A systematic review of school-based social skills interventions and observed social outcomes for students with autism spectrum disorder in inclusive settings

Michelle Dean[1] (iD) and Ya-Chih Chang[2] (iD)

Abstract

This review examined school-based social skills interventions for students with autism spectrum disorder who were educated in inclusive school settings. Secondary aims sought to explore observation protocols and the resulting social outcomes used to measure the social behaviors of students with autism spectrum disorder within authentic social environments at school. To meet the inclusion criteria, 18 studies (a) tested school-based social skills interventions for students with autism spectrum disorder who were educated in inclusive settings; (b) included typically developing peers to some degree within the intervention condition; (c) used naturalistic observation protocols; and (d) scored "strong" or "adequate" for group design, or "high quality" or "acceptable" for single-case design on methodological rating scales. Interventions were largely rooted in evidence-based practices, but were varied in terms of type, dose, and duration, and the extent to which typically developing peers and school personnel were trained to participate in the intervention. Observable social outcomes were similar across studies, and salient outcomes were able to measure post-intervention change across a wide age range. The identification of the active ingredients used in school-based social skills interventions as well as the salient social outcomes provides a roadmap for school practitioners as they move to incorporate evidence-based social skills interventions into their practice.

Lay abstract

Most social skills interventions for students with autism spectrum disorder have been conducted in clinic-based settings. While students with autism spectrum disorder are able to acquire new skills, the generalization of these skills to authentic social environments, like school, is more difficult. To address this issue, there is an increase in research examining the implementation of social skills interventions for students with autism spectrum disorder who are educated in inclusive school settings. This review included 18 research studies that focused on school-based social interventions for students with autism spectrum disorder who were educated in inclusive school settings. Typically developing peers also participated in the interventions to varying degrees. Secondary aims explored naturalistic observation instruments and subsequent social outcomes used to record the social behaviors of students with autism spectrum disorder at school. Social intervention components varied across studies, but all studies reported improvement in the targeted social behaviors of students with autism spectrum disorder. There were many similarities in the ways in which researchers measured and defined social outcomes. Observation protocols were able to measure change in the social behaviors of students with autism spectrum disorder across a wide age range. The recognition of evidence-based practices used in school-based social skills interventions, as well as the identification of observation protocols and salient social outcomes, provides a starting point for school practitioners to consider as they move to implement social skills interventions for students with autism spectrum disorder into inclusive school settings.

Keywords

inclusion, naturalistic observations, school, social skills

An increasing number of children with disabilities are being educated in general education classrooms for the majority of their school day (Hussar et al., 2020). From 2000 to 2018, there has been a 17% increase in students served under the Individuals with Disabilities Education

[1]California State University, Channel Islands, USA
[2]California State University, Los Angeles, USA

Corresponding author:
Michelle Dean, California State University Channel Islands, Madera Hall 2602, One University Drive, Los Angeles, CA 93012, USA.
Email: michelle.dean@csuci.edu

Act (IDEA) who were enrolled in general education for a majority of the school day (Hussar et al., 2020). Children with autism spectrum disorder (ASD) have followed these trends. As of 2017, 39.7% of students with ASD spent 80% or more of their school day in general education classes, and 18.3% of students with ASD spent 40%–79% in general education classes (National Center for Education Statistics, 2020). One purported benefit of inclusive education is social development—being educated alongside typically developing (TD) children provides students with disabilities access to normative social cultures, and the proximity to TD peers increases social opportunities (Ochs et al., 2001). Social inclusion is particularly relevant for students with ASD, whose social communication challenges can be exacerbated at school. Yet proximity to peers, in and of itself, is not enough to support the social development of students with ASD (Wainscot et al., 2008). Within the inclusive environment, students with ASD are more likely than their TD peers to be isolated or on the periphery of social groups (Kasari et al., 2011; Locke et al., 2010), to have difficulties maintaining mutual engagement with peers, and to be socially rejected or ignored (Dean et al., 2014). Without intervention, these types of social challenges persist and become more apparent over time, and ongoing social challenges increase the risk of developing mental health comorbidity in adolescence (Bellini, 2004; Corbett et al., 2014; Fisher & Taylor, 2016; Humphrey & Lewis, 2008; Humphrey & Symes, 2011). Given these risks, it is important that school personnel are able to recognize the social challenges of students with ASD within inclusive settings and to provide targeted social interventions accordingly.

Social skills interventions for children with ASD

Social skills interventions have been shown to improve social outcomes for students with ASD. Yet much of the empirical support for these interventions has been established in clinic-based settings. For school-age children with ASD, clinic-based social groups generally consist of students with ASD from different schools who meet after school hours (Gutman et al., 2010; Herbrecht et al., 2009; Laugeson et al., 2009, 2012; Olsson et al., 2017). Although participants are able to acquire new skills within the clinic setting, the generalization of skills to authentic social environments, like school, is more difficult. To address this issue, researchers have deployed empirically supported clinic-based interventions to school settings. For example, Bellini et al. (2007) conducted a meta-analysis examining the effectiveness of school-based social skills interventions for students with ASD. The study found that school-based social skills interventions were minimally effective for students with ASD, as evidenced by low treatment effects and low generalization effects. In a more recent meta-analysis of 34 single-subject design studies, school-based interventions showed more promising results for improving social outcomes in adolescents and adults with ASD (de Bruin et al., 2013), with the majority reporting moderate to strong effect sizes. Despite the promising results, reporting of generalization and maintenance was limited, and only one-third of the studies was implemented within the inclusive setting. Thus, these interventions largely emulated the clinic-based protocol where groups of students with ASD were removed from the inclusive setting to receive social interventions (i.e. self-contained classrooms and other types of pull-out services). Despite being held on school campuses, the segregated nature of these interventions limited the number of opportunities for students with ASD to practice social skills within the natural social environment at school, which includes TD peers. There is a need to broaden our understanding of social interventions for students with ASD who are educated in general education settings.

Social skills interventions in inclusive settings

Evidence-based practices (EBPs) have been shown to support the acquisition and generalization of social skills in schools. TD peer involvement with social interventions—either within the intervention setting or as intervention agent—helps provide supported opportunities for students with ASD to socialize with other children at school (Watkins et al., 2015). One EBP used to promote TD peer involvement is the use of antecedent-based intervention strategies. In this model, TD peers are included within the intervention environment, which increases proximity to peers and provides social opportunities. Peer-mediated intervention, in which TD peers are trained to serve as mentors to individuals with ASD, is another EBP shown to improve social outcomes for students with ASD (Chan et al., 2009; Steinbrenner et al., 2020a). When implemented with fidelity, peer-mediated interventions provide supported opportunities for individuals with ASD to practice skills within an authentic environment and increase opportunities for individuals with ASD to generalize newly acquired skills (Humphrey & Symes, 2010; Ochs et al., 2001). Research is needed to examine the involvement of TD peers in school-based social skills interventions and the degree of training received by these peers.

Naturalistic observations of social skills

It is important to consider how researchers are measuring social outcomes and the extent to which these measurement procedures can be used by practitioners in authentic settings. Many social intervention studies use survey measures, like the Social Skills Rating System (SSRS;

Gresham & Elliot, 1990) or the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005), for example, to measure the change in social behavior (Flynn & Healy, 2012). Although survey measures are useful, they are often completed by parents and teachers and are not designed to describe observed social behaviors within authentic social environments at school. Parents and teachers tend not to be present during unstructured social periods at school, and therefore, they could not accurately report on how the student with ASD socially interacts with other students within the social environment at school. Live observational recording systems have also been used to measure the extent to which targeted social behaviors of students with ASD occur in the natural setting. In contrast to parent and teacher survey reports of social behaviors, observation protocols are able to capture behavior change by systematically observing children in the natural settings before, during, and following the intervention (Cooper et al. 2007). For example, a recent review of social skills interventions for children with ASD in inclusive school settings reported that 20 out of 22 single-case designs (SCDs) reported positive outcomes (Sutton et al., 2019). In this review, positive outcomes refer to the observed social initiations and responses, and the level of social engagement between students with ASD and peers within the natural social setting at school. Research is needed to examine observation protocols used in schools to record the social behaviors of students with ASD within authentic inclusive settings.

Current study

The current review will expand the literature on school-based social skills interventions for students with ASD who are educated in inclusive settings. First, this review will examine school-based social interventions designed to support the social development of students with ASD across a wide developmental span. We will also describe the extent to which TD peers participate in these interventions. Second, we will examine the observation protocols used to record the social behaviors of students with ASD within the authentic social environments at school. We will also describe the social outcome variables these observations yielded. Third, practical implications of the social skills interventions and observation measures will be discussed.

Methods

Search criteria

The literature search was initiated on 12 February 2020 and terminated on 12 May 2020 by the first author and a librarian at one university. The following databases were used to ensure a comprehensive search: PubMed, PsycINFO, EBSCO, and ERIC. An example search string including Boolean operators was as follows: Autism OR Autistic OR asd OR Asperger* OR Pervasive development* disorder* OR pdd OR pdd-nos AND School* OR School-Based AND Observation AND Intervention AND Social* AND Inclusion OR Mainstream.

Inclusion and exclusion criteria

Articles were screened using the following criteria. First, articles must have been published in scientific journals and either written or translated into English. Second, the article must have focused on school-based social skills interventions for children and adolescents with ASD who were educated in inclusive settings. Third, TD peers needed to have been included to some degree within the intervention condition. Fourth, the studies must have measured social outcomes using naturalistic observation protocols in authentic school-based social settings. Fifth, study methodological quality needed to be rated as "strong" or "adequate" for group design studies (Reichow et al., 2008), or "high quality" or "acceptable" for SCD studies (Horner et al., 2005; Kratochwill et al., 2013). Finally, the articles must have been published in 1990—when the U.S. Department of Education added ASD as a special education eligibility category—or later (IDEA, 1990).

The initial search yielded 2,654 articles, 2,638 after the removal of duplicates. The first author read through the title of all 2,638 articles and excluded articles that obviously did not meet the criteria. This initial screening yielded 145 articles. In the second phase of screening, both authors screened the publication titles and abstracts. Inter-rater reliability between two coders was assessed using intraclass correlation coefficient (ICC=0.75). Disagreement was resolved through consensus after reading each of the articles in their entirety. Eighty-seven articles were read in their entirety and coded by both authors to determine eligibility for inclusion. Sixty-two articles were deemed not eligible because the intervention took place in a community or home setting, rather than school setting, or in a special education classroom rather than a mainstream setting. See Figure 1 consort chart.

Quality ratings of studies were reviewed for the remaining 25 studies. Fourteen studies utilized a SCD and 11 studies used randomized controlled trials (RCTs) or quasi-experimental design. The methodological quality of the SCDs was evaluated using the Quality Indicator Checklist that was adapted from Horner et al. (2005) and Kratochwill et al. (2013). Twenty quality indicators were used to classify the rigor of the research methodology including participants, setting, dependent variable, independent variable, procedures, results, and social validity. Studies meeting all 20 quality indicators were considered "high quality." Studies that met the first 16 indicators and at least 1 of the social validity quality indicators were considered "acceptable." Studies that do not meet the first 16 indicators were rated as "did not meet" criteria and AB Designs
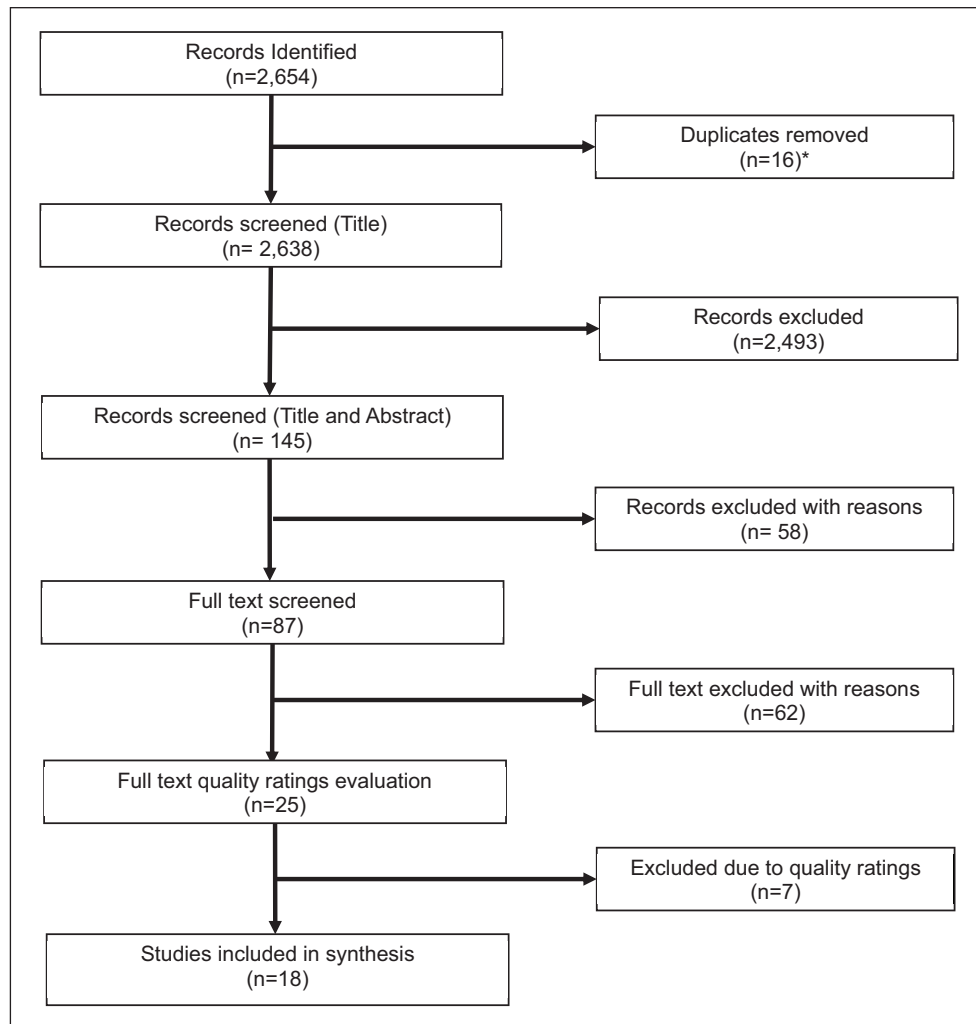
Figure 1. Flowchart of the search process.
*Most duplicates were automatically removed within search engines.

were rated as "weak." Seven studies were rated "high quality" or "acceptable" and were included in the analysis. The seven studies that "did not meet" were excluded. See Table 1 for quality ratings of studies.

Of the 18 remaining studies, 11 studies were group designs, including 1 quasi-experimental study (Locke, Rotheram-Fuller, et al., 2019) and 10 RCTs. The methodological quality of the group designs was rated using Reichow et al. (2008) evaluation protocol. The protocol included six primary quality indicators (participant characteristics, independent variable, comparison condition, dependent variable, the link between the research question and data analysis, and use of statistical tests), and eight secondary quality indicators (random assignment, interobserver agreement, blind raters, fidelity, attrition, generalization and/or maintenance, effect size, and social validity). Studies that meet all primary indicators and four or more secondary indicators were rated as "strong." Studies that meet four or more primary indicators and two

or more secondary indicators were rated as "adequate." Studies that meet less than four primary indicators and less than two secondary indicators were rated as "weak." All studies using group design were rated "strong" or "adequate" and were included in the review.

Community involvement: No individuals with ASD or other community stakeholders were involved in this study.

Results

Child and school characteristics

The 18 studies included 670 participants with ASD between the ages of 15 months and 16 years. ASD eligibility was confirmed using the Autism Diagnostic Observation Schedule (ADOS; n = 6; the Autism Diagnostic Interview— Revised was also used in two of these studies), the Childhood Autism Rating Scale (CARS; n = 5), or a special education eligibility of ASD (n = 6). Participants in one

Table 1. Intervention content and quality ratings of studies.

Authors	Study design	Quality indicator*	Social skills intervention	Intervention focus	Training			Maintenance	Generalization	Fidelity
					Staff	Target	Peer			
Brock et al. (2018)	RCT	Strong	Pivotal Response Treatment	Peer interactions and quality of play	Yes	No	Yes	No	No	Yes
Carter et al. (2016)	RCT	Strong	Peer Support Arrangements	Proximity to peers and social interactions	Yes	No	Yes	Yes	No	Yes
Dean et al. (2020)	RCT	Strong	SKILLS vs ENGAGE	Joint and solitary engagement	No	No	Yes	Yes	No	Yes
Dueñas et al. (2019)	Multiple probe across participants	Acceptable	Joint Video Modeling	Social communication	No	No	Yes	No	Yes	Yes
Harper et al. (2008)	Concurrent multiple baseline across participants	Acceptable	Pivotal Response Treatment	Gaining peers attention, turn-taking, and initiations	No	No	Yes	Yes	No	Yes
Hu et al. (2018)	Multiple baseline	High	LEGO© play intervention	Social interactions	No	No	Yes	No	No	No
Jung et al. (2008)	Multiple baseline across participants	High	Low- and high-probability request sequences	Prompted and unprompted initiations and responses	No	No	Yes	Yes	Yes	Yes
Kalyva and Avramidis (2005)	ABAB-reversal	Strong	Circle of Friends	Social initiations and responses	No	No	Yes	Yes	No	No
Kamps et al. (2014)	RCT	Strong	Comprehensive Peer Network Intervention	Communicative acts	Yes	No	Yes	No	Yes	Yes
Kasari et al. (2012)	RCT	Strong	CHILD vs PEER	Peer engagement and friendship	No	Yes	Yes	Yes	No	Yes
Kasari et al. (2016)	RCT	Strong	SKILLS vs ENGAGE	Peer engagement and friendship	No	No	No	Yes	No	Yes
Kretzmann et al. (2015)	RCT	Strong	Remaking Recess (RR)	Peer engagement	Yes	No	No	Yes	No	Yes
Locke, Shih, et al. (2019)	RCT	Strong	RR/RR + Implementation Support	Peer engagement and friendship	Yes	No	No	Yes	No	Yes
Locke, Rotheram-Fuller, et al. (2019)	Quasi-experimental	Adequate	Practiced-based vs Research-based	Peer engagement and friendship	Yes	Yes	Yes	No	No	No
Radley et al. (2017)	Multiple baseline across participants	High	Superheroes Social Skills Program	Peer engagement and friendship	No	Yes	Yes	Yes	No	Yes
Shih et al. (2019)	RCT	Strong	RR	Peer engagement and friendship	Yes	No	Yes	Yes	No	Yes
Sreckovic et al. (2017)	Multiple baseline probe across participants	High	Peer Network Training	Social communication with peers	No	Yes	Yes	Yes	Yes	Yes
Vivanti et al. (2019)	RCT	Strong	Early Start Denver	Social interactions, imitation, and spontaneous vocalizations	Yes	No	No	No	No	Yes

RCT: randomized controlled trials.

study had a dual diagnosis of ASD and intellectual disability (Carter et al., 2016). Ten studies reported cognitive scores, and participants in these studies had IQ scores within the average or above-average range. Cognitive scores were not reported in the remaining nine studies. Instead, the authors described participants in terms of their participation in general education or their academic levels. The varied assessment procedures used to determine eligibility are representative of assessment procedures in authentic school settings. Gold standard assessment protocols are not available in all school districts and many school practitioners depend on special education eligibility, observation, and/or independent diagnoses to inform intervention selection and development. Study participants were educated in preschool (n = 58), elementary school (n = 491), and secondary school settings (n = 121).

Consistent with the study criteria, all participants were educated in the general education setting for a portion of the school day. Participants in 15 studies were educated in the general education setting for 80% or more of the school day. Participants in three studies were included in the general education setting for between 1 h and half of the school day. Participants in one study met inclusion criteria if they were either fully or partially included in the general education setting (Kamps et al., 2002). Another study did not describe the proportion of the school day that participants spent in the inclusive environment (Brock et al., 2018). All social interventions were held on school campuses, took place in an inclusive environment, and included TD peers to varying degrees in the intervention condition. See Table 2 for child characteristics.

Interventions

A variety of different intervention approaches were used to increase the social engagement and interactions between students with ASD and their TD peers. Interventions were EBP for students for ASD or evidence-based comprehensive intervention packages (Steinbrenner et al., 2020b). Examples of EBP interventions included antecedent-based interventions (Carter et al., 2016; Kretzman et al., 2015; Locke, Shih, et al., 2019; Shih et al., 2019), peer-mediated intervention (Kalyva & Avramidis, 2005; Sreckovic et al., 2017), pivotal response training (PRT; Brock et al., 2018; Harper et al., 2007), video modeling (Dueñas et al., 2019), and structured play groups (Hu et al., 2018; Kamps et al., 2014; Radley et al., 2017). Six of these studies also used peer-mediated instruction in addition to another type of EBP (i.e. video modeling plus peer-mediation; Brock et al., 2018; Carter et al., 2016; Dueñas et al., 2019; Harper et al., 2007; Hu et al., 2018; Jung et al., 2008). Eight studies used comprehensive manualized intervention packages including a variety of EBPs, including social skills training, peer-mediated interventions, visual supports, modeling, and reinforcement (Dean et al., 2020; Kasari et al., 2012, 2016;

Kretzmann et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Radley et al., 2017; Shih et al., 2019). Vivanti et al. (2019) used a comprehensive behavioral intervention package for young children, which included antecedent-based intervention, peer-mediation, modeling, and reinforcement.

Interventions varied in dose and duration, and ranged in length from 6 weeks to 1 academic year. Shorter duration interventions occurred one to two sessions per week over the course of 6–8 weeks (e.g. Dean et al., 2020; Kasari et al., 2012, 2016; Kretzmann et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Radley et al., 2017; Shih et al., 2019). For example, Radley et al. (2017) held Superheroes Social Skills sessions in an elementary setting once a week for 8 weeks. Dean et al. (2020) facilitated ENGAGE sessions once a week over an 8-week period in secondary settings. In the preschool setting, Kalyva and Avramidis (2005) implemented 12 sessions of a Circle of Friends intervention once a week over the course of 3 months. Intervention sessions ranged from 30 to 70 sessions in a majority of the studies included in this review (e.g. Dueñas et al., 2019; Hu et al., 2018; Kamps et al., 2014). The longest intervention was a year-long Group-Early Start Denver Model (G-ESDM) delivered to preschool-age students with ASD (e.g. Vivanti et al., 2019).

Training

All interventions included TD peers, although the extent to which peers were involved varied. Some studies included training protocols within the intervention to teach peers specific strategies to support their interactions with students with ASD. Kalyva and Avramidis (2005) used a minimalist approach to peer training—without the presence of the student with ASD, peers were told that the purpose of the Circle of Friends intervention was to help the target student learn how to ask someone to play. Other studies provided didactic training for the peers. For example, Brock et al. (2018) conducted a 45-min peer training, in which facilitators (a) described the purpose of the intervention, (b) provided the background of the targeted student with ASD, and (c) shared five PRT strategies for peers to socially support the target student with ASD. In the Harper et al. (2007) study, peer training occurred over the course of seven consecutive sessions, in which the researcher used modeling, role-play, visual cues, prompting, and reinforcement to teach elementary school-aged peers the components of PRT. Jung et al. (2008) used role-play and discussion to train TD peers in preschool to use an embedded peer modeling procedure. At the secondary level, Dean et al. (2020) conducted two peer training sessions to introduce peers to the intervention and to discuss and role play strategies to support social interactions between peers and students with ASD. In Carter et al.

Table 2. Student characteristics.

Authors	Participants (n)	Age	IQ*	ASD severity	Setting	Inclusion
Brock et al. (2018)	11	8–12 years	76.6 (22.2)–83.5 (12.3) (range; KBIT-3, WIASC-1V)	Special Education Eligibility of ASD	Elementary and middle school	Not described
Carter et al. (2016)	51	N/A	N/A	CARS t score μ=43.1	High school	Students enrolled in μ=3.3 (SD=1.7) general education classes
Dean et al. (2020)	62	μ=14.72 (SD=1.83) years	IQ > 70 (SB-5)	ASD/Autism (ADOS)	Middle and high school	General education ≥ 80% of the school day
Dueñas et al. (2019)	3	4 years	N/A	Independent dx using ADOS/ADI	Preschool	2.5 h/day in inclusive classroom
Harper et al. (2008)	2	8–9 years	N/A	Special Education Eligibility of ASD	Elementary school	Full inclusion
Hu et al. (2018)	3	4–6 years	102–112 (VWPPSI-IV)	CARS 30–32	Preschool	General education with three teacher aids
Jung et al. (2008)	3	5–6 years	30–43 months (BDI)	PDD-NOS/Autism (CARS)	Pre-K transition classroom	Integrated Pre-K Classroom
Kalyva and Avramidis (2005)	5	3.10–4.7 years	N/A	Special Education Eligibility of ASD	Preschool	Integrated preschool/mainstream
Kamps et al. (2002)	56	5–6 years	50–123 (PPVT-4)	21–43 (CARS)	Kindergarten—1st grade	Fully or partially included in general education classroom
Kasari et al. (2012)	60	μ=8.14 years	M=90.97 (SD=16.33) (SB-5)	ASD/Autism (ADI-R/ADOS)	Elementary school	General education ≥ 80% of the school day
Kasari et al. (2015)	137	μ=8.14 years	IQ > 65 (SB-5)	ASD/Autism (ADOS)	Elementary school	General education ≥ 80% of the school day
Kretzmann et al. (2015)	24	6–11 years	N/A	Special Education Eligibility of ASD	Elementary school	General education ≥ 80% of the school day
Locke, Shih, et al. (2019)	31	μ=9 years; 8.6 years	IQ ≥ 65 (documented in school records)	ASD diagnosis by a community clinician	Elementary school	General education ≥ 80% of the school day
Locke, Rotheram-Fuller, et al. (2019)	91	M=8.4 (SD=1.6) years	N/A	Special Education Eligibility of ASD	Elementary school	General education ≥ 80% of the school day
Radley et al. (2017)	4	5–11 years	N/A	Special Education Eligibility of ASD	Elementary school	Inclusive classroom
Shih et al. (2019)	80	μ=8.19 years	M=91.58 (SB-5)	M=7.15 ADOS Severity Score	Elementary school	General education ≥ 80% of the school day
Sreckovic et al. (2017)	3	15 years	N/A	CARS 30–36	High school	General education classroom for a portion of school day
Vivanti et al. (2019)	44	15–32 months	MSEL VDQ: μ=59.63 (SD=22.82) NVDQ: μ=77.94 (SD=16.50)	ASD/Autism (ADOS)	Preschool	Inclusive classroom

ASD: autism spectrum disorder; IQ: Intelligence Quotient; NDQ: Non-verbal developmental quotient; PDD-NOS: Pervasive Developmental Disorder Not Otherwise Specified; VDQ: Verbal Developmental Quotient.
*Cognitive and ASD diagnostic assessments varied across studies. The following assessments were used in this review: Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000, 2012), Autism Diagnostic Interview—Revised (ADI-R; Lord et al., 1994), British Ability Scales Second Edition Early Years (BAS II; Elliott et al., 1996; Hill, 2005), Childhood Autism Rating Scale (CARS; Schopler & Reichler, 1986), Kauffman Brief Intelligence Test Second Edition (KBIT-2; Kaufman & Kaufman, 2005), Mullen Scales of Early Learning (MSEL; Mullen, 1995); Stanford Binet Fifth Edition (SB-5), Peabody Picture Vocabulary Test Fourth Edition (PPVT; Dunn & Dunn, 2007), Wechsler Adult Intelligence Scale Fourth Edition (WAIS; Wechsler, 2003), and Wechsler Preschool & Primary Scale of Intelligence (WPPSI; Watkins & Beaujean, 2014).

(2016), peers individually completed an intervention orientation, which provided an overview of peer support strategies, as well as intervention goals and expectations. Finally, three studies trained both the target student(s) with ASD and TD peers in the intervention (e.g. Kasari et al., 2012; Radley et al., 2017; Sreckovic et al., 2017). In Kasari et al. (2012), for example, peers met with an interventionist 20 min a week to learn strategies to support the engagement of students with social challenges. Concomitantly, participants with ASD met twice a week with an interventionist to develop skills to support social engagement with peers.

The training for these school-based interventions was mainly provided by researchers (n = 8). Five studies indicated that some level of staff training occurred prior to or during the intervention (Brock et al., 2018; Carter et al., 2016; Kretzman et al., 2015; Shih et al., 2019; Vivanti et al., 2019). There was considerable variance in the amount of staff training, ranging from a 1-h didactic training to year-long coaching support. Most staff training protocols (n = 5) included didactic informational sessions (Brock et al., 2018; Carter et al., 2016; Kamps et al., 2014; Kretzman et al., 2015; Locke, Shih, et al., 2019; Shih et al., 2019). For example, Brock et al. (2018) provided a 1-h training to each adult facilitator. During the training, participating staff learned to identify, train, and support peers to interact with target students during recess. Some staff training protocols also included guided discussions and handouts, as well as modeling, role-play, and implementation practice (Carter et al., 2016; Kamps et al., 2014; Kretzman et al., 2015; Locke, Shih, et al., 2019; Shih et al., 2019). Four studies provided ongoing in vivo coaching support during the intervention (Kamps et al., 2014; Kretzman et al., 2015; Locke, Shih, et al., 2019; Shih et al., 2019). For example, Shih et al. (2019) used two approaches to provide school personnel training on the Remaking Recess intervention. First, research personnel serving as coaches facilitated didactic informational training sessions. Next, coaches worked directly with school personnel during recess to model intervention strategies. There was a transfer of autonomy from the coach to school personnel over the course of the coaching sessions. Trainers faded coaching support as school personnel began to independently implement the intervention. Vivanti et al. (2019) used an intensive model of training support. Early childhood educators received formal training in the G-ESDM. One educator was fully certified, while others had participated in workshops and were progressing through their certification during the intervention period. All personnel continued to receive classroom coaching of G-ESDM across the school year (Vivanti et al., 2019). Most of the studies included fidelity checking procedures (n = 15). All but one of the group design studies reported fidelity and five of the SCDs reported fidelity.

Observation methods

Studies used systematic observation instruments to record the social behavior of participants in authentic social settings at school. Within the school setting, observation locations varied. Ten studies observed participants during unstructured social periods, including break time, recess, or lunch (Brock et al., 2018; Dean et al., 2020; Kasari et al., 2012, 2016; Kretzman et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Radley, 2017; Shih et al., 2019; Sreckovic et al., 2017). Seven studies observed the participants in the classroom during circle time, learning center time, or during group work (Carter et al., 2016; Dueñas et al., 2019; Hu et al., 2018; Jung et al., 2008; Kalyva & Avramidis, 2005; Kamps et al., 2002; Vivanti et al., 2019). One study observed participants across multiple settings, including recess and center time (e.g. Harper et al., 2007). Total observation periods ranged from 10 min to 1 h, with a majority of observation intervals ranging between 10 and 20 min (n = 15).

The observation instruments varied across the 18 studies. For this review, instruments were categorized as low technology (low-tech) or high technology (high-tech). Twelve studies used low-tech instruments—a paper-and-pencil form and a stopwatch (or stopwatch feature on a smartphone). Low-tech observations were timed interval recording systems used to record engagement, initiations, responses, and/or conversations. Six studies designed observation protocols specific to the study (Brock et al., 2018; Harper et al., 2007; Hu et al., 2018; Jung et al., 2008; Kalyva & Avramidis, 2005; Sreckovic et al., 2017), and participants were observed in classrooms, recess, and/or learning centers. Five studies used observation protocols to measure social initiations and responses (Harper et al., 2007; Hu et al., 2018; Jung et al., 2008; Kalyva & Avramidis, 2005; Sreckovic et al., 2017), and two observation protocols measured interactions (Brock et al., 2018; Jung et al., 2008). Six studies used the Playground Observation of Peer Engagement (POPE; Kasari et al., 2012, 2015; Kretzman et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Shih et al., 2019), and an additional two studies used an adaptation of the POPE (Dean et al., 2020; Radley et al., 2017). The POPE was designed specifically to observe the social behaviors of participants with ASD and their TD peers during recess/break time and lunch. Studies have used the POPE to measure engagement (Dean et al., 2020; Kasari et al., 2012, 2015; Kretzman et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Radley et al., 2017; Shih et al., 2019), initiations (Locke, Rotheram-Fuller, et al., 2019), and responses (Radley et al., 2017). Three studies used video to record the observation period, and low- and high-tech event recording procedures were used to code for the occurrence of target behaviors from

the video recordings (Dueñas et al., 2019; Jung et al., 2008; Vivanti et al., 2019). See Table 3 for descriptions of observation instruments.

High-tech refers to observation instruments requiring additional technology and technological support, including software, computer programs, wearable technological devices, and other types of digital equipment. High-tech instruments included (a) Multi-Option Observation System for Experimental Studies (MOOSES), a computer-based software programmed to measure the frequency that target behaviors occur (Carter et al., 2016); (b) Language Environment Analysis (LENA), a small device worn by young children that collects audio recordings to measure spontaneous vocalizations (Vivanti et al., 2019); (c) Measure Intentional Communication (M-COSMIC; Clifford et al., 2010), which uses video to capture footage during free play and semi-structured activities (Vivanti et al., 2019); (d) Personal Digital Assistant (PDA)-Based Data Collection System, which was programmed to facilitate live observations by asking questions and timestamping answers throughout the observation interval (Kamps et al., 2014); and (e) NOLDUS Mobile Module, a computer-based data collection system downloadable to PDAs for live coding which was also used to support live coding with pre-programmed prompting (Kamps et al., 2014). In the current studies, the MOOSES, NOLDUS Mobile Module, and M-COSMIC were used to measure initiations and/or responses (Carter et al., 2016; Kamps et al., 2014; Vivanti et al., 2019). The MOOSES also measured the total number of interactions (Carter et al., 2016) and the NOLDUS Mobile Module was also able to measure the type of communication behavior (Kamps et al., 2014). In the preschool setting, the LENA was able to capture spontaneous interaction data (Vivanti et al., 2019).

Engagement and initiations were the most commonly measured social outcomes (n = 10). Engagement refers to the extent to which a participant is engaged in activities with a peer or peers during the observation period. Studies measured the extent to which a child was mutually engaged with a peer or peers (joint engagement), or the extent to which a student was alone or with an adult (solitary). Interval recording systems were used to measure the level of engagement occurring during the majority of each timed interval; engagement scores denoted the percentage of the total intervals that participants were observed in each engagement state (i.e. solitary or joint engagement). Ten studies measured social initiations, which refers to the number of times the target child made a social initiation to a peer or peers (Carter et al., 2016; Harper et al., 2007; Hu et al., 2018; Jung et al., 2008; Kalyva & Avramidis, 2005; Kamps et al., 2014; Locke, Rotheram-Fuller, et al., 2019; Radley et al., 2017; Sreckovic et al., 2017; Vivanti et al., 2019). Eight studies measured social responses (Carter et al., 2016; Hu et al., 2018; Jung et al., 2008; Kalyva & Avramidis, 2005; Kamps et al., 2014; Radley et al., 2017;

Sreckovic et al., 2017; Vivanti et al., 2019). Response refers to the number of times the target child responded to a social initiation made by a peer or peers. Two studies measured social interactions (Carter et al., 2016; Jung et al., 2008). Interactions were coded when the target child and a peer or peers had a minimum of four consecutive reciprocal exchanges. Instruments measuring initiations, responses, and conversations used interval and event recording procedures to document the frequency of targeted behaviors within each interval and throughout the total observation period. Other observable social behaviors were recorded in the preschool setting: verbalizations and vocalizations, play acts and quality of play, and spontaneous communication. One study measured specific social behaviors of concern that were individually identified for each participant (i.e. gaining attention and turn-taking; Harper et al. 2007). Live observation protocols were effective in capturing change in students' social behaviors across the developmental span in a naturalistic social environment at school.

Post-intervention improvement on engagement outcomes was detected in preschool, elementary school, and middle and high school. Of the 10 studies that observed participant engagement, 7 studies were able to capture a post-intervention increase in joint engagement (Dean et al., 2020; Kasari et al., 2012, 2016; Kretzman et al., 2015; Locke, Shih, et al., 2019; Radley, 2017; Vivanti et al., 2019), and 6 studies detected a decrease in solitary engagement (Dean et al., 2020; Kasari et al., 2012, 2016; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Shih et al., 2019). Post-intervention improvement in initiations and responses were observed in participants ranging in age from 15 months (Vivanti et al., 2019) through adolescence (Sreckovic et al., 2017). Observation measures used in five studies detected a post-intervention increase in initiations (Harper et al., 2007; Hu et al., 2018; Kalyva & Avramidis, 2005; Kamps et al., 2014; Sreckovic et al., 2017), and three studies captured a post-intervention increase in responses (Hu et al., 2018; Jung et al., 2008; Sreckovic et al., 2017). One observation protocol recorded post-intervention change in unsuccessful initiations and unsuccessful responses (Kalyva & Avramidis, 2005). Observation protocols used in three studies detected post-intervention change in interactions: Carter et al. (2016) reported an increase in total interactions; Brock et al. (2018) reported an increase in target-to-peer interaction; and Jung et al. (2008) reported an increase in unprompted interactions. Other types of observed behavioral changes include unscripted or spontaneous and unscripted vocalizations (Dueñas et al., 2019), improved complexity or quality of play (Brock et al., 2018; Dueñas et al., 2019), post-intervention increase in the frequency of play acts (Dueñas et al., 2019), and improvement in gaining peers' attention and turn-taking (Harper et al., 2008).

Table 3. Descriptions of observation instruments.

Authors	Social observation measure	Setting	Interval	Length (min)	Location	Observed social outcomes
Brock et al. (2018)	Direct observation	Elementary and middle school	Yes	20–30	Recess	Solitary engagement, quality of play
Carter et al. (2016)	MOOSES	High school	N/A	M = 58.6	Classroom	Total interactions, initiations, and responses
Dean et al. (2020)	TOPI/POPE	Middle and high school	90s	15	Break and lunch	Solitary and joint engagement
Dueñas et al. (2019)	Video recorded observation	Preschool	N/A	15	Classroom	Scripted/Unscripted verbalizations, play actions
Harper et al. (2007)	Direct observation	Elementary school	N/A	10	Center play and recess	Gaining attention, initiations, turn-taking
Hu et al. (2018)	Unnamed observation	Preschool	N/A	N/A	Classroom	Initiations and responses
Jung et al. (2008)	Video recorded observation	Pre-K transition classroom	6s	10	Center time	Initiations, responses, and social interactions
Kalyva and Avramidis (2005)	Unnamed observation	Preschool	N/A	60	Circle time	Initiations and responses
Kamps et al. (2014)	Direct observation	Elementary school	40s	10	Classroom free play	Total communicative acts: initiations and responses
Kasari et al. (2012)	POPE	Elementary school	40s	15	Playground	Solitary and joint engagement
Kasari et al. (2016)	POPE	Elementary school	40s	10	Playground	Solitary and joint engagement
Kretzmann et al. (2015)	POPE	Elementary school	40s	15	Playground	Joint and solitary engagement
Locke, Shih, et al. (2019)	POPE	Elementary school	40s	15	Playground	Joint and solitary engagement
Locke, Rotheram-Fuller, et al. (2019)	POPE	Elementary school	40s	15	Playground	Initiations and solitary engagement
Radley et al. (2017)	POPE	Elementary school	40s	15	Playground	Initiations, responses, and engagement
Shih et al. (2019)	POPE	Elementary school	40s	15	Playground	Solitary and joint engagement
Sreckovic et al. (2017)	Live observation	High school	15s	15	Lunch	Initiations and responses
Vivanti et al. (2019)	M-Cosmic LENA	Preschool	N/A	10	Classroom	Initiations, responses, engagement, and spontaneous vocalization

MOOSES: Multi-Option Observation System for Experimental Studies; LENA: Language Environment Analysis; POPE: Playground Observation of Peer Engagement; TOPI: Teen Observation of Peer Interaction.

Generalization and maintenance

Twelve studies measured maintenance, the extent to which participants exhibited target behaviors after the withdrawal of the intervention condition. Targeted behaviors were measured in the natural setting 4–8 weeks following the completion of the intervention (Carter et al., 2016; Dean et al., 2020; Harper et al., 2007; Jung et al., 2008; Kalyva & Avramidis, 2005; Kasari et al., 2012, 2015; Kretzman et al., 2015; Locke, Shih, et al., 2019; Radley et al., 2017; Shih et al., 2019). Sreckovic et al. (2017) faded the intervention, reducing meetings from 2 to 3 times per week to once a week for 3 weeks, in preparation for maintenance. Once the intervention was completely faded, participants were observed once a week for an additional 3 weeks.

Four studies examined generalization (Dueñas et al., 2019; Jung et al., 2008; Kamps et al., 2014; Sreckovic et al., 2017), referring to the extent to which participants exhibited target behaviors in a setting or situation in which training has not been provided. Kamps et al. (2014) conducted generalization probes across four time points—participants with ASD and their peers were observed during naturally occurring social periods at school. Dueñas et al. (2019) used generalization probes after every third or fourth intervention session, in which participants were paired with a TD peer or peers who were not part of their intervention. Sreckovic et al. (2017) conducted generalization probes in the natural lunchtime environment (cafeteria or outside) to measure the extent to which social skills transferred from the intervention setting to the natural setting. Across all four studies, results indicated an increase in initiations and responses were maintained throughout the generalization and maintenance phases.

Discussion

This review sought to examine school-based social skills interventions designed to support students with ASD who are educated in inclusive settings. Eighteen studies met the eligibility criteria for review. Social skills interventions were implemented in preschools, elementary schools, secondary schools, and across various inclusive social environments at school. Intervention protocols were largely rooted in EBPs but varied in terms of type, dose, and duration. Some interventions also included training protocols for TD peers and school personnel. The extent to which peers and school personnel were trained also varied across studies. Observation protocols and social outcomes were quite similar across studies, and post-intervention change was reported across a wide age range. Thus, the findings provide a prospective roadmap for school practitioners to consider when designing interventions and when measuring change in social behavior at school.

The social environment at school can be difficult for students with ASD to navigate, yet qualitative aspects of the challenges may vary across individuals and settings (Dean,

2017; Newcomb et al., 1993). The variety and efficacy of EBPs reported in this review reinforce the notion that social skills interventions are not one-size-fits-all. There are multiple empirically supported intervention strategies available to support the social development of individuals with ASD at school. Some intervention protocols used a single EBP, while other studies used multiple EBPs within comprehensive manualized packages. The varying dose, intensity, and length of interventions highlight the menu of options available to support the social development of students with ASD in inclusive settings.

A majority of the studies in this review used research staff as primary intervention agents, and school practitioners received limited or no training. Although researcher-led interventions are often a necessary first step, incorporating staff training into intervention protocols is important for sustainability. Interventions without staff training protocols can be problematic. Research has shown that school personnel may have difficulties selecting and implementing EBPs with fidelity (Cook et al., 2008; Slavin, 2002; Suhrheinrich et al., 2007). Eight studies made an effort to bridge the research-to-practice gap by including school personnel training as an active ingredient in the intervention (Brock et al., 2018; Carter et al., 2016; Kamps et al., 2014; Kretzman et al., 2015; Locke, Rotheram-Fuller, et al., 2019; Locke, Shih, et al., 2019; Shih et al., 2019; Vivanti et al., 2019). Training models included at least one didactic informational session, which is consistent with traditional models of professional development conducted in schools (Joyce & Showers, 2002). More recently conducted studies also incorporated ongoing in vivo coaching and consultation sessions, as well as evaluation sessions using fidelity checklists; these strategies have been shown to increase the likelihood that interventions will be successfully implemented within authentic settings (Fixsen et al., 2005). Breaking away from traditional models of professional development, coaching and consultation models are more effective for school personnel. They provide clinical support within the authentic clinical setting and are considered best practices for adult learning (Jarvis et al., 2017; Joyce & Showers, 2002). Some staff training sessions included information and discussions related to selecting TD peer selection and peer training procedures (Brock et al., 2018; Carter et al., 2016; Kretzman et al., 2015; Shih et al., 2019), and four studies further reinforced peer training and inclusion using coaching techniques focused on identifying peers to facilitate engagement within the authentic social setting at school (Kamps et al., 2014; Kretzman et al., 2015; Locke, Shih, et al., 2019; Shih et al., 2019). As researchers work to test the efficacy of social interventions in school settings, there is a need for more research to examine staff training and other strategic dissemination procedures (Fixsen et al., 2005) and to further explore the relationship between staff training protocols and the social outcomes of students with ASD at school (Joyce & Showers, 2002).

Peer participation in the interventions, as well as generalization and maintenance conditions, helped to provide supported opportunities for students with ASD to socialize within the normative social culture in preschool, elementary school, and middle and high school. The extent to which peers participated in the interventions varied. Peers were (a) trained at the same time as the targeted student with ASD, (b) trained in vivo within the authentic social environment, but separate from the student with ASD, or (c) trained in private sessions without the students with ASD (Carter et al., 2016; Dean et al., 2020; Harper et al., 2007; Hu et al., 2018; Kalyva & Avramidis, 2005). Given the variability in the way that peers have been included to support social interventions, more research is needed to evaluate peer training protocols, and to examine the extent to which peer training and participation optimizes social outcomes for students with ASD. When considering the practical application of peer training models, one peer training model should not negate the other. Consistent with best practices in adult learning (Joyce & Showers, 2002), initial didactic instruction can be reinforced with ongoing in vivo coaching. Research is needed to examine the processes school personnel use to recruit peer mentors and to explore the feasibility of school personnel implementing social interventions for students with ASD within inclusive settings.

A secondary aim of this review was to examine the observation protocols used to measure change in observable social outcomes. These protocols were able to capture quantifiable post-intervention differences. Interestingly, salient social outcomes were relevant and identifiable across a wide age range—post-intervention improvement in engagement, initiations, and responses was detected in preschool, elementary, and secondary settings. Thus, these observation protocols may be useful to provide a consistent measurement of social outcomes (e.g. engagement and initiations) throughout the developmental stages. For example, salient social skills in early childhood settings include proximity to peers and the development of recursive interactions and reciprocal exchanges (Howes, 1996), three observable social behaviors that can be recorded using measures of engagement, and initiations and responses. In middle childhood through to adolescence, targeted social skills may focus on identifying shared interests, and extending and elaborating on shared conversations and activities (Bauminger-Zviely & Kimhi, 2017). These social behaviors can also be recorded using measures of engagement, initiation, and responses. Because engagement, initiations, and responses can be observed and measured across developmental stages, these outcomes may provide a useful starting point to track the social development of skills over the course of many academic years. Thus, the observation protocols and social outcomes described in this study may serve as a guidepost for school practitioners to use to measure social outcomes of students with ASD within inclusive school settings.

Naturalistic observation instruments can be especially useful for school practitioners. They can supplement the data that teachers are already collecting to monitor progress toward Individualized Education Plan (IEP) goals. The observation instruments described in this review included low-tech and high-tech options. The simplicity and relatively low cost of low-tech measurement tools may be more acceptable for schools to adopt; however, ongoing training may need to be provided to ensure that social behaviors are consistently and reliably measured. High-tech observation instruments can potentially make data collection more reliable and efficient. However, the cost and technical support necessary to maintain these systems may be barriers for schools. Observation instruments were not necessarily generalizable to all settings. The POPE, for example, is a low-tech free resource that can easily be used in school settings. This instrument, however, is designed for use during unstructured free periods and may not be appropriate for use during academic activities in the classroom. Video recordings of social activities were useful for recording social behaviors within the classroom, and smart devices make video recording relatively easy. Time may be one barrier to this method, as practitioners would need to review and code the video to effectively measure changes in social behaviors. Some observation instruments had the capacity to record the social behaviors of students with ASD as well as TD peers. Peer observations have the potential to improve social validity by providing deeper contextual information about the social environment, which may vary from school to school (Dean et al., 2017) and across the stages of social development. More studies are needed to examine teachers' current assessment practices, as well as the extent to which observation protocols used in research studies could also be used in applied settings to inform the teachers' current practices.

Conclusion

The findings from the review suggest that school-based social interventions have been effective in improving social outcomes for students with ASD in inclusive settings across a broad developmental span. Building on previous research, which identified commonly used active ingredients of school-based social interventions for students with ASD (Chang & Locke, 2016), the current review examined intervention components and observation instruments used to measure observable social outcomes in authentic settings. Observation protocols described in this review were useful to record the actual behavior of students with ASD across a wide age range within authentic social environments at school. Future studies are needed to explore the extent to which school personnel is able to use systematic observation protocols

to measure the extent to which the social behaviors of students with ASD respond to social interventions. A variety of EBPs were used to support the social development of students with ASD in inclusive settings, with grade levels spanning from preschool to secondary school. The inclusion of TD peers within the intervention setting helped to support improvement in engagement, initiations, and responses. The findings from this review suggest that school-based social interventions should also include school personnel training and peer training protocols. The identification of active ingredients used in social intervention and primary social outcomes provides a roadmap to guide school practitioners as they move to incorporate evidence-based social interventions into their practice.

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ORCID iDs

Michelle Dean https://orcid.org/0000-0002-6915-2710
Ya-Chih Chang https://orcid.org/0000-0003-3411-1123

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