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Systematic Review of Technologies to Collaborate and Co-educate Students With Special Educational Needs and Supporting Their Schooling

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ABSTRACT

Since 1994, the inclusion of students with special educational needs or disabilities (SEND) has been a vital part of the educational system (UNESCO, 1994). In the early 2000s, educational systems underwent reforms to accommodate this change, leading to increased communication and collaboration efforts between families and educational partners (Wehmeyer and Patton, 2017). These efforts are supported by the growth of digital technologies (Kefallinou et al., 2020; Zallio and Ohashi, 2022). Various models of family-professional collaboration, such as the "Sunshine Model" (Haines et al., 2017), "Whole School Model" (Lewallen et al., 2015), "Smart Holistic Model" (Hafidh et al., 2019) and polycentric approaches (Ebersold and Detraux, 2013), have been developed to involve the broader educational community. Despite the integration of technologies and the recognized importance of collaboration, limited research has been conducted on the potential of collaborative technologies in the educational context for SEND. However, relevant stakeholders endorse their use. To address this gap, a systematic review of international literature was conducted to identify collaborative technologies for the inclusion of SEND, along with their advantages and limitations. Out of 1360 identified articles, 10 were selected for analysis. These 10 articles focused on 8 different digital technologies that facilitate collaboration between families, education, and healthcare actors. The technologies were developed using various methodologies and aimed at different communication and collaboration objectives. Some technologies focused on communication related to student behavior or school activities, while others emphasized collaboration related to the student's inclusion project. We will present each of these technologies, their development context, as well as their advantages and limitations. We will highlight their relevance to the different theoretical models applied to family-professional collaboration, and their contributions Finally, we will highlight the contributions of collaborative technologies to promoting pupils' with SEND inclusion and reducing educational inequalities.

Keywords: Technologies, Student with special education needs or disabilities (send), Collaboration, Coeducation, Stakeholder

INTRODUCTION

The field of special needs education has witnessed significant advancements in promoting the inclusion of students with special educational needs or disabilities (SEND) since the Salamanca Framework for Action in 1994 (UNESCO, 1994). Countries such as the U.K. (Great Britain Department for Education and Skills, 2001a, 2001b), the USA (Boehner, 2002; Castle, 2004), and France (French Government, 2013, 2005) have implemented inclusive education through policy reforms and legal acts, influenced by the Convention on the Rights of Persons with Disabilities (Wehmeyer and Patton, 2017).

The most common form of "inclusive education" is the placement of students with disabilities in mainstream classrooms (Nilholm and Göransson, 2017) with an "Individualized Educational Plan", which formalizes, through a multidisciplinary team composed of teachers, administrators, parents and service providers, the needs of the student and the appropriate teaching strategies and required classroom accommodations including assistive technologies (Fernández-Batanero et al., 2022; Francisco et al., 2020). Inclusion success relies on various factors, including a clear vision, shared commitment, teacher responsibility, collaborative team approaches, parent engagement, and principal leadership (Lyons et al., 2016). This disability-related social transformation of school is currently undergoing an unparalleled digital transformation with the growing development of digital educational systems, some of which integrate specific educational needs (Cinquin et al., 2019), or of educational technologies, some of which are for student with special education needs (McNicholl et al., 2021; Pontikas et al., 2022). Several studies have investigated the positive impact of technology to foster the interprofessional collaboration in the management of disability-related care (Barr et al., 2017). To the best of our knowledge, there is no systematic review on digital technologies that include and promote communication and collaboration between stakeholders of educational community surrounding the children with disability. Our aim is to provide an overview of technologies that focus on collaborative process into the child's educational community including family, school, and care parties.

BACKGROUND

Collaboration and communication between school professionals, parents, and service providers have long been recognized as crucial for a child's educational development. Effective communication between teachers and parents makes it easier to understand and implement pedagogical adaptations (Walker et al., 2012). Parental involvement in schooling positively impacts children with SEND or disabilities, emphasizing the importance of family-school collaboration (Martinez et al., 2012; Parsons et al., 2009). However, several barriers to inclusion, particularly for students with Autism Spectrum Disorder (ASD), exist, including inconsistencies between services, expectations, and support perceptions (Roberts and Simpson, 2016). To address these challenges, schools need to provide guidelines, resources, and foster proactive involvement between parents and teachers. Digital technology has

the potential to facilitate collaboration between parents and teachers, promoting better communication and collaboration (Olmstead, 2013). Models of parent-professional collaboration extend beyond family-school collaboration to include family-school-community collaboration (Larivée et al., 2017). In North America, "Sunshine Model" and "Whole School, Whole Community, Whole Child" Model (ASCD and Centers for Disease Control and Prevention, 2014; Lewallen et al., 2015) emphasize partnerships involving all stakeholders impacting schooling and multidimensional collaboration among education and health actors. In Western Europe, researchers propose multi-professional (Emery, 2017) or polycentric approaches based on the child's life project (Ebersold and Detraux, 2013). These models advocate for a student-centered approach and aim to connect home, school, and community.

Despite the importance of technology in schools and collaboration, surveys indicate that caregivers desire technology to facilitate planning and communication with teachers, highlighting the need for technology-based solutions in supporting inclusive education (O'Neill et al., 2020).

RESEARCH QUESTIONS

Using a systematic literature search procedure, our goal is to explore the theoretical and applied aspects of collaborative technologies for the educational inclusion of children with educational needs particularly neurodevelopmental disorders such as ASD.

The overview of the field will be presented in terms of evidence-based information through three research questions to document the domain activity, the background scaffolding, and the research outcomes:

RQ1. *Domain characterization:* Is there existing literature that deals with digital technologies for supporting stakeholders' collaboration to foster the school inclusion of children with special education need and disabilities? Who are the targeted children? Which journals and conferences have published them? How has the field evolved? What are the studies' purposes?

RQ2. *Design of technologies:* How are these technologies designed? What are the technologies' purposes? What functionalities do they offer to support collaboration? What are the obstacles to their development?

RQ3. *Main outcomes:* What research methods were used? What are the findings in terms of evaluation?

METHODOLOGY

Search Strategy

The databases searches were conducted in November 2022 using Scopus, Web of Sciences, EBSCOhost (all databases included PsycInfo, PsyArticles, Psychology & Behavioral Sciences Collection, SocINDEX, CINAHL), Pubmed and IEEE Xplore. According to the research question, we use the following key phrase: *Collaboration AND Stakeholder AND Inclusion AND (Autism OR special need) AND Pupil AND Technology NOT College.*

Table 1 details the keywords used associated with the different search terms of the key phrase.

Table 1. Details of keywords used in key phrase.

Categories	Research Keywords
Collaboration	collab*; coop*; "working together"; communication; relationship; partnership; partner; alliance; connection; networking; "inter-relationship"; "inter-disciplinarity team"; "interagency collab*"; "information sharing"; coordinat*
Stakeholder	stakeholder; caregiver; "profession* caregiver"; "health profession*"; "health care provider"; provider; "inpatient team"; parent; team; "school team*"; "school staff"; teacher; community; educator
Inclusion	inclusion; integration; "inclusive partner"; "transition support"; "iep"; "educator project"; "curriculum"; "individual* education plan"
Autism OR special need	asd; autism*; tnd; ndd; "learning disability"; "neurodevelopmental disability"; "cognitive disability"; "impairment"; "specific need"; "special need"
Pupil	pupil*; child*; adolesc*; schooler*; student*
Technology	tech*; "messaging system"; "health information tech*"; "ict"; "information and communication tech*"; "information tech*"; "communication tech*"; "computer"; "web"; "social media"; "mobile device"; "mobile app"; website; internet
College	College; university

Eligibility Criteria

In this systematic review, we included all studies on the use of digital technologies supporting the collaboration between at least two types of stakeholders to promote the school inclusion of children with SEND. No restrictions were placed on the date of publication, but the included studies had to be in English. In addition, the studies were not to be about academic inclusion of college students and had to involve two different stakeholders. Finally, studies that were not journal or conference papers were excluded.

Screening et Study Selection

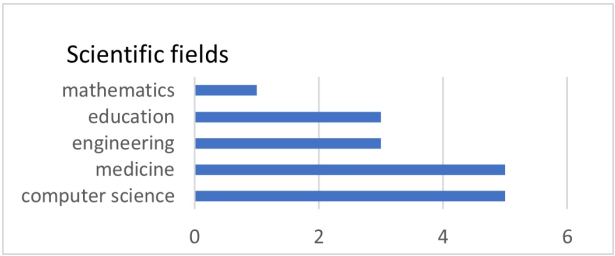
The screening process, performed with the Rayyan tool (Ouzzani et al., 2016), started with removing irrelevant papers. Articles were first excluded based on titles and abstracts (n = 1360) resulted in 131 articles to go through to the next stage of full-article review. This title-abstract screening process was carefully evaluated by both authors. The full-text review of the remaining papers results in 129 papers comprising 10 studies included for the systematic review.

RESULT

RQ1. Domain Characterization

The literature review identified a total of six articles and four conference papers discussing seven different digital technologies that support collaboration among stakeholders in inclusive education. These technologies

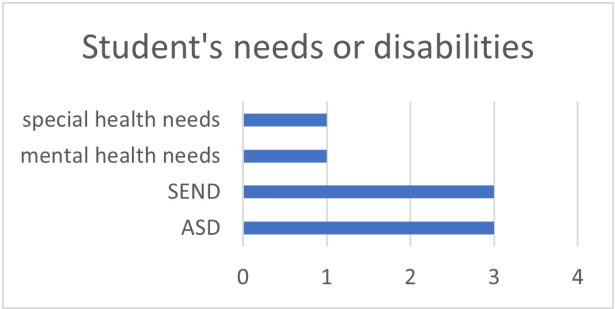
include seven projects: AMP (Linstead et al., 2016), CareNexus (Ranade-Kharkar et al., 2018, 2017), CC-project (do Carmo Alonso et al., 2020), IEP-Connect (Siyam and Abdallah, 2021), SINSAE project (Bermeo-Zambrano et al., 2020), Smart-School Care Coordination System (SCCS) (Hafidh et al., 2020, 2019), ToGather (Mazon et al., 2021), and a strategy based on ICT (Mendoza-González et al., 2019). These technologies have been developed in seven countries: the United States, Mexico, Ecuador, Brazil, France, and the United Kingdom. The studies have been published in ten different journals or conferences across fields such as computer science, medicine, engineering, education, and mathematics (see graph 1).



Graph 1: Scientific fields of research.

Out of the seven technologies, five were specifically designed for inclusive education, while the other three focused on care coordination teams. However, two of the care coordination technologies also incorporated information integration and involvement of school partners.

The target population for these technologies is children ranging from 0 to 25 years old. Three projects targeted K-12 students, one focused on preschoolers (0-5 years old), and the remaining technologies did not specify a particular age group. These technologies have been developed to support children with different disorders, in particular pupils with ASD (see graph 2).



Graph 2: Educational needs or disorders targeted by technologies.

The stakeholders involved in the design of these technologies include health professionals, teachers, and parents. Health professionals were involved in all studies, while parents were engaged in all except one. Teachers were

directly involved in five of the technologies. Two technologies aimed to integrate a wide range of formal and informal care providers, extending beyond traditional education settings.

RQ2: Design of Technologies

The literature review identified different design approaches used by researchers in developing technologies for collaboration in inclusive education. Half of the technologies were developed using participatory design, while two followed a generic user-centered design approach. The authors do not specify the design of the last two technologies.

CareNexus (Ranade-Kharkar et al., 2018, 2017), IEP-Connect (Siyam and Abdallah, 2021) and ToGather (Mazon et al., 2021) employed participatory design with continuous involvement of end-users in each phase and iteration. The CC-project (do Carmo Alonso et al., 2020) used a participatory design based on activity ergonomics. These studies emphasized the importance of addressing specific needs, including shared information, accessibility, and organization of technology. The SCCS project initially analyzed literature and conducted interviews with care providers to develop an ontology as a foundation for their technology (Hafidh et al., 2020, 2019). The SINSAE project (Bermeo-Zambrano et al., 2020) adopted a generic user-centered design approach, considering the needs of various end-users. The first technology developed in this field (AMP (Linstead et al., 2016)) was focused on technological choices and later adapted to meet user needs. The strategy based on ICT utilized a specific usage of a social network platform to organize discussion groups among stakeholders (Mendoza-González et al., 2019).

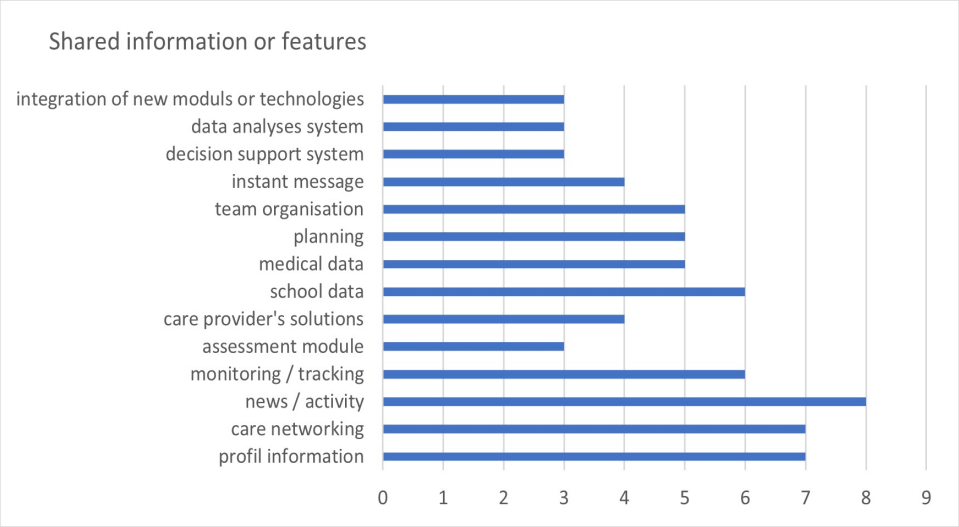
The technologies mainly use a single web application or one associated with mobile applications. Only one technology offers only a mobile application (IEP-Connect (Siyam and Abdallah, 2021)).

The coordination approaches varied among the technologies. Six technologies facilitated cooperation through information sharing, commenting, and providing feedback, but with unequal rights among stakeholders. ToGather allowed collaboration with equal editing rights, enabling stakeholders to modify information provided by others (Mazon et al., 2021). SCCS did not specify the degree of coordination (Hafidh et al., 2020, 2019).

The proposed architectures differed across technologies. AMP (Linstead et al., 2016) proposed an event feed for data management, while IEP-Connect (Siyam and Abdallah, 2021) and ToGather (Mazon et al., 2021) organized information via main pages. SINSAE project (Bermeo-Zambrano et al., 2020) employed a three-layer architecture, and SCCS (Hafidh et al., 2020, 2019) proposed a six-layer architecture. CareNexus (Ranade-Kharkar et al., 2018, 2017), grouped all features on one page. The ICT-based strategy is built around the use of a social network (Mendoza-González et al., 2019). CC-Project (do Carmo Alonso et al., 2020) has not yet proposed an architecture.

In terms of features (see graph 3), all technologies offered information sharing on youth-related activities and events. Except for ICT-based strategy (Mendoza-González et al., 2019), they included profiles of young persons and

team members. Six technologies facilitated sharing of school information, and five included medical information. The main features included monitoring and tracking, planning, solution sharing among care providers, evaluation of symptoms or behaviors, and internal organization of the follow-up team. Three technologies integrated machine learning-based modules for information analysis and decision-making support.



Graph 3: Shared information or features offered by the different technologies.

RQ3: Main Outcomes

In the reviewed articles, five needs analyses were conducted to identify requirements and guidelines, while eight studies employed evidence-based approaches. Different methods were carried out to identify needs in each project. For example, observation and document examination were used in the IEP-connect project (Siyam and Abdallah, 2021), while a needs analysis interview was conducted for CareNexus (Ranade-Kharkar et al., 2018, 2017). The CC-project (do Carmo Alonso et al., 2020) utilized non-directed interviews, and the SCCS project (Hafidh et al., 2020, 2019), involved official document analysis and interviews. The ToGather project (Mazon et al., 2021) conducted a questionnaire and interviews with various participants.

Several requirements and guidelines emerged from the needs analyses, including facilitating communication among stakeholders, easy access to information, minimizing effort and time required to use the technology, assessment and planning capabilities, coordination of interventions, integration with other services, and ensuring data security. Differences in perception and needs among stakeholders were highlighted in the CC-project (do Carmo Alonso et al., 2020), while specific categories of desired information were emphasized in the ToGather project (Mazon et al., 2021). The SCCS (Hafidh et al., 2020, 2019) project developed an ontology-based framework highlighting the contributions of different stakeholders.

Evidence-based approaches varied among the projects. Hafidh et al. (2020) used case scenarios to test the ontology in SCCS and demonstrated its effectiveness as a real-time solution. CareNexus (Ranade-Kharhar et al., 2018) tested different interfaces using case vignettes, and usability and usefulness were assessed. The IEP-connect application underwent a Think Aloud study and usability assessment (Siyam and Abdallah, 2021). The ToGather project employed iterative prototyping, refining the needs and interfaces based on feedback from professionals and parents (Mazon et al., 2021).

Four articles evaluated the benefits of the digital technologies, with three including field studies. The SINSAE project (Bermeo-Zambrano et al., 2020) tested the collaborative tool with volunteers who responded to a survey, indicating its potential for inclusive schooling. The AMP project (Mazon et al., 2021) involved 10 teachers who provided feedback through a questionnaire, highlighting the ease of use and multimedia data collection. The IEP-Connect study demonstrated positive attitudes toward the app's usefulness through think-aloud sessions and surveys (Siyam and Abdallah, 2021). The ICT-based strategy study showed that a communication strategy based on a social network facilitated collaborative work among stakeholders in achieving an inclusive school ecosystem (Mendoza-González et al., 2019). None of these studies used a control group or assessed the impact of the technologies on students or stakeholders. When collaboration was assessed, this was done using non-standardized measures via a survey.

DISCUSSION

Our review identified a total of seven digital technologies and one ICT-based strategy that support collaboration among stakeholders in inclusive education. These technologies have been developed in various countries and have targeted children with different disorders, primarily ASD. The stakeholders involved in the design of these technologies include care providers, teachers, and parents. Regarding the design of technologies, different design approaches were used in developing these technologies: participatory design then user-centered design were the predominant approaches employed by researchers. These approaches emphasize the involvement of end-users throughout the design process, ensuring that the technologies meet their specific needs. The various functionalities and architectures of the technologies have been developed to facilitate cooperation and information sharing between stakeholders. Only one of the technologies has been developed to enable collaboration. The research reviewed highlights the potential of these technologies for school inclusion, to support care projects, and to facilitate collaboration. The studies identify key requirements and guidelines, including facilitating communication among stakeholders, easy access to information, minimizing effort and time required to use the technology, assessment and planning capabilities, coordination of interventions, integration with other services, and ensuring data security.

The technologies, whether they are designed with participatory or classic design, can be part of the different models of collaboration between the school, the family, and the care providers. Most of the technologies

are part of the multi-professional approach or the whole community model. One technology was centered on the IEP's objectives and corresponds to the multi-focused approach on the pupil's future.

The studies reviewed have limitations. Especially, only the ICT-based strategy study assessed the impact on collaboration, health, or well-being of students, but the measures were not standardized. Furthermore, none of the field studies included control groups.

CONCLUSION

In conclusion, this systematic review highlights the potential of digital technologies to support collaboration among stakeholders in inclusive education settings. The findings provide valuable insights into the design considerations, requirements, and guidelines for developing effective technologies in this field. Future research should focus on rigorous evaluations of these technologies' impact and effectiveness in promoting inclusive education and improving outcomes for students with special educational needs.

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