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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 (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 SEND inclusion and reducing educational inequalities. 3, 8.

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

## 40 INTRODUCTION

41 The field of special needs education has witnessed significant advancements  
42 in promoting the inclusion of students with special educational needs or  
43 disabilities (SEND) since the Salamanca Framework for Action in 1994  
44 (UNESCO, 1994). Countries such as the U.K. (Great Britain Department  
45 for Education and Skills, 2001a, 2001b), the USA (Boehner, 2002; Castle,  
46 2004), and France (French Gouvernement, 2013, 2005) have implemented  
47 inclusive education through policy reforms and legal acts, influenced by the  
48 Convention on the Rights of Persons with Disabilities (Wehmeyer and Patton,  
49 2017).

50 The most common form of “inclusive education” is the placement of stu-  
51 dents with disabilities in mainstream classrooms (Nilholm and Göransson,  
52 2017) with an “Individualized Educational Plan”, which formalizes, through  
53 a multidisciplinary team composed of teachers, administrators, parents and  
54 service providers, the needs of the student and the appropriate teaching strate-  
55 gies and required classroom accommodations including assistive technologies  
56 (Fernández-Batanero et al., 2022; Francisco et al., 2020). Inclusion suc-  
57 cess relies on various factors, including a clear vision, shared commitment,  
58 teacher responsibility, collaborative team approaches, parent engagement,  
59 and principal leadership (Lyons et al., 2016). This disability-related social  
60 transformation of school is currently undergoing an unparalleled digital  
61 transformation with the growing development of digital educational systems,  
62 some of which integrate specific educational needs (Cinquin et al., 2019),  
63 or of educational technologies, some of which are for student with special  
64 education needs (McNicholl et al., 2021; Pontikas et al., 2022). Several  
65 studies have studied the positive impact of technology to foster the inter-  
66 professional collaboration in the management of disability-related care (Barr  
67 et al., 2017). At the best of our knowledge, there is no systematic review  
68 on digital technologies that includes and promote communication and col-  
69 laboration between stakeholders of educational community surrounding the  
70 children with disability. Our aim is to provide an overview of technologies  
71 that focus on collaborative process into the child’s educational community  
72 including family, school, and care parties.

## 73 BACKGROUND

74 Collaboration and communication between school professionals, parents,  
75 and service providers have long been recognized as crucial for a child’s  
76 educational development. Effective communication between teachers and  
77 parents enhances educators’ awareness of a child’s specific needs and facili-  
78 tates pedagogical adaptations (Walker et al., 2012). Parental involvement in  
79 schooling positively impacts children with SEND or disabilities, empha-  
80 sizing the importance of family-school collaboration (Martinez et al., 2012;  
81 Parsons et al., 2009). However, several barriers to inclusion, particularly  
82 for students with Autism Spectrum Disorder (ASD), exist, including incon-  
83 sistencies between services, expectations, and support perceptions (Roberts  
84 and Simpson, 2016). To address these challenges, schools need to pro-  
85 vide guidelines, resources, and foster proactive involvement between parents

86 and teachers. Digital technology has the potential to facilitate collaboration  
87 between parents and teachers, promoting better communication and collabo-  
88 ration (Olmstead, 2013). Models of parent-professional collaboration extend  
89 beyond family-school collaboration to include family-school-community col-  
90 laboration (Larivée et al., 2017). In North America, “Sunshine Model”  
91 and “Whole School, Whole Community, Whole Child” Model (ASCD and  
92 Centers for Disease Control and Prevention, 2014; Lewallen et al., 2015)  
93 emphasize partnerships involving all stakeholders impacting schooling and  
94 multidimensional collaboration among education and health actors. In West-  
95 ern Europe, researchers propose multi-professional (Emery, 2017) or poly-  
96 centric approaches based on the child’s life project (Ebersold and Detraux,  
97 2013). These models advocate for a student-centered approach and aim to  
98 connect home, school, and community.

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

## 103 RESEARCH QUESTIONS

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

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

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

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

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

## 121 METHODOLOGY

### 122 Search Strategy

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

129 Table 1 details the keywords used associated with the different search terms  
130 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

### 131 Eligibility Criteria

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

### 139 Screening et Study Selection

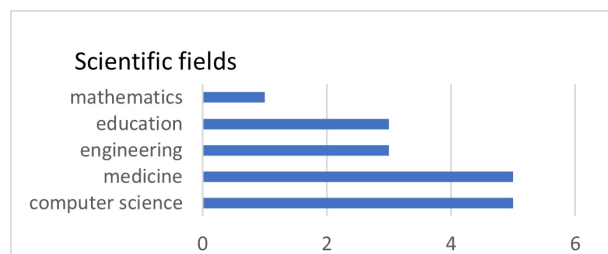
140 The screening process, performed with the Rayyan tool (Ouzzani et al.,  
141 2016), started with removing irrelevant papers. Articles were first excluded  
142 based on titles and abstracts (n = 1360) resulted in 131 articles to go through  
143 to the next stage of full-article review. This title-abstract screening process  
144 was carefully evaluated by both authors. The full-text review of the remaining  
145 papers results to 129 papers comprising 10 studies included for the systematic  
146 review.

## 147 RESULT

### 148 RQ1. Domain Characterization

149 The literature review identified a total of six articles and four confer-  
150 ence papers discussing seven different digital technologies that support  
151 collaboration among stakeholders in inclusive education. These technologies

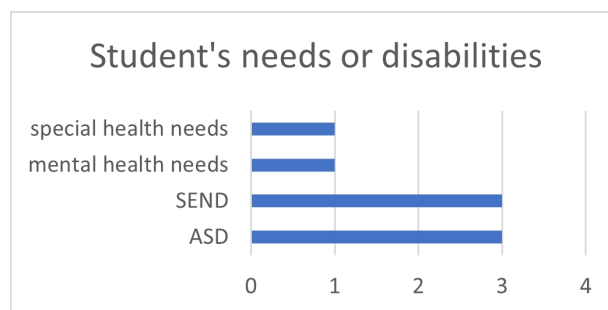
152 include seven projects: AMP (Linstead et al., 2016), CareNexus (Ranade-  
 153 Kharkar et al., 2018, 2017), CC-project (do Carmo Alonso et al., 2020), IEP-  
 154 Connect (Siyam and Abdallah, 2021), SINSAE project (Bermeo-Zambrano  
 155 et al., 2020), Smart-School Care Coordination System (SCCS) (Hafidh et al.,  
 156 2020, 2019), ToGather (Mazon et al., 2021), and a strategy based on ICT  
 157 (Mendoza-González et al., 2019). These technologies have been developed in  
 158 seven countries: the United States, Mexico, Ecuador, Brazil, France, and the  
 159 United Kingdom. The studies have been published in ten different journals  
 160 or conferences across fields such as computer science, medicine, engineering,  
 161 education, and mathematics (see graph 1).



**Graph 1:** Scientific fields of research.

162 Out of the seven technologies, five were specifically developed for inclusive  
 163 education, while the other three focused on care coordination teams. How-  
 164 ever, two of the care coordination technologies also incorporated information  
 165 integration and involvement of school partners.

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



**Graph 2:** Educational needs or disorders targeted by technologies.

171 The stakeholders involved in these technologies include health profession-  
 172 als, teachers, and parents. Health professionals were involved in all studies,  
 173 while parents were engaged in all except one. Teachers were directly involved

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

## 177 **RQ2: Design of Technologies**

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

183 CareNexus (Ranade-Kharkar et al., 2018, 2017), IEP-Connect (Siyam and  
184 Abdallah, 2021) and ToGather (Mazon et al., 2021) employed participatory  
185 design with continuous involvement of end-users in each phase and itera-  
186 tion. The CC-project (do Carmo Alonso et al., 2020) utilized a participatory  
187 design based on activity ergonomics. These studies emphasized the impor-  
188 tance of addressing specific needs, including shared information, accessibility,  
189 and organization of technology. The SCCS project initially analyzed litera-  
190 ture and conducted interviews with care providers to develop an ontology  
191 as a foundation for their technology (Hafidh et al., 2020, 2019). The SIN-  
192 SAE project (Bermeo-Zambrano et al., 2020) adopted a generic user-centered  
193 design approach, considering the needs of various end-users. The first tech-  
194 nology developed in this field (AMP (Linstead et al., 2016)) was focused  
195 on technological choices and later adapted to meet user needs. The strategy  
196 based on ICT utilized a specific usage of a social network platform to organize  
197 discussion groups among stakeholders (Mendoza-González et al., 2019).

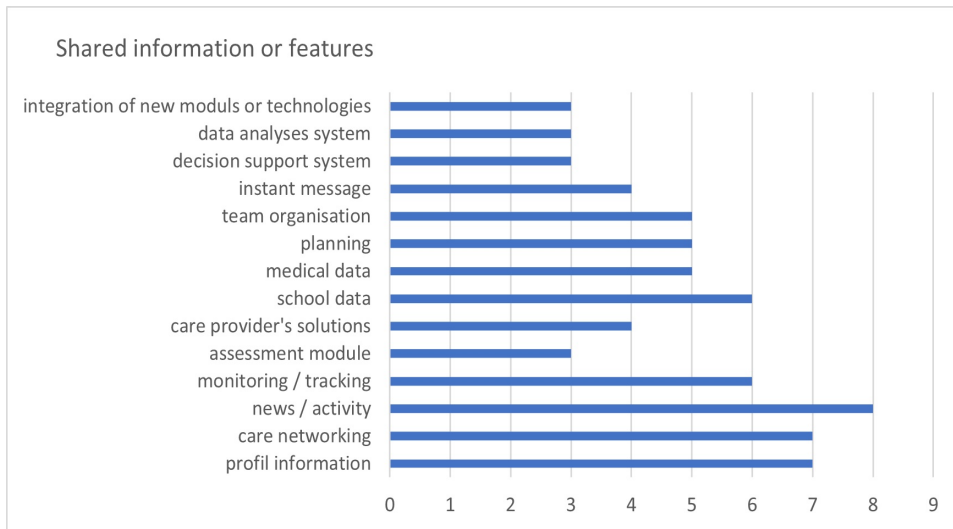
198 The technologies mainly use a single web application or one associ-  
199 ated with mobile applications. Only one technology offers only a mobile  
200 application (IEP-Connect (Siyam and Abdallah, 2021)).

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

207 The proposed architectures differed across technologies. AMP (Linstead  
208 et al., 2016) utilized an event feed for data management, while IEP-Connect  
209 (Siyam and Abdallah, 2021) and ToGather (Mazon et al., 2021) organized  
210 information via main pages. SINSAE project (Bermeo-Zambrano et al., 2020)  
211 employed a three-layer architecture, and SCCS (Hafidh et al., 2020, 2019)  
212 proposed a six-layer architecture. CareNexus (Ranade-Kharkar et al., 2018,  
213 2017), grouped all functionalities on one page. the ICT-based strategy is built  
214 around the use of a social network (Mendoza-González et al., 2019). CC-  
215 Project (do Carmo Alonso et al., 2020) has not yet proposed an architecture.

216 In terms of functionalities (see graph 3), all technologies offered infor-  
217 mation sharing on youth-related activities and events. Except for ICT-based  
218 strategy (Mendoza-González et al., 2019), they included profiles of young  
219 persons and team members. Six technologies facilitated sharing of school

220 information, and five included medical information. The main functionali-  
 221 ties included monitoring and tracking, planning, solution sharing among care  
 222 providers, evaluation of symptoms or behaviors, and internal organization  
 223 of the follow-up team. Three technologies integrated machine learning-based  
 224 modules for information analysis and decision-making support.



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

### 225 **RQ3: Main Outcomes**

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

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



246 Evidence-based approaches varied among the projects. Hafidh et al. (2020)  
247 used case scenarios to test the ontology in SCCS and demonstrated its effec-  
248 tiveness as a real-time solution. CareNexus (Ranade-Kharhar et al., 2018)  
249 tested different interfaces using case vignettes, and usability and usefulness  
250 were assessed. The IEP-connect application underwent a Think Aloud study  
251 and usability assessment with the SUS scale (Siyam and Abdallah, 2021).  
252 The ToGather project employed iterative prototyping, refining the needs and  
253 interface based on feedback from professionals and parents (Mazon et al.,  
254 2021).

255 Four articles evaluated the benefits of the digital technologies, with three  
256 including field studies. The SINSAE project (Bermeo-Zambrano et al., 2020)  
257 tested the collaborative tool with volunteers who responded to a survey, indi-  
258 cating its potential for inclusive schooling. The AMP project (Mazon et al.,  
259 2021) involved 10 teachers who provided feedback through a questionnaire,  
260 highlighting the ease of use and multimedia data collection. The IEP-Connect  
261 study demonstrated positive attitudes toward the app's usefulness through  
262 think-aloud sessions and surveys (Siyam and Abdallah, 2021). The ICT-  
263 based strategy study showed that a communication strategy based on a social  
264 network facilitated collaborative work among stakeholders in achieving an  
265 inclusive school ecosystem (Mendoza-González et al., 2019). None of these  
266 studies used a control group or assessed the impact of the technologies on  
267 students or stakeholders. Where collaboration was assessed, this was done  
268 using non-standardized measures via a survey.

## 269 **DISCUSSION**

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

290 The technologies, whether they are designed with participative or clas-  
291 sic design, can be part of the different models of collaboration between

292 the school, the family, and the care providers. Most of the technologies  
293 are part of the multi-professional approach or the whole community model.  
294 One technology was centered on the IEP's objectives and corresponds to the  
295 multi-focused approach on the pupil's future.

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

## 300 CONCLUSION

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

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