Literacy Learning Among Students with Complex Support Needs in Postsecondary Education Programs: A Scoping Literature Review

Abstract

Literacy skills are valuable for an individual's quality of life and participation in society. However, many individuals with complex support needs (CSN) do not experience opportunities for skill development in literacy. The recent expansion of postsecondary education opportunities for individuals with CSN offers them an opportunity to expand literacy skills development through participation in coursework, internships, employment, and recreational or social activities on college and university campuses. Very few studies have examined literacy skills within postsecondary settings for students with CSN. The purpose of this scoping review was to explore existing research to understand how students with CSN experience literacy learning opportunities in postsecondary education. The results of our analysis reveal a need for future research to include as participants individuals who are reading at pre-first grade levels and to investigate opportunities to acquire or develop literacy skills for these students within inclusive university classes with other students who do not have disabilities. Implications for future research and practice are presented.

Keywords: literacy, reading, intellectual disability, complex support needs, postsecondary education

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Acquiring literacy skills is associated with having a personally satisfying life and participating more fully within society (UNESCO, 2004). Literacy encompasses "the ability to identify, understand, interpret, create, communicate and compute, using printed and written materials associated with varying contexts" (p. 13, UNESCO, 2004). Literacy forms the foundation for learning other academic skills, opens opportunities for full participation in social situations (e.g., corresponding with friends and family; Forts & Luckasson, 2011), employment (Vaccarino et al., 2006), civic activities (Lundberg & Reichenberg, 2013), and is associated with improved health outcomes (Sentell & Halpin, 2006). Notwithstanding the link between improved literacy skills and life satisfaction, many adults across the world have not experienced effective literacy instruction. The 2003 National Assessment of Adult Literacy (NAAL), for example, reported that an estimated 56 million adults in the U.S. have only basic or below basic literacy abilities (Lesgold & Welch-Ross, 2012). A subgroup of adults with low literacy skills are individuals with complex support needs (CSN) who have intensive needs for supports related to physical, cognitive, behavioral, and communication challenges and who have diagnoses such as intellectual disability (ID), autism spectrum disorder (ASD), or multiple disabilities (MD). This group may be at special risk for low literacy levels due to a number of factors including not receiving systematic, individualized literacy instruction while in PK-12 schools (Erickson et al., 1994; Schalock et al., 2010).

There is limited research examining outcomes for adults who are considered to have low literacy levels (Lesgold & Welch-Ross, 2012), and researchers do not typically include

participants who have CSN in these adult literacy studies. Furthermore, data on literacy levels of adults with CSN are not collected in national surveys such as the National Assessment of Adult Literacy (Kutner et al., 2007). Consequently, relatively little is known about how or if these individuals have access to any type of continuing literacy instruction as adults or the characteristics of literacy instruction that best meet their learning needs.

The lack of inclusion of adults with CSN in adult literacy research creates barriers to a deeper understanding of the role of literacy in their lives or creating literacy learning programs to develop their skills. One possible option for continuing literacy skill development for adults with CSN who may have not have had sustained, appropriate literacy instruction in PK-12 settings is through postsecondary education programs. Postsecondary education in general is associated with successful adult life outcomes (College and Career Readiness and Success Center; 2013; Ma et al., 2016) including better health, less reliance on government assistance programs, higher rates of civic engagement, and increased likelihood of employment and earning higher wages than individuals without postsecondary education (Ma et al., 2016).

Until recently, far fewer adults with CSN had the opportunity to experience postsecondary education as compared to adults with other disabilities or adults without identified disabilities. This began to change with reauthorization of the Higher Education Opportunity Act (2008) that created new opportunities for individuals with ID to attend institutions of higher education (IHE) programs by providing ways to secure financial support and establishing guidelines for these programs. Programs funded through this legislation are considered as comprehensive transition programs offered by IHEs. These PSE programs serve individuals with ID, autism, and other complex support needs and place a strong emphasis on academic and social integration with peers without disabilities (Grigal et al., 2019). Students must spend at least half

of their time in the programs designated as comprehensive transition programs taking credit or non-credit coursework or internships with peers without disabilities (Grigal et al., 2019). These characteristics distinguish these PSE programs from other adult training programs that are solely focused on work-based training with little or no emphasis on academic skills development. There has been a substantial increase in the numbers of youth with CSN enrolling in such programs since passage of this Act as well as an expanded emphasis on supporting students with CSN to attend inclusive classes on higher education campuses with natural supports (e.g., peer support). Over 27% of young adults with intellectual and/or developmental disabilities (IDD) have enrolled in college, and there are now 295 IHE programs tailored to the needs of this population (Sanford et al., 2011; Think College, n.d.). Research examining outcomes of PSE graduates has documented positive benefits, including higher rates of employment of PSE graduates as compared to individuals with CSN who have not attended postsecondary programs (e.g., Moore & Schelling, 2015).

Goals and structures for postsecondary programs for adults with CSN vary across universities and colleges in the types of courses students take and modes of academic, social, and vocational supports offered; their length; and the primary focus or area of emphasis of each program. Some, for example, are organized so that students take a substantial number of typical college courses (with varied levels of support); in contrast, others are organized so that students take more specialized courses and fewer inclusive courses (Grigal et al., 2019). Program length varies from four-year, residential programs to those housed in two-year community colleges. Although some programs include specialized supports for students with CSN (e.g., one-to-one tutoring by program staff, peer mentors), others primarily utilize existing supports available for all college students (e.g., campus writing labs, existing disability service centers). Another point

of difference in these postsecondary programs is the extent of emphasis on employment. Although all have employment skill development components, some programs have a broader focus that also includes academic and social goals.

All postsecondary programs for students with CSN, regardless of their overarching mission, provide students with some level of academic instruction or academic support. Think College, a national organization dedicated to developing, expanding, and improving inclusive higher education options for people with intellectual disability, highlights provision of academic access for students with ID to college courses taken by students without disabilities as a quality indicator of PSE programs (Think College, n.d). Increased literacy skills could potentially expand that access (e.g., increase participation), leading to additional positive outcomes for students. Postsecondary education would seem, then, to be a potentially promising setting for students with CSN to continue to build their literacy knowledge and skills while working on assignments for courses.

In addition to the literacy learning opportunities in coursework, students with CSN who are enrolled in PSE programs may experience opportunities to learn and practice literacy skills that are associated with being a college student (e.g., scheduling using technology; using a learning management system; using text, email, or social media to communicate with peers or instructors; Pennington et al., 2014). However, relatively few researchers have examined opportunities to expand literacy skills through inclusive university courses or through these associated activities such as social media and using technology. Given the lack of representation of individuals with CSN in adult literacy research in general and the small number of extant studies of literacy development in PSE for this population, further research is warranted. We began an exploration of this area by conducting a scoping review of the existing research that has

examined literacy learning for students with CSN within PSE programs. Scoping reviews synthesize what is known in an area of research and, among other things, identify gaps in knowledge that can be addressed in future studies (Colquhuan et al., 2014). The broad research question guiding our review was: How do students with CSN experience literacy learning opportunities in postsecondary education? We analyzed studies selected for inclusion in this review to describe: (a) participants' characteristics, (b) settings for instruction or intervention, (c) literacy skills targeted, (d) types of instruction or interventions, (e) types of materials used for instruction or assessment, and (f) outcomes of literacy interventions.

Method

Search Procedures

We conducted a literature search using the following electronic databases: CINAHL complete, Education Research Complete, PsychInfo, PsychArticles, Academic Search Complete. We limited the search to peer-reviewed studies using the following Boolean phrases and keywords (a) "intellectual dis*", "multiple dis*", "developmental dis*", autism, ASD, "autism spectrum disorder, "severe dis*"; (b) "postsecondary", "post-secondary", transition; and (c) "read*", literacy. The initial search revealed 614 abstracts after the duplicates were removed. The two authors screened each abstract, and abstracts were selected for a full-text review if they met the following inclusion criteria: the study took place in the United States, the study involved students in a postsecondary program (i.e., a post-high school education program on an IHE campus, designed for adults age 18 or older with intellectual disability, autism, and/or multiple disabilities); at least some of the students included were students with CSN (e.g., ID, ASD, MD), the study was published after 1990 (We selected 1990 because the Individuals with Disabilities Education Act (IDEA) of 1990 included transition planning and support as a mandated service

which increased interest in development of PSE programs (Neubert et al., 2000); and the study was an investigation of an intervention to targeted literacy skills of PSE students with CSN (e.g., word recognition, vocabulary, writing, reading comprehension, fluency, or skills associated with academic course work such as notetaking). Exclusion criteria for abstracts and articles in this review included studies examining only parent perspectives and interviews, studies that did not examine at least one literacy skill intervention, studies that did not take place in a PSE program, or studies in which participants were not attending a post-secondary education program (e.g., studies in which young adults were enrolled in an employment training program with no focus on developing academic skills).

Because the initial abstract search revealed articles from two special issues, we also reviewed abstracts from these two special issues of *Focus on Autism and Developmental Disabilities* (2010) and *Education and Training in Autism and Developmental Disabilities* (2004). Following the completion of the abstract reviews, we reviewed 55 full-text articles. Using the same inclusion and exclusion criteria listed above, we selected 14 full-text articles to be included in this review. Reasons for studies' exclusion were varied (i.e., studies did not include participants with ID, ASD, MD; they were not empirical investigations of literacy interventions or instruction; they were conducted in high schools rather than in PSE programs based on college campuses). Following our database search, we also completed an ancestral search of articles in a recently published summary of research completed by Hua et al. (2019). Through referral from colleagues in the field, we also discovered two additional articles which were added to the 14 articles selected for the review. In total, we included 16 articles in this scoping review.

Analysis Procedures

To analyze the results of this literature review, the two authors descriptively coded articles for the following categories: type of design, participants and setting, targeted literacy skill (e.g., oral reading fluency, decoding, reading comprehension, sight word recognition, vocabulary knowledge), intervention components, interventionists, instructional materials, and study results. We did not systematically evaluate the quality of studies' designs so conclusions draw from their results may be influenced by design flaws. The results of this analysis are included in Tables 1, 2, and 3. If a study included participants who did not have ID, ASD, or MD and we could exclude their performance data on the dependent variables (e.g., in single case research studies), we did so. For group design studies included in the review, however, it was not possible to disaggregate individual participant data.

Results

The sixteen studies that met inclusion criteria were published between 2012 and 2018 and appeared in nine different research journals. Notably, nine of the studies were conducted by one research group (researchers at the University of Iowa). Researchers employed a variety of research designs to investigate the literacy experiences of students with CSN enrolled in PSE programs (see Table 1). Most studies employed a single case design (n = 10) and most often a multiple baseline across participants (MBP) was chosen. Researchers in six studies used treatment comparison design (i.e., a pre-post group design with a control group).

Participant and Setting Characteristics

The reviewed studies included 129 participants with CSN in total whose ages ranged from 19 to 25. The majority were male (65%) and the most widely reported participant diagnosis was ID (57%; see Table 1 for more detail on participant characteristics). Although well below reading levels of typically developing college students, (i.e., word recognition, reading fluency

and comprehension performance), participants' reading levels across studies reporting this data were relatively high for students with CSN (e.g., first through sixth grade). Researchers provided no description of participants' literacy instructional experiences before entry into the PSE programs, nor details on how current literacy skills were tested, other than some researchers providing scores on standardized tests of reading (e.g., Reed et al., 2016).

Settings for instruction or intervention were not well described in all studies (see Table 1). Of those reporting detailed information, only Reed et al. (2016) took place in part during a typical (inclusive) college classroom. The remainder of the studies in this review took place in specialized classes (i.e., courses offered only to students with CSN; $n = 5$) or non-classroom settings such as faculty offices or conference rooms. The study implemented by Reed et al. (2016) included an intervention that was implemented outside of the inclusive college course; specifically, the interventionist met with two of the three participants in the PSE program lounge to deliver the instruction, and then the interventionist and student attended the course to take notes. The intervention for the third student also took place entirely in this separate setting (lounge; Reed et al., 2016). Almost all studies included in this review used one-to-one instruction to teach participating students targeted literacy skills, likely because of the type of research design selected (e.g., MBP).

Target Behaviors and Interventions

The sixteen studies included in this review were intervention studies in which researchers taught participants one or more literacy skills. Researchers in seven studies employed systematic instruction to teach literacy skills and in one study, to teach use of an augmented reality (AR; McMahon et al., 2016) app to teach science vocabulary. Pennington et al. (2014) used a robot combined with systematic instruction to teach texting. Nine studies employed cognitive strategy

instruction, sometimes combined with goal setting to advance self-determination. Reed et al. (2016) targeted note taking skills of the three participants using a "problem solving model of intervention" (Reed et al., 2016, p. 201) in order to be responsive to the student needs.

Intervention Targets

Researchers utilizing interventions to teach or expand participants' literacy skills targeted an assortment of skills that were primarily focused on one or more of the components of effective literacy instruction (e.g., word recognition, fluency, comprehension, vocabulary, writing; see Table 2). Some researchers focused instruction on teaching a single discrete skill (e.g., Cazzell et al., 2016; sight word recognition) although others targeted improvement of multiple skills within one intervention (e.g., Hua et al., 2018; oral reading fluency, decoding, and reading comprehension). Writing skills were the most commonly taught skill across studies (n=6). Creating and editing paragraphs was taught in five separate studies (all by the same research group), and two separate studies taught participants to text on smart phones or create and send email messages across three platforms. Reading comprehension skills were also taught in three studies. Five separate comprehension skills were taught across five different studies. These included recalling details, retelling stories, and answering either inferential or factual questions about passages read. Oral reading fluency was the focus of intervention in two studies (Hua et al., 2012; 2018), and word recognition (sight words or phonics) was the target in two separate studies (Cazzel et al., 2016; Hua et al., 2018). Researchers in two studies taught literacy-related skills typically needed to be successful in PSE settings (i.e., note taking and paraphrasing; finding information in a course syllabus and using technology to manipulate course information). Only two studies examined outcomes of an intervention designed specifically to improve vocabulary knowledge (Hua et al., 2013; McMahon et al., 2016).

Intervention Methods and Results

Fifteen studies demonstrated positive effects of the various interventions applied to teach literacy skills. The participant in Chezan et al. (2012) acquired the targeted literacy skills and generalized them beyond the teaching examples, but this study's design included only two opportunities to demonstrate an effect which does not allow for documentation of a functional relation between the intervention and changes in the dependent variable. The one study that did not document a positive effect in increasing students' literacy skills is discussed below (Hua et al., 2018).

The instructor or interventionist in the majority of studies was a member of the research team. Five studies employed a member of the PSE program staff as the instructor after providing them with training on the intervention. Undergraduate students were hired for two studies as literacy tutors and trained to deliver the intervention. None of the studies used an interventionist who was the regular instructor in a participant's typical college course, and none of the studies included a peer mentor as the interventionist (See Table 3).

Researchers in only three studies used instructional materials taken directly from participants' inclusive or specialized college courses. These materials included the syllabi from one participant's courses, sight words taken from course texts, or notetaking materials used during class lectures. McMahon et al. (2016) taught participants science vocabulary similar to the vocabulary from the courses in which the participants were enrolled, but the words taught did not come from the participants' actual course materials. Cihak et al. (2015) taught participants to email using their university email system on three different platforms, and Pennington et al. (2014) taught participants to text using a smart phone. All other researchers employed instructional materials and/or assessments they created for the purposes of their interventions.

These included short stories (often derived from children's literature), writing prompts, and comprehension questions used for assessment. Hua et al. (2018) used AIMSweb passages to assess participants' oral fluency and comprehension as measures of the dependent variables.

The seven studies that relied on systematic instructional procedures (e.g., constant time delay) documented positive outcomes (see note above about the Chezan et al. [2012] study design). These studies employed single case designs and although not all participants had positive outcomes, with the exception of the study completed by Chezan et al., there were three clear demonstrations of effect within each study. McMahon et al. (2016) utilized an augmented reality (AR) app to teach science vocabulary after first using systematic instruction to teach participants how to use the AR app. All four participants successfully learned to label and define three sets of vocabulary terms and rated this type of instruction as enjoyable and helpful in social validity ratings.

Nine studies, most from the same group of researchers (University of Iowa), examined the effects of four different types of cognitive strategy instruction on literacy skills. These strategies had previously been well-researched with students with learning disabilities (e.g., Therrien et al., 2006). The studies included the use of cognitive strategy instruction to support students with a range of developmental disabilities, most notably ID and ASD. Two of these strategies focused on improving reading comprehension (Read-Ask-Put in my own words [RAP] and Reread-Adapt-Answer and Comprehend [RAAC]), and two strategies were designed to improve components of effective writing (e.g., paragraph structure; Enter your first draft-Do a spell check-Interrogate yourself-Type in corrections [EDIT] and Analyze action words-Notice requirements-Set up an outline-Work in the details-Engineer your answer-Review your answer [ANSWER]). As described in Table 3, eight of the nine studies examining strategy instruction

reported positive changes in participants' reading or paragraph writing skills after intervention. The study that did not document a functional relationship between the strategy instruction (combined with goal setting) and the targeted comprehension or writing skill was the only one that used non-researcher developed materials to assess the dependent variable but instead used passages from AIMSweb (Hua et al., 2018). Participants in this study also received relatively brief duration of strategy instruction (5-14 sessions). The six studies employing strategy instruction as the independent variable that utilized a treatment comparison design found significant differences in performance on reading comprehension or writing skills between the intervention and control groups.

The intensity of intervention varied widely across the reviewed studies making it difficult to analyze any effect of this variable on outcomes. Length and frequency of intervention sessions ranged from as short as 12-15 min three times per week (e.g., McMahon et al., 2016), to 60-min sessions two times per week (Hua et al., 2014; see Table 3). The total number of interventions sessions was also variable, ranging from as few as 5 sessions for some participants (e.g., Hua et al., 2018) to as many as 16 for others (e.g., Woods-Groves et al., 2015). Researchers in all but one study measured intervention fidelity, most using researcher-developed procedural checklists and all reported high levels of fidelity.

Discussion

Overall, very few studies have examined PSE settings as a place for continued literacy instruction for students with CSN. We were able to locate only 16 studies meeting selection criteria for this scoping review. In 15 of these studies, the intervention implementation resulted in an increase in student skills in literacy. However, the research included in this review mostly targeted literacy skills in isolation, using content and materials that were not derived from

inclusive PSE courses, and researchers often implemented interventions that were separated from the typically occurring courses. Consideration of the gaps in the existing research is necessary given the potential for inclusive PSE programs to provide literacy learning opportunities that are meaningful and age-appropriate for individuals with CSN who may not have receive sustained, evidence-based literacy instruction during their PK-12 schooling. Having the opportunity to acquire and hone their literacy skills within PSE settings may contribute to improved positive outcomes across an array of life domains, and has the potential to support increased inclusion in their community if they are able to use literacy skills to communicate and connect with others (e.g., texting, email, social media), manage daily living demands, and be successful in employment.

Although most participants experienced an increase in literacy skills as a result of the interventions implemented, it is important to note that the majority of the participants in the included studies were able to read between the first and sixth grade reading level and therefore may not represent many individuals with CSN (e.g., individuals with ID) who may be emergent readers (e.g., Di Blasi et al., 2019; Ratz & Lenhard, 2013). Additionally, individuals who participated in the included studies did not use Augmentative and Alterative Communication (AAC) systems and so likely do not represent all students with complex communication needs who attend PSE programs.

Importantly, almost all studies in this review took place in specialized, non-inclusive settings or classes that participants were taking with other students who had disabilities. Only one study took place in part in the inclusive college course, but the instruction for the intervention took place in a separate location (PSE program lounge; Reed et al., 2016). The most recently published report from Think College on the progress of funded projects stated that 56%

of class time was spent in inclusive courses (Grigal et al., 2019); however, almost all of the studies examined in this review did not take place in inclusive courses. This represents a significant gap in the existing literature on literacy learning opportunities in inclusive university courses that students with CSN may be taking with their peers who do not have disabilities.

Most of the intervention and assessment materials used in the studies were created by the researchers, representing an additional gap in the current understanding of how students experience literacy learning opportunities through course materials in inclusive university courses. In studies that used materials linked to a course, the focus and materials were still limited; for example, researchers used syllabi from the course in one study (Chezan et al., 2012) and sight words taken from the course textbook in a different study (Cazzell et al., 2016). This represents a gap in the understanding of how students can be supported to access textbooks, reading materials, lectures, or group assignments in inclusive courses.

The interventionists in the studies in this review represent an additional gap in the existing research given that the interventionists were often researchers or graduate students in special education. Eighty six percent of funded PSE programs use peer mentors to support students enrolled in the program (Grigal et al., 2019), so this finding represents a substantial gap in the understanding of how peer mentors may support continued development in literacy skills.

The results of this review are particularly important to consider given the recent findings from Transition and Postsecondary Programs for Students with Intellectual Disabilities (TPSID) researchers that attending inclusive university courses is related to more positive employment outcomes (Grigal et al., 2019). It is possible that developing literacy skills that enhance participation in inclusive university courses may increase the likelihood that students will be included in those classes and experience the short and long-term benefits of doing so. Given the

importance of literacy skills across the lifespan as well as the potential for PSE settings to provide a natural opportunity for continued literacy instruction and learning opportunities, these results suggest necessary directions for future research and practice.

Limitations

Although we used a systematic process for searching the literature, it is possible that relevant articles were not selected due to errors in the library database search process. Given the purpose of this scoping review, we did not systematically evaluate the quality of studies' designs and procedures so conclusions drawn from their results may be influenced by design flaws. A careful examination of the quality of the studies could identify areas for improved research.

Implications

Overall, there is a need for future research to investigate naturally occurring literacy learning opportunities for students with CSN in PSE programs. In many inclusive PSE programs, students attend university courses with peers who do not have disabilities, they are supported to participate in and complete in-class activities or assignments outside of class, and they are supported to participate in internships and recreational activities on and off of the PSE campus. Given the rich opportunity these experiences pose for learning content relevant to future employment and perhaps incidentally practicing literacy skills, (e.g., reading content related to their interests, finding transportation or job-related information online, using the course learning management system, communicating with instructors via email, communicating with peers via texting or social media), future research should investigate how students are supported to participate in literacy learning opportunities in these PSE programs. For example, future research should investigate the impact of embedded instruction as an intervention for supporting an individual with CSN to learn content in an inclusive university course. Embedded instruction

(McDonnell et al., 2002) is an evidence-based practice for students in K-12 general education classrooms (Jimenez & Kamei, 2015); however, its potential for supporting students with CSN in inclusive PSE courses has not been investigated. Given the frequency of peer supports for students with CSN in inclusive PSE courses (e.g., 100% of TPSID-funded projects incorporated peer supports; Grigal et al., 2019), a necessary direction for future research is to investigate the impact of embedded instruction with peer mentors as the interventionists. The existing research examined in this review does not provide any insight into how interventions can be designed and implemented in inclusive PSE courses as a support for the student with CSN.

Future research must also investigate the effectiveness of accommodations and modifications that may be provided in inclusive PSE programs to support students with CSN to access the content in inclusive PSE courses. The findings of this review revealed a dominant focus on researcher-created materials, which leaves a significant gap in the research regarding the design and implementation of accommodations and modifications to support access to the content in inclusive PSE courses. The implementation of accommodations and modifications in inclusive classrooms has been investigated in research in K-12 settings and is associated with positive outcomes (Lee et al., 2010); however, the impact of such supports for literacy in inclusive PSE programs has not been investigated at all. Given that students with CSN may be accessing such supports in order to participate in these courses, this is a critical direction for future research.

As inclusive PSE programs continue to develop and expand, it will be important for program personnel to consider the naturally occurring opportunities for learning literacy skills through not only coursework, but also internships, recreation, and social activities. Beyond this willingness to think about the participation of students with CSN in these contexts in an inclusive

way, it is important to consider the different types of literacy skills an individual with CSN might practice during a course or during internships or recreation and social activities. For example, using text-to-speech features on mobile devices or laptops provide an opportunity for the student to practice listening comprehension. Using speech-to-text features on mobile devices or laptops offer an opportunity for the student to practice reading fluency or decoding strategies as the students read what the device typed. Additionally, participation in inclusive PSE courses offers a tremendous opportunity to access new vocabulary, for which technology is available to support the understanding and integration of that vocabulary into the student's assignments.

Opportunities for gaining literacy skills associated with activities and tasks that are meaningful and naturally occurring in inclusive PSE programs include the use of social media; sending emails to instructors, peers, or employment supervisors; finding information online; or texting. All college and university students use technology to not only engage in coursework but also to connect with each other, and many of these technology-based skills involve literacy either through written expression or listening or reading comprehension. These are meaningful ways for individuals with CSN to acquire and practice literacy skills, but most importantly, these literacy skills support engagement in activities that will promote connections with others (e.g., email, texting, social media) and greater levels of inclusion and belonging in their community. The research identified in this review was implemented in separate settings and did not support the individuals with CSN to connect with others for coursework, social, or employment reasons (Cihak et al., 2015; Pennington et al., 2014). Therefore, there is a critical need to examine the naturally occurring literacy learning opportunities that would be supported by technology.

Conclusion

The findings of this scoping review revealed a relatively small set of existing research that has investigated interventions targeting literacy skills for students with CSN enrolled in PSE programs. Although this research documented increases in student skills, there is a need for future research to use appropriate and rigorous research methodologies, and to investigate interventions that focus on literacy skills in naturally occurring courses that students with CSN are taking with their peers who do not have disabilities. Future research should also investigate the integration of naturally occurring materials, accommodations, modifications, and interventionists that are already involved in the course (e.g., peer mentors, course instructors). Given the need for students with CSN to gain literacy skills that will support positive outcomes and increased involvement and inclusion in their community, future research should investigate ways to embed literacy learning opportunities in inclusive PSE programs.

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Table 1

Study Characteristics: Design, Setting, Participants

Study	Design	Setting	Participants
Cazzell et al. (2016)	MBP Assessed maintenance and generalization	Room adjacent to PSE classroom	1 female, 2 male w/ID; ages 20-25; IQs = 53-65 Reading grade levels = 2.0-3.0
Chezan et al. (2012)	MBP Assessed generalization	Researcher office	1 male w/ PDD-NOS; age 25; IQ = "high 60s" Reading grade level = 2.7
Cihak et al. (2015)	MPBx (devices) Assessed generalization and maintenance	University computer lab	1 female, 3 male w/ID; ages 21-22; IQ = 51-70; Reading grade levels = minimum 4.0
Hua et al. (2018)	MBP Randomized assignment Assessed generalization	PSE program (no other information provided)	4 male/1 female w/ID; ages 19-22; IQs = 53-79 Reading grade levels = 1.0-6.0
Hua et al. (2014)	Treatment and comparison Assessed maintenance and generalization	PSE special class	5 female/5 male w/ ID; ages 20-23; IQs 67-78 Reading grade level = 6.0
Hua et al. (2013)	AT	PSE conference room	1 female/2 male w/ ID; 1 male with LD; ages 19-21 IQs = 58-77 Reading grade level = 6.0
Hua, Hendrickson et al. (2012)	MBP Assessed generalization	PSE offices	3 male w/ASD; age = 21; IQs = 64-69 Reading grade levels = 6.0
Hua, Therrien et al. (2012)	MBP	PSE offices	1 female w/ LD; 3 male w/ ID; ages = 19-21; IQs = 65-92 Reading grade levels = 1.0-6.0
McMahon et al. (2016)	MPBx	University computer lab	1 male w/ASD; 3 female w/ID; ages = 19-25; IQs 48-85 Reading grade levels = 2.0-8.0

Study	Design	Setting	Participants
Pennington et al. (2014)	MBP Assessed generalization and maintenance	PSE class	2 female/1 male w/ID; ages = 19-21; IQs = 40-63; Reading grade levels = NR
Reed et al. (2016)	MBP Assessed maintenance	Typical course classroom and PSE study lounge	1 female/2 male w/ ASD; ages = 20-23; IQs = 68-86 Reading levels (TOSCRF percentile rank) = <1 - 3
Woods-Groves et al. (2017)	Treatment and comparison Assessed maintenance	PSE class	N = 15; tx = 7, comparison = 8; 1 ASD, 3 PDD, 7 ID, 4 MD; 6 female/9 male; ages = 18-23; IQs = NR Reading grade level = minimum was 3.0
Woods-Groves et al. (2015)	Treatment and comparison Assessed maintenance	NR	N = 19; tx = 11, comparison = 8; 1 w/ NVLD, 2 w/ Asperger's, 6 w/ ASD, 9 w/ID, 1 w/ OHI/CP; 5 female/ 14 male; ages = 20-23; IQs = NR Reading grade level = minimum was 3.0
Woods-Groves et al. (2014)	Treatment and comparison Assessed maintenance	PSE class	N = 19; tx = 10, comparison = 9; 2 w/ Asperger's; 2 with NVLD, 6 w/ASD, 9 w/ID; 5 female/14 male; ages = 19-22; IQs = 46-107 Reading levels (WJII Broad Reading scores) = 58-92
Woods-Groves, Hughes et al. (2012)	Treatment and comparison	PSE class	N = 16; tx = 8, comparison = 8; 5 w/ ASD; 1 w/ NVLD; 6 w/ ID; 1 w/ TBI; 2 w/ severe LD; 1 w/ Asperger's; 5 female/11 male; ages 19-23; IQs = 61-98 Reading levels = NR
Woods-Groves, Therrien et al. (2012)	Treatment and comparison	PSE class	N = 16; tx = 8, comparison = 8; 2 w/ASD; 2 w/Asperger's; 1 w/NVLD; 3 w/severe LD; 7 w/ID; 1 w/TBI; 8 female/8 male; ages = 17-24; IQs = 54-107 Reading levels (WJII Broad Reading scores) = 62-99

Note. ASD = autism spectrum disorder; AT = alternating treatments; CP = cerebral palsy; ID = intellectual disability; IQ = intelligence quotient score; LD = learning disability; MBP = multiple baseline across participants; MD = multiple disabilities; MPBx = multiple probe across behaviors; NR = not reported; PDD = pervasive developmental disorder; NVLD = non-verbal learning disorder; OHI =

other health impaired; PDD-NOS = pervasive developmental disorder - not otherwise specified; TOSCRF = *Test of Silent Contextual Reading Fluency;* tx = treatment.

Table 2

Literacy Skills Taught

Study	Word Reading			Vocabulary	Reading Comprehension				
	Fluency	Sight words	Decoding		Retelling	Main idea	Recalling details	Answering factual questions	Answering inferential questions
Cazzel et al. (2016)		X							
Hua et al. (2018)	X		X		X				
Hua et al. (2014						X	X		
Hua et al. (2013)				X					
Hua, Hendrickson et al. (2012)	X						X	X	
Hua, Therrien et al. (2012)									
McMahon et al. (2016)				X					

	Writing			Other Literacy Skills		
	Paragraph writing	Edit/ Proofread	Text/ Email	Locate Information	Notetaking	Paraphrasing
Cihak et al. (2015)			X			
Chezan et al. (2012)				X		
Pennington et al. (2014)			X			
Reed et al. (2016)					X	X
Woods-Groves et al. (2017)		X				
Woods-Groves et al. (2015)		X				
Woods-Groves et al. (2014)	X					
Woods-Groves, Hughes et al. (2012)	X					

Woods-Groves, Therrien et al. (2012)	X	

Table 3

Study Characteristics: Intervention Components and Outcomes

Study	**Intervention Components**	**Interventionists**	**Instructional materials**	**Intensity/ duration**	**Fidelity**	**Outcomes**
Cazzell et al. (2016)	Computer Flashcard Instruction	Researchers	Sight words taken from course text (intervention)	One-hour sessions 3 days per week; 20% of sessions canceled for absenteeism or schedule conflicts	Researcher-developed protocol; assessed across all sessions in all conditions Mean = 100%	All participants acquired and maintained novel sight words but number varied across participants.
Chezan et al. (2012)	General case programming	Researchers	3 syllabi from participant's courses and 12 from other courses; Blackboard; college email system	30 min sessions 5 days per week	Not assessed	Participant acquired and generalized the skills but b/c of the design, could not establish a functional relationship between IV and DV
Cihak et al. (2015)	Visual task analysis; constant time delay with system of least prompts	Program instructor (doctoral student in special education)	Three digital platforms: Windows, Macbook Pro; Apple iPad 2; university emailing system	3 days per week	Researcher-developed protocol; assessed across a minimum of 50% of all sessions Means = 95%, 88%, 95%, 90% across all four participants	All four participants learned the emailing skills and maintained all skills across all three platforms across 9 weeks.

Study	Intervention Components	Interventionists	Instructional materials	Intensity/ duration	Fidelity	Outcomes
Hua et al. (2018)	Cognitive strategy instruction (RAAC) Goal setting	Two graduate students with five years of experience in special education	Researcher-developed instructional reading passages and comprehension questions at Grades 1 & 6 level AIMSweb passages to measure dependent variables	Number of sessions per participant: 5, 9, and 14; Length of sessions /number per week not reported	Researcher-developed checklist; script Assessed in 29% of baseline and 21% of intervention sessions Mean = 95% (range = 90%-100%) across all session	No functional relation found between intervention and dependent measures.
Hua et al. (2014)	Cognitive strategy instruction (RAP)	Researchers and program staff member	Researcher developed expository passages at 6th grade level	60 min lessons 2 days per week for a total of 12 lessons	Researcher-developed protocol; assessed across all sessions in all conditions Mean = 100%	Students in the experimental group improved their number of main ideas and details recalled.
Hua et al. (2013)	Constant time delay	Researchers and program staff member	Researcher-developed passages written at 5th-8th grade level	1:1 15 min sessions 2 days per week.	Researcher - developed procedural checklist; measured 25% of sessions in each condition Mean = 100%	Students increased vocabulary knowledge in the experimental condition but no functional relation established between vocabulary acquisition and passage comprehension
Hua, Hendrick-son et al. (2012)	Cognitive strategy instruction (RAAC)	Undergraduate tutors	Researcher-developed passages written at 3rd and 6th	1:1 15 min sessions, 3 days per week	Researcher - developed procedural checklist;	Increased CWM, correct responses to inferential and factual comprehension questions (some variable data).

Study	Intervention Components	Interventionists	Instructional materials	Intensity/ duration	Fidelity	Outcomes
			grade level for instruction		measured 25% of sessions in each condition Mean = 100%	
Hua, Therrien et al. (2012)	Cognitive strategy instruction (RAAC)	Undergraduate tutors	Researcher-developed passages written at 1st, 2nd, and 6th grade levels	1:1 15 min sessions, 3 days per week	Researcher - developed procedural checklist (% of sessions assessed not provided) Mean = 100%	Increased oral reading fluency and decreased word recognition errors. Number of correct responses to comprehension questions improved but did not document a functional relation across all participants.
McMahon et al. (2016)	Augmented reality mobile app (Aurasma) (used Model-Lead-Test with least-to-most prompting to teach app use)	Researchers	Science vocabulary words related to but not taken directly from students' textbooks or courses	1:1; one 12-15 min session per day, 3 days per week	Researcher developed procedural checklist; assessed in 60% of each condition for each participant. M = 96% (range = 92%-100%)	Acquisition of science vocabulary; positive social validity findings
Pennington et al. (2014)	AI (robot) instruction with prompting and self-graphing	Researchers	Texting using an iPhone 4	1:1 session, 5 days per week	Researcher-developed protocol; assessed in 83% of sessions across all participants and conditions Mean = 100$ across all three participants	All participants acquired the skill and generalized it to a novel communication partner; two participants maintained the skill across two weeks but not across 4 weeks.
Reed et al. (2016)	Direct instruction (rationale,	Program student mentor (master's student)	Used split-page notetaking format during	1:1 sessions, approximat	Researcher-developed procedural	Increased skills in distinguishing between subtopics and details, paraphrasing, and using

Study	Intervention Components	Interventionists	Instructional materials	Intensity/ duration	Fidelity	Outcomes
	model, guided practice, feedback)		class lectures in face-to-face or online sessions	ely 15 min in length	checklist Mean = 95% (range = 94%-96%)	abbreviations and symbols; performance varied
Woods-Groves et al. (2017)	Cognitive strategy instruction (EDIT)	Program instructor	Researcher-developed writing prompts and materials (3rd grade reading level)	11 sessions 2 days per week, across 5.5 weeks	Researcher-developed procedural checklist; assessed on each lesson Mean = 100%	Significant positive difference for the EDIT strategy instruction group compared to the control group. Decreased number and type of editing errors
Woods-Groves et al. (2015)	Cognitive strategy instruction (EDIT)	Doctoral student in special education	Researcher-developed writing prompts and materials (3rd grade reading level)	16, 50 min group sessions, 2 days per week	Researcher-developed procedural checklist; assessed on each lesson Mean = 100%	Treatment group scored significantly higher on mastery prompts than students in the control group (effect size was large). Overall appearance and punctuation were significantly different in favor of the treatment group but other aspects (e.g., substance) were not significantly different. A maintenance probe at 11 weeks found the superior performance of the treatment group remained intact.
Woods-Groves et al. (2014)	Cognitive strategy instruction (ANSWER)	Doctoral student in special education	Researcher-developed writing prompts and materials	10, 45 min group sessions, 2 days per week	Researcher-developed procedural checklist assessed on each lesson Mean = 100%	Treatment group required explicit instruction to make gains over pretest writing; treatment group did not maintain those gains across 2 and 13 weeks respectively
Woods-Groves, Hughes et al. (2012)	Cognitive strategy instruction (ANSWER)	Former special education teacher	Researcher-developed writing prompts and materials	6, 30 min sessions, 3 days per week	Researcher-developed procedural checklist assessed	Significant positive difference between treatment and control group post rubric scores on

Study	Intervention Components	Interventionists	Instructional materials	Intensity/ duration	Fidelity	Outcomes
				across two weeks	in on each lesson Mean = 99%, range = 97-100%	implementation of strategy steps and but not on essay construction.
Woods-Groves, Therrien et al. (2012)	Cognitive strategy instruction + individualiz-ed goal setting (ANSWER)	Former special education teacher	Researcher-developed writing prompts and materials	6, 50 min group sessions, 2 days per week across three weeks	Researcher-developed procedural checklist assessed in on each lesson Mean = 99%, range = 97-100%	Significant positive difference between treatment and control group post rubric scores on both implementation of strategy steps and essay construction.

Note: ANSWER = Analyze-Notice-Set up-Work-Engineer-Review; AT – alternating treatments; CWM = correct words per minute; DV = dependent variable; EDIT = Enter-Do-Interrogate-Type; IV = independent variable; MBP = multiple baseline across participants; PSE = Postsecondary education; ; RAAC = Reread-Adapt-Answer-Comprehend; RAP = Read-Ask-Put.