AUTISM SPECTRUM DISORDERS (ES BRODKIN, SECTION EDITOR)

School-Implemented Interventions for Preschool to High School Students with Autism: An Update on Recent Research

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Abstract

Purpose of Review The purpose of this review is to provide an update on the recent research (2016–2021) that evaluates the effectiveness of school-implemented interventions for students with autism (3–21 years old) from preschool to high school.
Recent Findings Overall, the recent literature demonstrated that there are EBPs that help students with autism acquire a variety of skills across domains (academic, social communication). Though many educators and peers were able to achieve high-fidelity implementation, there remains variable fidelity of intervention use in some studies.
Summary Though there is some evidence that educators and peers can successfully implement interventions, there are additional focal areas that are missing from the literature that are needed in schools (e.g., mental health, vocational). Future research should leverage implementation science approaches to support the use of proven efficacious interventions in schools.

Keywords Autism · Intervention · School · Implementation science · Evidence-based practice

Introduction

Current prevalence rates show that 1 in 54 children in the USA has autism. [1] The available evidence presents two types of evidence-based practices (EBPs) for autistic young people[1]: Comprehensive treatment models [3], which are packaged programs that address several different skills, and focused intervention practices, which are specific strategies or combinations of strategies focused on one or a few skills [4]. Although schools are the primary service setting for autistic students [5, 6], educators have limited training in EBPs [7], and school-based implementation of interventions is variable [8–10]. There is a need to mobilize research in practice to build capacity for intervention use for autistic students in schools [11].

While most research engages expert university-based clinicians as interventionists [4], building capacity in schools for sustainable

EBP use requires training those who exist in schools, like educators and peers, to support autistic students. Therefore, the purpose of this review is to provide an update on school-based intervention research in the USA for autistic students from preschool to young adulthood. We summarize and evaluate the recent (2016–2021) studies that examine the effectiveness of school-implemented interventions (i.e., educator or peer implemented). Given the heterogeneity of skills and developmental needs of autistic students, these studies use various methods (single-case research design, [12•, 13–15] randomized controlled trials [RCT] [16], and qualitative analysis [17•]) to help answer the questions: what works, for whom, within school conditions? We will discuss these trends across ages (preschool–high school; see Table 1) and developmental areas and focus on the scaled use of EBPs in schools through implementation science approaches. Finally, we describe the implications of this research to address the research-to-practice gap.

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[1] To respect the diversity and preferences of the autistic community, we are using identity-first language [2].

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School-Based Interventions Across Ages and Domains

Preschool

Children are diagnosed with autism earlier in life than in the past,[1] which allows for earlier intervention services. In the USA, 3–5-year-old children with special education eligibility receive educational services across their areas of need (i.e.,

Table 1   Included articles from 2016 to 2021 that evaluate the effectiveness of school-implemented interventions for students with autism (3–21 years old) from preschool to high school

Citation	Sample size and age	Study design	Intervention	Setting	Implementer	Fidelity	Outcomes
Preschool							
Mancil et al. (2016)	Three 4–5-year-olds	Single case: alternating treatment design	Function-based mand (i.e., request) communication training	School playground	Teachers	$M = 95\%$ (93–100%)	Each participant had higher generalized and maintained[a] communication with the iPodTouch™ than traditional devices
Radley et al. (2016)	Two 4-year-olds	Single case: multiple probe across skills	Social Skills Superheroes™—peer mediation, video modeling	School office room	School psychologist	100%	Both students improved at introducing self, getting ready, participating, and body basics that were maintained over the intervention period and 6 weeks following
Thiemann-Bourque et al. (2018)	23 ages 3–5 ($M = 48$ months)	RCT	Speech-generating device peer-mediated intervention	Child's classroom, hallway, other school room	Speech language pathologists, special education teachers, paraprofessionals, behavior therapist	Adult; $M = 89\%$ (67–100%) of intervention components implemented Peer; 80% (50–100%)	Students had significant growth in rate and reciprocity of communication that was generalized to novel settings and mixed generalization to untrained peers. These gains were maintained 4 to 8 weeks after the intervention, though there were nonsignificant differences between groups on standardized measures except treatment group on Expressive Language Subtest. Overall, teachers and parents rated the intervention as highly acceptable
Young et al. (2017)	41 preschools (ages 3–5)	RCT	Comprehensive Autism Program (environmental arrangement, visual supports, task analysis, reinforcement, prompting, pivotal response training, discrete trial teaching)	Preschool classroom	Special education teachers, general education teachers, paraprofessionals, speech-language pathologists	Environment and visuals $M = 1.41$/SD .41, PRT = 3.68/.59, DTT = 3.89/.62, behavioral strategies = 3.49/.64	Positive impact on receptive language, social skills after 6 to 8 months of intervention. No detected impact between groups on interaction, cognitive, parent report of social skills, challenging behavior, or adaptive behaviors
Elementary school							
Azad et al. (2018)	49 kindergarten–third-grade students and their parents	Pilot trial	Partners in school problem-solving model	Special education classroom	Special education teachers	69% of steps reported by teachers	Improvements in students' outcomes and reduction in target behavior associated with parent and teacher

Table 1 (continued)

Study	Sample	Design	Intervention	Setting	Implementer	Fidelity	Outcomes
							communication improvements
Brock et al. (2018)	11 elementary and middle school students	Pilot feasibility with random assignment	Peer-mediated pivotal response training (PRT)	Recess	General education teacher, special education teachers, paraprofessionals	Adult; 100% Peer; $M = 3.3$ strategies per observation	Significant differences between groups for total interactions, interactions from peers, and interactions to peers, but nonsignificant effects on quality of play, though substantial effect sizes
Henry & Solari (2020)	43 elementary students (ages 5–9)	Pilot randomized trial	Story-based scripted vocabulary and listening comprehension intervention	Special education classroom	Special education teachers	Adherence, $M = 2.54$, $SD = 0.16$; Quality of engagement, $M = 2.78$, $SD = 0.10$	Significant improvement in expressive vocabulary, narrative ability, and listening comprehension as compared to the control group. Teachers found the intervention highly acceptable and feasible
Locke et al. (2018)	Four first–fifth-grade students (age $M = 9$)	Pilot feasibility trial	Remaking recess	Recess	Paraeducators	$M = 4.0$ ($SD = 1.08$)	Students spent less time in solitary play, more time in joint engagement with peers, and had higher social network inclusion. These effects did not maintain 6 weeks after intervention
Lopata et al. (2019)	52 elementary students (ages 6–12)	Cluster randomized trial	Comprehensive intervention schoolMAX	Various school locations	School counselor, teacher	92–98.9% across components	Significant improvements in emotion recognition, ASD symptoms, and social communication skills, but no difference in interactions and academics for the intervention group as compared to the control group
Root et al., (2020)	3 kindergarten students	Single case: multiple probe across students	Early number sense	Special education classroom	Teacher	98.8–100% per student	Improvements in counting, sets, symbol use, patterns measurement, calendar skills, and number identification that was generalized[a]
Pellecchia et al. (2020)	154 kindergarten–second–grade students	RCT	TeachTown	Special education classroom	Special education teachers, general education teachers, paraprofessionals, speech-language pathologists	NR	No significant differences for students who received the intervention on communication, or cognitive, or academic skills
Shih et al. (2019)	97 elementary school students (ages 5–11)	RCT	Remaking recess	Recess	Paraeducators		Less solitary play and more friendship nominations in the

Table 1 (continued)

	Participants	Design	Intervention	Setting	Personnel	Fidelity	Outcomes
						$M = 74$ (self-rating)—76% (coach rating) of strategies used	intervention group, which were maintained at 1-month follow-up, but no significant increases in joint engagement
Middle school							
Solis et al. (2020)	5 students (ages 12–14; grades 6–8)	Single case: simultaneous replication design	Multicomponent vocabulary and reading intervention embedded with a choice component	Special education classroom	Special education teachers	98.5% across both teachers (for sessions coded, which was 30% of all sessions)	Improvements on reading comprehension and vocabulary curriculum-based measures, although there was variation in students' responses from day to day. No differences between scores in choice and no-choice conditions
High school							
Carter et al. (2017)	Four high school students (ages 16–19)	Single case: noncurrent multiple baseline across participants	Peer support arrangements, including the creation of an individualized written peer support plan (e.g., social and academic support strategies)	General education classrooms (e.g., physical education, math) without special education staff present	Peers (recruited from general education) and general education teachers	Peer partners interacted with students in a class (100% across all four students) and peer partners assisted the student academically (range of 67–100% across all four students)	Increase in social interactions with peers for all four students, accompanied by smaller improvements in the initiation of interactions. Mixed results on academic participation (increased for two students, maintained for one, decreased for one). Students and peer partners found the intervention acceptable
Sreckovic et al. (2017)	Three high school students (age 15; grades 9–10)	Single case: multiple baseline across participants design	Peer network intervention	Available classroom during lunch	Peers (recruited by guidance counselor)	98% for peer partners	Increase in total social interaction between autistic students and peers across intervention and maintenance/generalization phases. Maintenance occurred 3 weeks post-intervention and included generalization to the typical lunch setting with any peer (not just the peer partner). Exploratory data showed mixed results (with decreases for two students) related to changes in bullying victimization. Students with ASD, peer partners, parents, and school personnel rated

Table 1 (continued)

Roberts et al. (2019)	Two high school students (ages 17–18; grades 11–12)	Single-case design	Self-management (i.e., self-monitoring, self-recording, self-evaluation, and reinforcement) with a peer training intervention	Special education classroom ("study skills" class period)	Peer and special education teacher/-paraprofessional	100% for peer training; 95% across all intervention sessions	Moderate improvements in academic engagement, with some evidence of non-effects. Teacher data indicated that the intervention was feasible, acceptable, and useful	the intervention as feasible and acceptable

The sample information provided is for students who received the intervention (i.e., intervention group). Reported fidelity is for the intervention provided in school (e.g., the intervention provided at home is not reported) during the intervention phase by any school-based implementer (e.g., peer/educator). Age is presented in years

M, mean; *RCT*, randomized control trial

[a] The timing of maintenance or follow-up data was not reported in the original study

social, emotional, behavioral), often in preschools [18]. One recent study used a randomized controlled trial (RCT) to test the effects of a comprehensive treatment model (Comprehensive Autism Program, CAP) in preschools addressing several identified developmental needs for young children with autism [16, 19]. CAP included using EBPs such as environmental arrangement, discrete trial teaching, visual supports, and pivotal response training, though CAP teachers also reported using other-focused intervention practices that were not core to the model (e.g., picture exchange communication systems, social skills training, structured work systems). Schools in the control condition received no training or materials from the research team and were asked to continue their instruction as usual. Analysis of teachers' fidelity of CAP implementation, or the degree to which they implemented CAP as designed [20], suggested that teachers in both conditions used many of the same practices (e.g., discrete trial teaching, visual supports, behavioral strategies). Despite similarities between conditions in the duration of implementing some CAP components (e.g., discrete trial teaching), CAP teachers used some practices (environmental arrangement and visuals, pivotal response training, and discrete trial teaching) with greater quality than the control group. Students in both groups made gains across skill areas. Students in CAP made statistically significant gains on social skills and receptive language, moderated by a child's autism severity, after 6–8 months of intervention compared to the control group. Given the minimal impact in other skill areas and duration of impact on students' skills, this research calls attention to the challenges in measuring the effectiveness of comprehensive models for students with heterogeneous skills. However, the researchers found that school-based implementers could, with training and coaching, use these practices with their students and that sustaining this use may be the key to improving children's long-term outcomes at scale.

To systematically address the research-to-school gap, some researchers have shifted from efficacy (i.e., does this practice work?) to effectiveness trials (i.e., does this work under routine conditions? [21]) of focused intervention practices for autistic preschoolers. Most of these focused intervention practices target social communication skills. Radley and colleagues [14] used a multiple-probe single-case design to extend Social Skills Superheroes, a manualized research-based social skills training program, to schools. Social Skills Superheroes uses peer, teacher, and video models of specific social skills such as introducing oneself, orienting their body to their communication partner, and turn-taking. A school psychologist provided the intervention to two preschoolers with autism resulting in substantial and maintained effects for both students. The authors assert that this manualized approach holds promise for more routine use of this intervention in other schools [14]. Complementing this work, Thiemann-Bourque et al.[22•] used an RCT, and Mancil et al. [13] used a

single-case design to extend their tests of interventions to peers, educators, and technology (e.g., iPad and iPod touch). Using peer-mediated intervention (PMI), which involves training the student's peers to provide teaching on a skill, both studies showed significant positive effects for students' initiation and responses to trained peers using vocal and augmentative communication (e.g., their devices). Together, these recent studies on social skills interventions for preschoolers demonstrate that educators can implement these practices with fidelity and that peers can and may need to be incorporated and trained to support students' maintained social and communication skills with autism in preschool settings. These findings highlight the need to incorporate and explicitly teach peers to be supportive communication and relationship partners with autistic students.

Elementary School

Recent studies also have evaluated the effectiveness of elementary school-based interventions. To address differences in children's social participation and engagement during recess, [14, 23] researchers have trained school personnel and peers to support students with autism in social conversations, reciprocal interactions, and navigating social challenges [9, 24, 25] Educators achieved variable fidelity of implementing the focused intervention practices (e.g., social skills training, low–moderate, [9, 25] high [24]). Despite this variable implementation, children with autism still improved in their joint engagement, peer play, and social networks [9, 24]. These studies show promise for improving students' interactive participation with peers. They also call attention to the need to explore educator fidelity related to different components of practices necessary to achieve desired student outcomes and ongoing consultation needs for maintained use [9, 24, 25].

Although much research focuses on social and communication skills, teachers report that academic skills are a high priority for teaching autistic students [26] who often need intensive intervention in these areas [27]. A few recent studies have studied the efficacy of interventions addressing academic skills with mixed effects. First, Pellechia and colleagues [28] used an RCT to test the effects of a technology-based intervention, TeachTown, in addressing communication, academic and cognitive skills. Although this intervention supplements the technology-based component with teacher-delivered interventions, most teachers reported they did not use the educator-delivered components. There were no observed effects for students receiving TeachTown compared to control. Schools and families should consider the effectiveness of such programs, despite the possible appeal of the technology. Two other studies focused on training teachers to use content-specific interventions for mathematics [29], language, and listening comprehension [30] with high fidelity. Root and colleagues [29] performed a single-case systematic replication of

a scripted early numeracy curriculum [31] designed to be delivered by one educator to one student at a time. They found that teachers found the intervention to have high social validity, and students improved their counting, sets, symbol use, patterns measurement, calendar skills, and number identification. Similarly, Henry and Solari [30] used an RCT to test the effects of a supplemental small group intervention (three to four students) and found that students in the intervention group had improved vocabulary, narrative ability, and listening comprehension. Though there were few educator-delivered studies, research on specific academic interventions that incorporated focused intervention practices (e.g., prompting, visual supports) helped autistic students acquire critical early math and literacy skills [29, 30].

While findings across the above studies showed that a variety of educators could use interventions with fidelity (e.g., paraeducators, [9, 25, 28–30] both paraeducators and teachers [24]), improved collaboration between educators and families also could enhance outcomes. Two recent studies have explored this essential collaboration. Based on their earlier qualitative review for identifying a need for teachers and parents of autistic students to communicate to understand each other [32], researchers used a brief three-stage consultation model for parents and teachers to build relationships and understanding and co-plan intervention to address this. [17] Both parents and teachers implemented their intervention plans with moderate fidelity, and their target concerns decreased in the frequency of occurrence. Another essential collaboration for improving school-based autism services is between the many personnel who serve different roles in supporting autistic students (e.g., school psychologists, speech pathologists, social workers, teaching assistants, counselors, teachers). To reduce the burden on a few educators and use a team-based approach to implementing a comprehensive model in elementary schools, researchers supported personnel in different positions to hold various roles in implementing weekly team planning meetings [33]. This approach shows promise for ways to leverage the many members of a child's individualized education plan (IEP) team (e.g., occupational therapist, speech-language pathologist, general education teacher, special education teacher, administrator, caregivers, and student [18]). Such collaboration may improve communication between educators and families, which may especially support families who experience marginalization and systemic barriers [34] and could benefit students across their educational experiences [35].

Middle School

Recent research on educator-delivered interventions for middle school students is limited, despite the clear need for these supports. Specifically, as autistic students enter adolescence, social differences persist [36], and there are increased

academic and social-emotional demands. For instance, adolescents are expected to read more expository text as they progress academically, and research has demonstrated significant heterogeneity in reading and language among autistic students [37]. One recent study on the academic achievement of middle schoolers with autism examined a multicomponent vocabulary and reading small-group intervention with an embedded choice component to address reading problems via a simultaneous replication single-case design [38]. The research team provided initial training followed by daily coaching to two teachers who served as interventionists for the five students. Results suggested improvement on curriculum-based measures of vocabulary and comprehension, indicating promise for reading comprehension instruction for autistic students [38]. While an improvement from the intervention was modest, teachers were able to independently implement each lesson following about 10 intervention sessions, which suggests that a small group multicomponent intervention may be a feasible and effective approach to reading comprehension instruction in middle schoolers with autism.

High School

Peer relationships are one of the most important features of adolescence. Because this age group may require different intervention goals than young children [39], extending interventions targeting social interaction to adolescents is a recent research priority. Researchers have found that peer-mediated interventions are a promising approach to increasing social interaction for autistic students [40], particularly adolescents [39]. Recent studies have extended peer-mediated intervention, such as peer support arrangements[11•] and peer network interventions [15], to high school students with autism without co-occurring intellectual disability. Peers were recruited from the general education setting based on their interest, shared activities with the autistic student, or overlap in classes. Both pilot studies used single-case designs, involved educators to some degree, and students demonstrated increases in social participation[11•] and interaction [15] following intervention. Carter and colleagues[11•] trained peer partners to provide social and academic support in general education classrooms according to a written peer support plan, whereas in the peer network intervention, researchers facilitated twice weekly peer network meetings with the goal of increased social interactions during lunch and eventual fading of structured meetings [15]. Importantly, the study included a generalization phase testing students' use of the skills with other untrained peers, and effects were consistent with those observed during the active intervention phase [15]. Overall, these studies highlight the importance of considering the individualized support needs and preferences of high school students with autism, as student needs vary greatly and some autistic students in inclusive settings may not disclose their disability status to peers and may not want to be singled out with formalized supports that are not delivered to all students.[11•]

Researchers also have investigated the effects of peer-mediated intervention combined with a self-management intervention, a practice in which the learner is taught to identify, monitor, regulate, and reward their appropriate behaviors in a specific context [4], on the academic engagement of high school students with autism [41]. One peer trainer, an autistic student, received one 50-min training in the self-management intervention and then subsequently co-facilitated two training sessions with the special education teacher for the focal autistic students on the strategies (e.g., self-monitoring, self-evaluation, reinforcement). Results suggested that the intervention was delivered with fidelity by the peer trainer with autism, feasible and acceptable to the teachers and students, and moderately improved academic engagement during a study skills class. While additional research is needed to parse out the effects of the different components of the intervention (e.g., self-management, reinforcement), self-management interventions are a promising framework that can be individualized to the needs of students and beneficial for increasing student independence [41].

Conclusions

The recent focus of EBP implementation from early intervention to young adulthood in schools is promising to reduce the research-to-practice gap [42, 43]. Overall, the reviewed studies tested the effectiveness of interventions across various individuals in the school setting (e.g., school psychologist, special education teachers, peers), skill areas (e.g., social communication, academic), and student ages (preschool through high school). The majority of studies indicated that interventions were implemented with fidelity, and autistic students achieved desired results—this shows the importance and promise of EBP delivery in schools. The studies in this review also suggest specific trends in school-based services related to the (a) focal population and skills, (b) intervention types tested (i.e., comprehensive treatment models, focused intervention practices), and (c) approach (e.g., incorporating peers in the intervention). Finally, we discuss these trends in relation to implications for future research.

Focal Population and Skills

Although some studies included more diverse samples[16•,22•,39] than have been included in prior research, [4, 44, 45] there remain significant gaps in the inclusion of populations underrepresented in research (e.g., racial/ethnic minority youth, autistic females, autistic students with co-occurring mental health needs). These groups need to be prioritized. Autistic students' needs are everchanging and become increasingly complex as they approach adulthood, which highlights the importance of the inclusion of understudied ages (e.g., middle school, high school) and skill areas in school (e.g., mental health).

Most of the studies included in this review focus on the social communication and academic skills of autistic students. Many skill areas warrant additional research, including adaptive functioning, disruptive behavior, co-occurring mental health conditions, executive functioning, and transition and vocational preparation, to name a few. Given the high prevalence of co-occurring mental health conditions [46] that often emerge in elementary and middle school years and persist if left untreated [47], research in this area is essential. Promising research on interventions targeting executive functioning [48], anxiety [49], social skills [50], and transition to adulthood [51] seek to adapt and test EBPs to address these areas in schools, though these have primarily been researcher implemented. Future research that prioritizes educator- or peer-implemented intervention is a crucial next step to address the social–emotional and other needs of autistic students.

Intervention Types Tested in Schools

Though the current literature tested the effectiveness of both comprehensive treatment models (e.g., CAP, [16] SchoolMAX [33]) and singular or a small combination of focused intervention practices (e.g., peer-mediated intervention [11, 12•, 22•, 42]), the most promising effects were those of the focused intervention practices. Comprehensive treatment models integrate many different focused intervention practices (e.g., reinforcement, discrete trial teaching, visual supports). Therefore, the implementation of these models may be challenging for a few reasons. First, it may be hard to tease apart the components of the comprehensive treatment models. Second, global outcome measures typically used in these trials may show limited change, though students may gain specific skills.[22•, 52, 53] Third, the practical utility and usability of comprehensive treatment models in schools are questionable. These complex multicomponent interventions may be too challenging for educators to deliver with fidelity in addition to the academic, behavioral, and socio-emotional practices and programs they are required to use in schools [54].

Incorporating Peers Within the Intervention

Third, many of the studies that showed significant intervention effects included training neurotypical and neuro-atypical peers, which suggests a paradigm shift towards more inclusive efforts to support autistic students. Of note, one study [41] trained the autistic students' autistic peer, showing the feasibility and importance of neurodiverse peers supporting one another. Importantly, in some of the reviewed studies, generalized effects of the intervention (e.g., the child using the skill in new situations) were only observed when peers were trained in the generalization contexts. This finding reinforces the notion that communities that welcome and embrace neurodiversity change the environment and behavior of those around autistic individuals. This approach places shared agency and onus on both autistic students and their neurotypical and neuro-atypical peers and has the largest evidence-based in improving outcomes [40].

Limitations and Future Directions

While this review provided the current state of educator- and peer-delivered intervention studies in the USA, it does not encompass the current state of autism research conducted in schools. We recognize that there are additional autism intervention studies in schools that have been published in the past 5 years that have a different intervention agent (e.g., researcher, clinician [14, 55, 56]), focus on students with developmental disabilities, including students with autism [57], test innovations not currently commercially or publicly available, or occurred in non-US schools [58] that are promising to enhance our understanding of school-based interventions for this population. This work would likely benefit from further replication to fully understand the possible impacts of the interventions' core components, effectiveness, and sustainment in schools. We recommend that future research focus on collaboration among stakeholders and leverage different implementation mechanisms to achieve desired implementation and student outcomes.

The included studies have all selected which EBPs for autistic students should be implemented without much-shared decision-making with stakeholders. Future research ought to consider how best to address the priorities and preferences of autistic students and their educators and truly embed and integrate their voices in research [59, 60]. It is interesting to note that the reviewed studies have variable fidelity and improvements in student outcomes. Perhaps, when educators' and autistic students' needs and desires are considered, we may see higher implementation fidelity and better outcomes as well as a stronger link between implementation fidelity and student outcomes.

Though these studies are essential to identify what EBPs have been used in schools [4, 61], there is still a need to understand the best ways in which to improve EBP fidelity. Researchers should focus on using innovative methods to identify mechanisms of change in order to understand how interventions are successfully implemented and sustained in schools [9, 56, 62, 63]. The studies included in this review have underscored the necessity to partner with school districts, schools, educators, peers, autistic students, and families to support the implementation of EBPs for autistic youth [32]. Future research should focus on how implementation strategies are designed and matched to ameliorate barriers to implementation commonly observed in schools [64].

Declarations

Human and Animal Rights and Informed Consent   All reported studies/ experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

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