E., & O'Neill, C. (2021). Identifying Barriers and Solutions to Increase Parent Practitioner Communication in Early Childhood Care and Educational Services: The Development of an Online Communication Application. *Early Childhood Education Journal, 49*(2), 283–293. https://doi.org/10.1007/s10643-020-01068-y

Ordóñez, D. L., Bonilla, D. D., Macías, V. E., & Vásquez, A. S. (2023). Plasticidad cerebral: Como el cerebro se adapta y cambia en repuestas a diferentes estímulos. E-IDEA 4.0 *Revista Multidisciplinar, 5*(17), 16-28. https://doi.org/10.53734/mj.vol5.id282

Orellana, J., & García, A. (2023). Uso de las tecnologías en la educación infantil: Un estudio empírico. *Revista de Ciencias Sociales y Educativas, 10*(3), 55-67.

Outhwaite, L. A. (2023). App-based support for parental self-efficacy in the first 1,000 days: A randomized control trial. *Frontiers in Psychology, 13*. https://doi.org/10.3389/fpsyg.2022.998170

Ouzzani, M., Hammady, H., Fedorowicz, Z. & Elmagarmid, A. (2016). Rayyan—a web and mobile app for systematic reviews. *Syst Rev 5*(210), 1-10. https://doi.org/10.1186/s13643-016-0384-4

Page, M.J., McKenzie, J.E., Bossuyt, P.M., Boutron, I., Hoffmann, T.C., Mulrow, C.D., Shamseer, L., Tetzlaff. J.M., Akl, E.A., Brennan, S.E., Chou, R., Glanville, J., Grimshaw, J.M., Hróbjartsson, A., Lalu, M.M., Li, T., Loder, E.W., Mayo-Wilson, E., McDonald, S., McGuinness, L.A., Stewart, L.A., Thomas, J., Tricco, A.C., Welch, V.A., Whiting, P., & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ, 29*(372). http://dx.doi.org/10.1136/bmj.n71

Restiglian, E., Raffaghelli, J. E., Gottardo, M., & Zoroaster, P. (2023). Pedagogical Documentation in the Era of Digital Platforms: Early Childhood Educators' Professionalism in a Dilemma. *Education Policy Analysis Archives, 31*(137). https://doi.org/10.14507/epaa.31.7909

Sáiz-Manzanares, M. C., Marticorena-Sánchez, R., & Arnaiz-González, Á. (2022). Improvements for Therapeutic Intervention from the Use of Web Applications and Machine Learning Techniques in Different Affectations in Children Aged 0–6 Years. International Journal of Environmental *Research and Public Health, 19*(11). https://doi.org/10.3390/ijerph19116558

Sáiz-Manzanares, M. C., Solórzano Mulas, A., Escolar-Llamazares, M. C., Alcantud Marín, F., Rodríguez-Arribas, S., & Velasco-Saiz, R. (2024). Use of Digitalisation and Machine Learning Techniques in Therapeutic Intervention at Early Ages: Supervised and Unsupervised Analysis. *Children, 11*(4). https://doi.org/10.3390/children11040381

Sawyer, B. E., Hammer, C. S., Santoro, J. K., Smith, J. C., & Feil, E. G. (2022). Developing Parents Plus: A Parent-Implemented Intervention for Young Children with Developmental Language Disorders. *Infants and Young Children*, *35*(3), 205–221. https://doi.org/10.1097/IYC.0000000000000219

Subiñas, P., García-Grau, P., Gutiérrez-Ortega, M., & León-Estrada, I. (2022). Prácticas centradas en la familia en la atención temprana: confianza, competencia y calidad de vida familiar. *Psicología, Sociedad y Educación, 14*(2), 39–47. https://doi.org/10.21071/psye.v14i2.14296

Swadi, M. R., & Croock, M. S. (2024). Intelligent Mobile Application for Autism Detection and Level Identification System Using Deep-Learning Model. *Traitement Du Signal*, *41*(5), 2539–2548. https://doi.org/10.18280/ts.410527

Wagner, L., Corona, L., Khan, N., Hooper, M., Dixon, A., Lavanderos, A. M., Zheng, Z., Sarkar, N., Sarkar, N., & Warren, Z. (2023). Development of an App for Tracking Family Engagement with Early Intervention Services: Focus Groups and Pilot Evaluation Study. *JMIR Human Factors*, *10*(1). https://doi.org/10.2196/45957