Research to Practice: K-12 Scholarship Journal

VIRGINIA FEDERATION OF THE COUNCIL FOR EXCEPTIONAL CHILDREN

Summer 2017, Volume 5

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Our Purpose

The Virginia Federation of the Council for Exceptional Children (VA CEC) *Research to Practice: K-12 Scholarship Journal* is a peer-reviewed journal that publishes research-to-practice articles which incorporate the application of research and how that research applies to best practice in support of the K-12 population.

A Publication of the Virginia Federation of the Council for Exceptional Children

Editorial Board

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An increasing number of students with Autism Spectrum Disorder (ASD) are enrolling in higher education. Universities are seeking to develop programs to meet this need; however, little research is available on best practices. This review of the literature identified four key areas for supporting success in higher education for students with autism: transition, individualization, autism training for professors, and social interventions. The research indicated a deficit in

support, especially in the area of social processing issues. While insight can be gained from existing research, evidence based best practices has yet to be established to help disability service offices to create programs which will promote success in higher education for students with autism.

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Letter from the Editor

Dear Readers,

I am very pleased to present the Summer 2017 edition of the Virginia Federation of the Council for Exceptional Children (VA CEC) *Research to Practice: K-12 Scholarship Journal.*

This edition of the journal begins with a letter from our new President, Dr. Brooke Blanks. Dr. Blanks is an Associate Professor in Special Education at Radford University. Dr. Blanks has a BA in Psychology from the University of Virginia, her Masters degree is from University of North Carolina at Greensboro in Specialized Education Services-High Incidence Disabilities and her doctorate is from University of North Carolina at Greensboro in Specialized Education Services. Dr. Blanks has served on the board of the VA CEC since 2013 and in November 2016 accepted the position as President. Dr. Blanks brings a wealth of passion and experience to this role. Her many years of service in the helping professions include K-12 special education in a variety of public and private settings, clinical reading education, and social work with community based service-learning programs serving at-risk youth and their families.

Dr. Blanks' letter is followed by four articles presenting evidence-based best practices for early literacy instruction, to facilitate student discussion and explanation in the classroom, to support students with dyscalculia, and to assist students with Autism Spectrum Disorder (ASD) transition into higher education. While authors present research findings on a range of topics and for educators from PreK-12 through higher education, each were intentional to articulate implications for practice, providing a range of information, tools, and strategies to equip parents, teachers, and administrators to meet the specific needs of the families and children we serve.

I wish to thank each of the contributing authors for their significant contribution to the field and to this edition of the VA CEC *Research to Practice: K-12 Scholarship Journal*. I also want to acknowledge the editorial board for their careful reviews and insightful suggestions for improving the articles presented in this edition.

Happy reading!

Cindi Spaulding

Letter from the Virginia Federation of the Council for Exceptional Children President

Dear Colleagues, Advocates, and Friends:

Thank you for all you do on behalf of Exceptional Children, their families, and their teachers! I am honored to serve as your President for 2017-2018. I have been working with our wonderful Board to plan some exciting changes for the Virginia Federation of the Council for Exceptional Children in the near future! To this end, this will be the last volume of the journal in its current format. We want to make it more accessible and user friendly for all of our members. Thus, we will re-launch the journal in Fall/Winter 2017 as an online "hub" for all of our members. The updated format will allow us to be more inclusive of all members' voices and may feature the following sections.

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a. Traditional research: One to Two traditional research articles to share what our members in higher education are learning about effective practices.
b. Teacher's Corner: Short, teacher authored/teacher focused articles and resources that you can implement in your classrooms.
c. Policy update: Regular updates from our Child Advocacy Network representative describing the state of things related to education in Richmond and Washington.
d. Family Connections: Short narrative essays from parents describing what works for them and their children as they interact with public schools.
e. Emerging Scholars: A place for students to publish their work based on their research.
f. Book reviews: Find out what your colleagues are reading and how they are using it in their classrooms.
g. Technology corner: Learn about the latest technology tools and how to use them in your classrooms, homes, and communities.

WE NEED AUTHORS! Have good ideas? Know what works for your kids? Let us know! We have a great Editorial Board and are happy to help you share your experiences and expertise with our members!

We look forward to hearing from you! As always, please feel free to email me directly at Brooke.Blanks@gmail.com with questions, ideas, or other thoughts you may have. Stay tuned, more information will be coming to your inbox soon!

Happy Summer!

Brooke

Get REAL: An Early Literacy Strategy Framework for Educators and Parents

Alexandra Barnett, Ed.D
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Abstract

Early literacy education serves as a foundation for learning to read. Using empirically-based early literacy practices to build this foundation becomes the cornerstone of an effective early literacy curriculum. Typically developing children and those with developmental delays benefit from early literacy practices that incorporate developmentally appropriate strategies and activities. Research indicates that several factors contribute to effective early literacy education, including repetition, using explicit teaching methods, incorporating alphabet learning opportunities, and utilizing phonemic awareness activities. These components can be summed up as: Repetition, Explicit teaching, Alphabet activities, and Language sounds (R.E.A.L.). The purpose of this article is to present a review of studies depicting effective early literacy strategies and to equip general and special educators as well as parents with the R.E.A.L. acronym as a framework for planning and delivering effective early literacy instruction.

Keywords: Effective practices, early literacy, developmental delays, teaching strategies, parents, early intervention, early childhood teacher

Introduction

Early literacy skills have been established as an indicator of later academic success (Claessens, Duncan, & Engel, 2009; Duncan et al. 2007). Reading success, in turn, has been related to better life outcomes, both personally and professionally (Duncan et al. 2007; Davis et al. 1999; Christle & Yell, 2008). Given the importance of early literacy instruction, typically developing students and those with developmental delays must be taught using empirically-based strategies and activities to ensure early literacy skill acquisition (Schuele, 2004).

It can be challenging for educators and parents to apply research-based strategies consistently, as the literature on the topic is both vast and complex. The R.E.A.L. framework simplifies the application of effective practices for teachers and caregivers by providing an acronym that is easily remembered and incorporated into early literacy curriculum planning. Each of the R.E.A.L. components contributes to effective early literacy instruction for students with and without developmental delays and can be defined as follows.

Repetition

Repetition refers to multiple readings of the same text, repetition of sound stimuli, as well as early literacy activities that are frequently repeated. Holt (2011) conducted a study on the effectiveness of repeating sound stimuli for participants who are hard of hearing and determined that “sequential and alternating repetitions improve speech-sound discrimination” (p. 1444). Repeated readings have also been shown to increase vocabulary learning in preschoolers with hearing loss (Bobzien et al., 2015). Students from lower socio-economic status (SES) backgrounds also benefit from repeated readings (Korat & Blau, 2010), as do preschoolers in general (Korat, 2009; Gorp, Segers, & Verhoeven, 2014; Mcgee & Schickedanz, 2007).

In addition to sound stimuli repetition, findings on repeated readings indicate the effectiveness of such readings for developing reading fluency, including reading fluency of students with learning disabilities (Staudt, 2009). Children's natural inclination to enjoy certain stories or poems over and over contributes to the practical nature of implementing repeated readings in the early literacy curriculum (Diamant-Cohen, Prendergast, & Estrovitz, 2013). For the classroom educator, this may mean reading a classroom favorite book multiple times, while pointing to each word being read and encouraging students to read along. Big books, oversized books with large illustrations and text, are especially useful for this purpose, as they allow the entire class to participate in the reading experience. Additionally, repeated readings can serve as transition aids if read at certain times, such as before lunch or after recess, providing a sense of routine. Creating books with students can contribute to repeated readings of them. Taking photographs during a field trip or another high-interest activity to add to a class book and then working with students to write down information about the activity can also encourage repeated readings. Student-made books can be added to the classroom Reading Center to be read on a regular basis. Encouraging children to read books to their peers and their families will also increase repeated readings while allowing the child a sense of pride in his or her reading accomplishment, even if the reading consists mostly of memorization (see Table 1 for additional activity examples).

Table 1
Explicit Teaching

Direct instruction, defined as "continuous reinforcement of key concepts and skills as new material is introduced at a measured pace" (Donlevy, 2010, p. 225) is sometimes frowned upon as a developmentally inappropriate practice for younger students. However, early-literacy

R is for Repetition – Practical Strategies for incorporating repetition in daily literacy instruction
• Encourage students to fill in missing words on large charts of familiar poems or stories
• Re-read favorite stories and Poems
• Use the same vocabulary words frequently in conversations with the students
• Begin read-alouds by looking at the book's pictures, encouraging students to make predictions and to ask questions they would like the reading of the text to answer
• Read different genres of text which contain the same vocabulary
• Allow students to choose books during free reading and read-aloud times, even if they have read them previously
• Create theme-based "Reading Nooks" that contain reading materials reinforcing the same vocabulary
• During read-alouds, point to each word while reading it
• Use matching games to find identical vocabulary words

acquisition research and meta-analyses confirm the effectiveness of explicit teaching for pre-readers (Loftus-Rattan, Mitchell, & Coyne, 2016). While explicit teaching is viewed by some as scripted and lacking in creativity, the benefits to typically developing and readers with developmental delays appear to outweigh the risk of learner boredom (Swanson et al., 2011). Reynolds, Wheldall, and Madelaine (2011) evaluated federal reviews from three countries of reading acquisition of struggling readers and determined that explicit teaching of all early

literacy skills was an effective intervention method for these students. Table 2 lists explicit teaching strategies practitioners and parents can implement.

Table 2

E is for Explicit Teaching – Practical Strategies for incorporating explicit teaching in daily literacy instruction

- Create detailed lesson plans for the concepts to be taught
- Keep direct teaching sessions short and ensure you know the script well
- Use engaging body language and sound enthusiastic to engage learners during direct instruction time
- Provide a rationale for the explicit teaching activity to help students see the benefits of it
- Follow explicit teaching sessions with less formal instructional time
- Plan direct teaching times when your learners are able to concentrate and engage the best
- Create detailed lesson plans for the concepts to be taught

Alphabet Activities

Teaching the alphabet to pre-readers is an important part of any comprehensive early literacy program and works best by avoiding separation of letter-sound and letter naming activities. Rather than teaching only the sound of a letter or only the name of a letter, it is more effective to connect the two during early literacy instruction (Piasta, Purpura, Wagner, 2010). For example, reviewing a poster of letters of the alphabet and naming the accompanying illustration of objects that begin with those letters' sounds combines letter-sound and letter naming instruction. Alphabet knowledge can also be fostered through songs, games, educational toys, such as magnetic alphabet letters, and other activities as outlined in Table 3. Such activities should be implemented frequently, as alphabet knowledge is considered one of the most reliable indicators of later reading ability (Jones, Clark, & Reutzel, 2013).

Table 3

A is for Alphabet Activities – Practical Strategies for incorporating alphabet activities in daily literacy instruction

- Teach students the alphabet song
- Label small plastic tubs with a letter of the alphabet and add items that begin with that letter to that container for children to explore
- Create large cardboard cutouts of each letter and collaborate with students to glue items that begin with the same letter to the cardboard one
- Use masking tape to create large letters on your classroom floor and ask children to jump on the letter you call out
- Provide alphabet puzzles and alphabet magnets in your play area or reading/writing space
- Read alphabet books and stock the Reading Corner with them

Language Sounds

The definition of the language sound component of the R.E.A.L. framework aligns with the definition of phonological awareness, including phonemic awareness and is understood as

the pre-reader's ability to segment sounds within words, syllables, and in the case of phonemic awareness, the smallest units of sounds (Callaghan & Madelaine, 2012). Phonological awareness lessons taught explicitly contribute to better outcomes for students with reading difficulties (Hagans & Good III, 2013).

Lundberg, Larsman, and Strid (2010) confirmed that girls acquire phonemic awareness more easily; an important gender characteristic teachers must consider when planning early literacy activities. Since stereotyping of boys as less likely to enjoy reading can damage their self-concept, teachers must actively combat such preconceived ideas by reflecting on their perceptions (Retelsdorf, Schartz & Asbrock, 2015). Language sound activities (see Table 4 for examples), can be combined with literature exploration to contribute to learner engagement and enjoyment of the sound awareness lesson, a strategy that may benefit male pre-readers especially (Zeece, 2006). Additionally, choosing books with topics of high interest to preschoolers, including nature, transportation, and holidays, increases preschoolers' attentiveness, thereby increasing their engagement in literacy activities (Hume, Allan, & Lonigan, 2016). Some of these activities include reading books that contain alliteration, such as *Silly Sally*, by Audrey Wood (1999) and acting out nursery rhymes.

Table 4
L is for Language Sounds – Practical Strategies for incorporating language sound activities in daily literacy instruction

- Teach sound segmentation and other phonemic awareness strategies during explicit teaching sessions
- As a group, name words and then clap for each syllable heard in that word
- Use a rubber band to "stretch" words so that each letter sound can be heard more distinctly
- Play "I am thinking of a word, it begins with the ___ sound," repeating the sound of the letter often until children guess the word ("Mmm, mmm, mouse!")
- Ask students to listen for specific sounds while playing outdoors, such as chirping birds or cars going by.

Conclusion

The importance of high-quality early literacy skill instruction for all pre-readers has been well established (Bingham & Patton-Terry, 2013). Using strategies and activities that are research-based allows for the best possible outcomes for students with and without delays (Goldstein, 2011). Equipping teachers with the ability to easily remember the components of such an empirically-grounded approach is essential for ensuring the application of such strategies and activities. The R.E.A.L. acronym provides a way for educators to incorporate research-based components in their early literacy teaching practice. The classroom poster in Appendix A provides a visual reminder to teachers to incorporate the essential components of the R.E.A.L. framework daily: activities that foster repetition of both words and sounds, lessons teaching explicit literacy skills, alphabet awareness activities, and language sound awareness. General and special educators, as well as parents may also find the R.E.A.L. activities found in this article useful for supporting the development of literacy in their preschoolers.

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Appendix A – Classroom Poster

Jar Discussions:
An Adaptable Instructional Strategy to Facilitate Students' Explanations

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Abstract

Well-designed discussion protocols can result in learning by facilitating open-ended and collaborative dialogical exchanges, higher-order thinking, the construction of new understandings, and increased comprehension of a text or topic (Murphy, Wilkinson, & Soter, 2011). Jar discussions are a versatile, interactive, discussion format in which positive peer interactions, collaborative explanations, and peer feedback exchanges are facilitated in small groups even if the class size is large. The protocol is designed to increase student engagement by increasing the opportunity for learning-focused student talk. Relevant literature is reviewed, the jar discussion format is described, and instructional adaptations to meet the needs of diverse students across ages, abilities, and content areas are presented.

Keywords: discussion, discussion protocols, instructional strategies, differentiation, student explanations, teacher education

Introduction

With instructional time at a premium, teachers need strategies that capitalize on evidence-based methods that can be adapted to meet the needs of diverse students. Discussion has been shown to be an evidence-based instructional strategy (Murphy, Wilkinson, & Soter, 2011) that can "promote deep and meaningful learning" (Nussbaum, 2008, p. 348). Research has shown that constructive and interactive learning activities facilitate students' conversion of "information into usable skills and knowledge" (Fonseca & Chi, 2011, p. 296) better than passive and active strategies. Cooperative learning, or learning with peers, has also been shown to improve student achievement (Slavin, 2011). Positive peer interactions can be academically motivating, and the "instructional approach that a teacher adopts . . . can have an impact on the students' opportunities to make friends" (Wentzel & Watkins, 2011, p. 334). Quality peer feedback via "peer discussions . . . elaborations and critical discourse" facilitates positive learning outcomes (Hattie & Gan, 2011, p. 264). Jar discussions are an interactive, cooperative discussion format in which positive peer interactions, collaborative explanations, and peer feedback exchanges are facilitated in small groups even when the class size is large. Jar discussions increase the time each student has to contribute to a dialogue and explain their thinking. Relevant literature is reviewed, the jar discussion format is described, and instructional adaptations to meet the needs of diverse students across ages, abilities, and content areas are presented.

Literature Review

Discussion is an open-ended and collaborative dialogical exchange that, ideally, results in higher-order thinking, the construction of new understandings, increased comprehension and appreciation of a text or topic (Murphy et al., 2011). For the purpose of this paper, discussion is defined as "collaborative student discourse . . . about academic content" (Murphy et al., 2011, p. 348). Discussion is sometimes confused with the common IRE (initiate/respond/evaluate) or IRF (initiate/respond/feedback) instructional exchanges in which the teacher asks a question, a

student answers the questions, and then the teacher evaluates or gives feedback to the student's answer (Murphy et al., 2011). Discussion is an interactive sharing of ideas with unpredictable results. Discussion can reveal a gap in knowledge or a misunderstanding about the focal topic or text. Discussion can result in deeper understanding or strengthen participants' established convictions about the focal topic or text. Or, discussion can result in altogether new ideas—a different understanding of the topic or text being discussed. Hearing multiple perspectives may reveal that there is not one right answer to a question, but rather multiple useful perspectives. Jar discussions, the instructional strategy described here, can be designed with any or all of these potential outcomes in mind.

Theoretical Foundations

Constructivist learning theory holds that "existing knowledge is used to build new knowledge" (Bransford, Brown, Cocking, & National Research Council, 2000, p. 11). Learners construct new knowledge as they "actively engage in the search for meaning while participating in discourse" (Murphy et al., 2011, p. 391). Students engage prior knowledge and make connections as they actively engage in discourse with classmates. "Reasoning is inherently dialogical" (Murphy et al., 2011, p. 391) and dialogue between students facilitates opportunities to reason.

Sociocultural theory is also relevant to discussion-based instruction (Murphy et al., 2011). "Discourse plays a primary role in the creation and acquisition of shared meaning making" and that discourse is "culturally embedded and socially mediated" (Murphy et al., 2011, p. 391). Anderson et al. (2001) analyzed 48 discussions in four coeducational fourth-grade classrooms. The discussion group size ranged from six to ten. They found that students learned effective reasoning and argumentation strategies from each other. Specifically, "once an argument stratagem emerges in a discussion, it tends to spread to other children and occur with increasing frequency" (Anderson et al., 2011, p. 41). They called this the snowball phenomenon; students not only copied reasoning strategies from each other, but were able to identify effective strategies and use them effectively (Anderson et al., 2011). They also found that students were "more susceptible, or permeable, to social influence during open rather than teacher-controlled discussions" (Anderson et al., 2011, p. 37). In teacher-controlled discussions, the teacher called on students to speak, whereas in open discussions discussants initiated contributions and negotiated conversational turn-taking on their own. This suggests the possibility that student-led discussion formats like jar discussions may be more effective than discussion formats in which the teacher controls who gets to talk and when. Learning is a social process (Nussbaum, 2008; Vygotsky, 1978). As students discuss concepts, text, and topics, they learn from each other.

Social constructivist and sociocultural theories describe the role discussion plays in creating understanding and address social and cultural impacts on discourse. Discourse allows for shared meaning making and exposes learners to new thinking. These theories explain how group interactions facilitate new and deeper understandings than students could achieve individually (Murphy et al., 2011).

Cognitive theory is also helpful in describing the learning that results from discussion-based instruction. "From a cognitive perspective, argumentation and collaborative discourse are frequently thought to promote conceptual understanding and deeper learning of content" (Nussbaum, 2008, p. 346). Cognitive learning theory focuses on understanding the internal mechanisms at work when learning occurs (Murphy et al., 2011). During discussion, learners internalize knowledge and store it in some mental representation—hopefully making multiple

connections creating a stronger understanding and longer retention (Murphy et al., 2011). In a review of the collaborative discourse literature, Nussbaum (2008) found that the "research suggests that difference of viewpoints can trigger sociocognitive conflict, and when this conflict is resolved through discussion and hypothesis testing, better and more lasting learning is obtained" (Nussbaum, 2008, p. 351). Small group discussion formats like jar discussions afford each individual student more opportunities than whole class discussions to verbalize their viewpoint, and compare or contrast it with that of their peers.

Fonseca and Chi (2011) described interactive learning as "dialoguing with substantive contributions . . . responding to expert's questions, challenging a partner's statements, asking and answering each other's questions . . . taking new perspectives, [and] creating novel understandings" (p. 303). They reported that interactive instructional strategies result in greater learning outcomes than passive, active, and constructive strategies (Fonseca & Chi, 2011). The jar discussion strategy described here not only facilitates dialogue, but has students respond to expert questions that have been crafted in advance to align with learning objectives, facilitates the opportunity for students to challenge each other's statements in a structured small-group setting, and ideally results in students taking on deeper understandings and possibly new perspectives. Jar discussions meet Fonseca and Chi's (2011) criteria for interactive learning.

Teachers' instructional practices influence the opportunity for and quality of peer interactions in the classroom (Wentzel & Watkins, 2011). With jar discussions, teachers can strategically group students based on ability, interest, personality, gender, friendship networks or any other variable deemed relevant given the learning objective. Students can be grouped homogeneously or heterogeneously depending on the objectives of a particular jar discussion.

Jar discussions can also be structured to provide peer feedback. Peer feedback has been found to be an effective instructional tool as peers "are not merely providers of right/wrong feedback, but interpreters of the usefulness of feedback" (Hattie & Gan, 2011, p. 264). Discussions allow students to explain concepts to each other. In some cases, peers can identify misunderstandings and better explain concepts to each other strengthening the understanding of the one explaining *and* other group members. Student work (e.g., writing) can also be the focus of a jar discussion providing a structured discussion format for peers to provide useful feedback.

Having students explain their thinking results in better learning outcomes than hearing explanations or just giving answers (Nussbaum, 2008; Webb et al., 2008), so structuring discussion in small groups to allow students increased time to verbally explain their thinking can be helpful. For example, if only one person talks at a time and every student is given an equal opportunity to talk, each student can talk 25% of the time during a four-person discussion, but each student can talk only 4% of the time in a whole group discussion in a class of 25 students.

Webb et al. (2008) studied the impact of teacher practices on elementary students' dyadic discussions, specifically students' explanations of mathematical problem-solving. They found that student achievement was correlated with student explanations, and the best learning outcomes occurred with "teachers who encouraged further explanation of students' thinking beyond their initial explanations, whether they asked for further elaboration for both correct and incorrect strategies" (Webb et al., 2008, p. 378). Teaching practices that not only elicit explanation, but push for greater elaboration of initial explanations are helpful. Jar discussions can be designed to elicit quality student explanation by providing quality teacher-crafted prompts to which students, without direct teacher intervention, explain and elaborate. Students

are responsible for wrestling with the prompts in their assigned small groups. This requires that teachers prepare students in advance for successful collaborative discourse during the jar discussion, as not all student discourse is educative (Murphy et al., 2011; Nussbaum, 2008).

Quality of discussion is more important than quantity (Murphy et al., 2011). Chiu (2008) found that disagreements in group discussion were more likely to lead to new ideas than agreements, particularly when students responded to each other politely. Rude disagreements and commands were less likely to result in new ideas than polite disagreements, questions and statements (Chui, 2008), and he recommended that teachers "encourage students to evaluate ideas carefully, speak politely, and avoid impulsive responses to rude behaviors" (p. 382). I suggest that teachers provide direct instruction about how to effectively participate in collaborative discourse before students start a jar discussion. Communicating expectations in the beginning is helpful, and students get better at facilitating jar discussions with practice.

Reeve and Tseng (2011) defined "agentic engagement as students' constructive contribution into the flow of the instruction they receive" (p. 258). In their study of 369 middle-class high school students in Taiwan, they found that agentic engagement was positively related to student motivation and achievement. I suggest that the jar discussion format affords students the opportunity to constructively contribute to their own instruction in that they are given agency to collaboratively facilitate educative discourse during class. The teacher provides planned prompts, but students are given agency to construct new knowledge with each other via discussion. This strategy has been used successfully with elementary students, secondary students, college students, and adult learners. It is best used by groups in which at least one student can (and is willing to) read the discussion prompts.

Basic Jar Discussion Format

In a jar discussion, discussion prompts are prepared in advance and students are divided into small groups. Groups of four to five students allow for multiple perspectives to be shared while still being small enough so that everyone can contribute substantially to the conversation with ample opportunity to explain, elaborate, and respond. Each group is given a jar (or other convenient container) filled with prepared discussion prompts. Discussion prompts should be directly related to learning objectives.

Each discussion prompt should be on a single card or slip of paper so that prompts can be randomly selected one at a time. Random prompt selection is important; when prompts are drawn randomly, groups are unlikely to discuss the same topic at exactly the same time. Random prompt selection discourages the tendency of students to eavesdrop on other groups for response ideas since each group is most likely responding to a different prompt at any given time during the discussion. The tendency for some students to eavesdrop on other groups for responses rather than developing their own response was one stimulus for developing the jar discussion protocol. Random selection of prompts helps group members focus on their group's unique discussion even when all groups are responding to the same set of prompts. In this way, the jar discussion protocol makes simultaneous small-group discussions logistically feasible despite large class sizes. Because groups will respond to prompts in a random order, this method is only appropriate when prompt sequence is inconsequential.

Using a jar or other clear container is important. A clear container allows teachers to easily monitor the progress of simultaneous small group discussions in the classroom without interrupting students' discussion. The teacher can easily see how quickly each group is working

through the prompts—which groups are finishing quickly and which groups are stuck or deeply discussing an early prompt. Students may be encouraged to discuss fewer prompts deeply rather than feeling pressured to discuss all the prompts in the jar before the allotted discussion time has ended. For groups that race through prompts too quickly, teachers should encourage further elaboration of explanations from the group's members without offering their own "right" answer; it is important for teachers to resist the urge to volunteer their perspective before students have an opportunity to wrestle with the prompts.

The teacher should explain jar discussion guidelines to students before groups begin their jar discussion. Instructions can be adapted to the meet students with consideration to age, maturity, ability, content area, and learning objectives, but the basic instructions are as follows.

1. One student in the group draws a discussion prompt from the jar and reads the prompt aloud to the group.
2. The group responds thoroughly to the discussion prompt. Responding to the prompt thoroughly means that the group will answer any questions included in the prompt, explain their responses, ask for clarification and details from each other as necessary, and give everyone in the group an opportunity to offer their own explanation.
3. Group members are encouraged seek further explanation from group members and to ask each other questions for clarification.
4. Group members should always be polite and considerate, keeping in mind that disagreement is expected and part of the learning experience.
5. Once the group agrees that a prompt has been discussed thoroughly, another prompt is drawn and the process is repeated.

Differentiating Jar Discussions for Diverse Learners

In Wilkinson et al.'s (2007) review of classroom discussions, they analyzed nine approaches implemented with recognizable fidelity; the approach "had to look the same wherever it was implemented" to be included in their review (Murphy et al., 2011, p. 393). Discussion jars are a much more flexible instructional strategy that can be easily differentiated to meet the needs of all learners. Jar discussions may not look exactly the same when differentiated to meet the needs of students, but that is the beauty of this adaptable instructional tool. Examples of differentiated strategies I have used for jar discussions are listed below.

1. A designated prompt reader can be assigned or students can take turns drawing and reading the prompt.
2. The jar, jar lid, and/or prompts drawn from the jar can serve as fidgets for students that need or want a fidget during the discussion.
3. The same set of discussion prompts can be applied to different texts, problems, or scenarios. For example, students in a language arts class reading *different* books can be grouped by book and respond to the *same* jar questions about setting, plot structure, characterization, imagery, etc.
4. Discussion prompts can be differentiated by difficulty for each group. A class can be reading the *same* book, with one group responding to prompts about the plot while another group is responding to *different* prompts about the author's writing style. Prompts can be written for any level of Bloom's Taxonomy (Anderson, Krathwohl, & Bloom, 2001). For example, discussion jar prompts about a novel read by students can include the following:

- Describe the setting of the story? (Remembering)
- Summarize the plot of the novel? (Understanding)
- What part of the novel was particularly relevant to you and your life experience? (Applying)
- How does the protagonist in this novel compare to the protagonist in the last novel that you read? (Analyzing)
- Do you think the school library should invest in class sets of this novel and put it on the recommended reading list for next year's students? Explain why or why not. (Evaluating)
- If you wrote a sequel to this novel, what would be the plot? (Creating)

5. Groups can use timers to signal when to move on to the next prompt. This strategy can be used to encourage groups to spend more or less time on each prompt as needed.
6. Teachers can also differentiate jar discussions by putting more or fewer prompts in the jar, or providing scaffolding (i.e. hints) with the prompts for some groups. Each group is engaged in their own discussion, so differentiating for ability levels can be accomplished without drawing attention to differences between groups.
7. Jar discussions can be differentiated by group size. Jar discussions can be used with pairs or small groups as needed.
8. Students can be grouped homogeneously or heterogeneously based on the learning objective, prompt selection, personalities, discussion experience, and/or any other class-specific variables.

Versatility of Jar Discussions

Prompts can be written for practically any subject area including, but not limited to, language arts, science, math, history, and social studies. The jar discussion strategy can be easily adapted to improve text comprehension and higher-order thinking, review material, practice problem-solving, practice critical thinking through argumentation, and/or provide peer feedback. Nussbaum (2008) reported in his literature review that "scripting discourse with roles and procedures has limitations, but some prompting of elaborative and metacognitive thinking is useful" (p. 347). Jar discussions provide prepared prompts for focused elaborations and metacognitive thinking without using constraining discussant scripts and roles.

Discussion prompts do not have to be questions. Discussion jars can be stocked with scenarios, short case studies, quotes, book characters, or historical figures. Groups are then provided instructions specifying how they are to respond to the information on each slip drawn from the jar. For example, if characters from a novel the students have been reading are in the jar, the group can respond to prepared discussion prompts provided on an index card or separate sheet of paper about each name drawn from the jar. For example,

- What did you like (or dislike) about this character? Explain.
- How did this character contribute to the plot? Explain.

Given a jar stocked with quotes, groups can be given an index card with the following questions and be told to answer these questions about various quotes drawn from the jar.

- Who might have said this? Explain why you think that person might have said this.
- What do you think the speaker meant when they said this?

- Do you agree or disagree with the message of this quote? Explain why.

Similarly, groups can be given a short list of questions to prompt discussion about historical figures or book characters. For example, a jar discussion can be used as a review activity for a history class. Teachers can put names of historical figures in the jar and give each group a list of the following questions to answer about the historical figures that they randomly select from the jar.

- Why is this person significant to what we have been studying in class?
- What do you have in common with this person?
- What do you know about this person's strengths and weaknesses?
- Explain how this person's strengths or weaknesses impacted their historical significance.

As students become more familiar with jar discussions, they can craft their own discussion prompts to put in the discussion jar. Having students write down their questions about course content can facilitate higher-order thinking and serve as a useful formative assessment tool for the teacher. This can also set the class up for effective small group discussion sessions that facilitate a semi-structured peer tutoring session in which students explain and elaborate on their understandings of concepts to each other.

Preparing for Successful Discussions

Students need to be prepared for a successful jar discussion. For best results, students need to know how to take turns talking, listen attentively, encourage elaboration, and disagree politely (Chiu, 2008). Students may also need to know the difference between debate and discussion. Students do not necessarily take sides in a discussion, rather they "are free to explore positions flexibly and to make concessions" (Nussbaum, 2008, p. 349). Persuasion is not the objective when disagreement occurs during a jar discussion, but rather the exploration of ideas toward multiple, deeper and possibly new understandings. Nussbaum (2008) described "collaborative argumentation as a social process in which individuals work together to construct and critique arguments" (p. 348); collaborative argumentation is appropriate for jar discussions.

Direct instruction provided in advance about the discussion protocol is also helpful. For example, teachers may need to provide direct instruction about conversational turn-taking, polite and impolite ways to disagree, and active listening skills. Since this strategy can be used with young elementary students to adult learners, the amount of direct instruction about discussion protocol will vary widely. Teachers will also need to answer the following questions asked frequently by students.

- How do we know when to move on to the next question?
- What do we do if we get stuck?
- What do we do if we finish all of the questions in the jar?

In their literature review of discussion-based instruction, Murphy et al. (2011) identified curricular decisions that teachers should make when designing discussion-based lessons—stance, text (or topic) selection, facilitative control, and interpretive authority. Teachers should consider whether the learning objective for the jar discussion is more consistent with an expressive, efferent, or critical-analytic stance. An expressive stance encourages affective,

spontaneous, emotional responses, while an efferent stance encourages a utilitarian response resulting in usable, actionable information for discussion participants (Murphy et al., 2011). A critical-analytic stance encourages an objective response to the text to analyze assumptions and logic (Murphy et al., 2011). Determining the stance in advance should help the teacher develop relevant discussion prompts. The teacher generally controls the topic unless the students write prompts for the discussion jar, but the students facilitate the discussion and control conversational turn-taking. Thus, teachers will need to plan the instructions in advance keeping in mind the maturity and skills of the students; students need to understand what is expected.

Teachers should craft discussion prompts that elicit explanations. “Both theoretical and empirical literature supports the power of giving explanations compared to other kinds of participation” (Webb et al., 2008, p. 361). For example, in a jar discussion for a math class, telling students, “Explain how you would solve the problems in the discussion jar to your group members and discuss your different problem-solving strategies with your group members” will elicit more explanations and higher-order dialogue than telling the groups to “Solve the problems in the discussion jar.”

Conclusion

With instructional time at a premium, teachers need strategies that capitalize on evidence-based methods that can be adapted to meet the needs of diverse students. Jar discussions provide a logistically feasible way for teachers to facilitate simultaneous and differentiated small-group discussions so that students can engage deeply with course content. Further research empirically analyzing the effect of various jar discussion formats on learning outcomes would be helpful. Research on the effectiveness of utilizing jar discussions to differentiate content and process in inclusive classrooms settings would be beneficial. Because jar discussions are so versatile, research investigating the impact of jar discussion on learning outcomes for specific aged students, content areas, and jar discussion design features would also be beneficial.

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Dyscalculia Across Disciplines: An Overview of the Literature

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Abstract

This article provides an overview of the term *dyscalculia* across three different databases. The definitions, measures and variables used in research, and the general outcomes related to dyscalculia across disciplines are highlighted. The results of the overview emphasize that identification of dyscalculia is still in its infancy. The majority of the participants in the identified studies were from grades K-4. Studies were limited to concepts of number sense and mathematical calculations. Implications for practitioners are also discussed.

Keywords: dyscalculia, mathematics, learning disability, mathematics learning disability

Introduction

In 2015, the Assistant Secretary of the United States Department of Education's Office of Special Education and Rehabilitative Services issued a policy guidance letter clarifying the appropriateness of using terms such as *dyslexia, dyscalculia,* and *dysgraphia* when the use of these terms will contribute to "ensuring a high-quality education for children with specific learning disabilities" (Yudin, 2015, October 23). The most recent edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-V; American Psychiatric Association, 2013) also uses the term *dyscalculia*, defining it as "a pattern of difficulties characterized by problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations" (p. 67).

In a seminal article published in 1974, Kosc defined *dyscalculia* as a term used to refer to a learning disability in arithmetic computation. Since that time, researchers in the fields of psychology, cognitive neuroscience, and education have made advancements in understanding dyscalculia and determining evidence-based practices for students with dyscalculia. Researchers currently use the terms *dyscalculia* and *developmental dyscalculia*, along with *mathematics learning disability*, across disciplines. However, researchers tend to work within, rather than across, their respective fields. This lends itself to an investigation of information across the fields of psychology, cognitive neuroscience, and education.

Research conducted on the topic of dyscalculia across different disciplines fails to account for the multiple perspectives that can aid with the understanding of the term *dyscalculia*. An overview of the term *dyscalculia* and its constructs across disciplines can assist educators in providing more comprehensive services to students diagnosed with this disability. The research questions guiding this overview were: How is dyscalculia defined across disciplines? What are the similarities and the differences? Specifically, (a) what measures were used in the research across the different fields to determine the presence or severity of dyscalculia, (b) what are the variables related to dyscalculia across disciplines, (c) what are the general outcomes from the

research across disciplines, (d) are there themes and patterns regarding the conclusions across disciplines, and (e) how do the conclusions drawn relate to best practices in teaching?

Methods

A literature search was conducted across databases representing three different fields, specifically PsychInfo (psychology), Medline (cognitive neuroscience), and ERIC (education), terms *dyscalculia* AND *learning disab** (in truncated form). This search yielded 61 articles in the PsychInfo database, 54 articles in the Medline database, and 21 articles in the ERIC database. Some duplicates were removed. Exclusionary criteria included informational articles, literature reviews (i.e., articles that did not include original research), articles that dealt with adults, case studies or articles based on questionnaires, and articles that highlighted a disability in which dyscalculia was considered only one characteristic of that disability. Once exclusionary criteria were applied and overlapping articles across databases were accounted for, 39 articles were included in the review (see Figure 1). Thirty percent of the articles were checked by both authors to ensure consistency of the application of inclusionary and exclusionary criteria. The search and review of articles across three databases is a replication of research conducted by Basho (2015) on characteristics of executive functioning skills across databases.

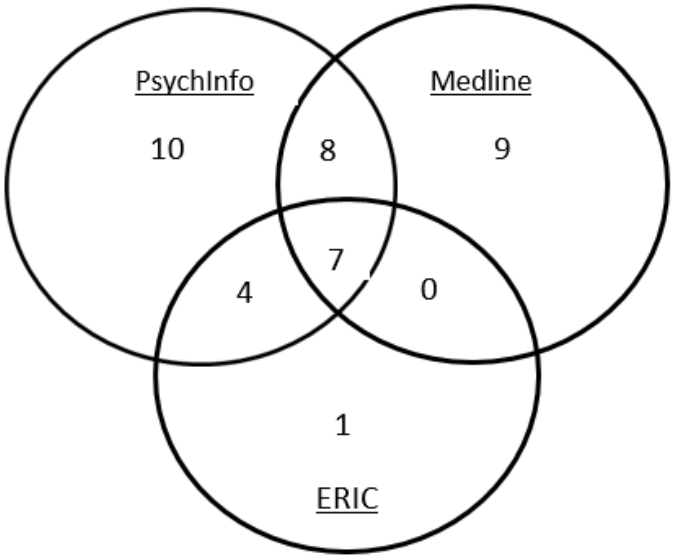

Figure 1. Articles meeting criteria across databases included in this review.

Since this was an exploratory overview, articles were included irrespective of the date of publication. The two earliest articles identified in the search were published in 1993 and were located in the Medline database. In 1995, two more articles were identified which appeared in the PsychInfo database. It was not until 1997 that an article meeting our search criteria on the topic of and using the term *dyscalculia* appeared in the ERIC database. Since 2010, use of the term *dyscalculia* and research involving dyscalculia has increased across databases. In 2014 eight articles were identified in this search across all databases (see Figure 2).

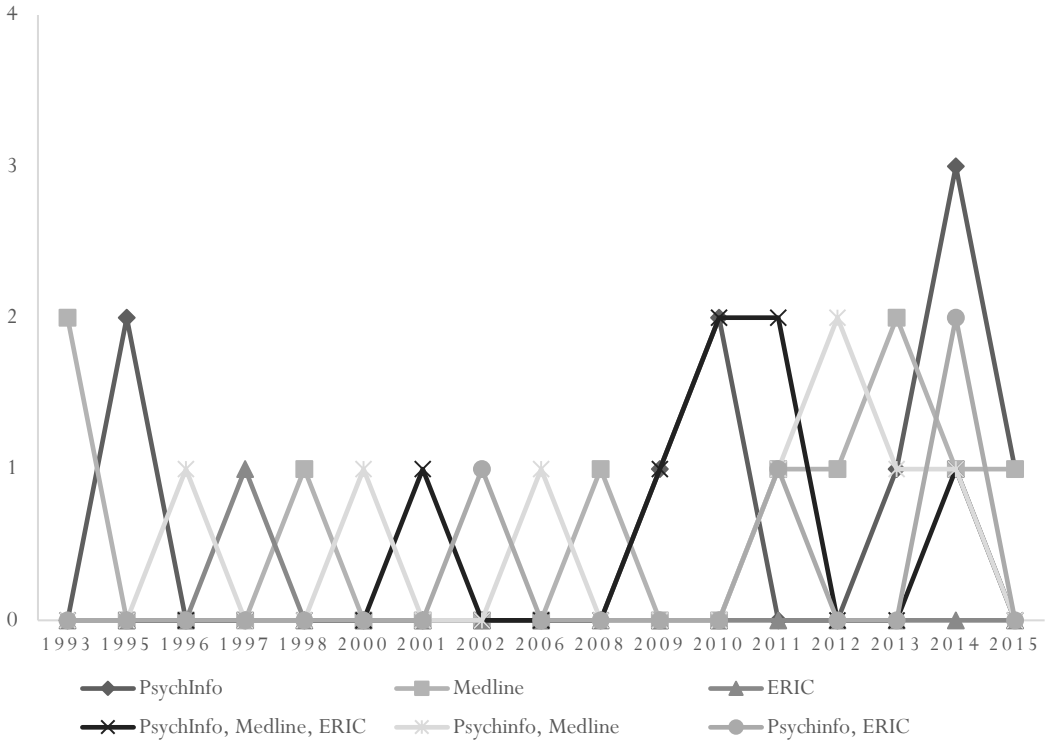

Figure 2. Numbers of articles included in this review by year published.

Across the three databases, researchers from 15 countries published research investigating dyscalculia included in this review. The country from which researchers published the most articles, seven, on the topic of dyscalculia was Israel; many of the authors overlapped across the articles (e.g., Gross-Tsur, Manor, & Shalev, 1996; Shalev, 1997; Shalev, Auerbach, Manor, & Gross-Tsur, 2000; Shalev & Gross-Tsur, 1993; Shalev, Manor, Amir, & Gross-Tsur, 1993; Shalev, Manor, Auerbach, & Gross-Tsur, 1998; Shalev, Manor, Kerem, Ayali, Badichi, Friedlander, & Gross-Tsur, 2001). Researchers from Switzerland wrote five articles on the topic of dyscalculia that were considered in this review; many of the authors of these articles also overlapped (e.g., Kucian et al., 2011; Kucian, Loenneker, Dietrich, Dosch, Martin, & Von Aster, 2006; Rotzer, Kucian, Martin, Von Aster, Klaver, & Loenneker, 2008; Rotzer, Loenneker, Kucian, Martin, Klaver, & Von Aster, 2009). Only three articles included in this review were contributed by researchers in the United States. Two of these articles included overlapping authors (Mazzocco, Feigenson, & Halberda, 2011; Mazzocco, Murphy, Brown, Rinne, & Herold, 2012).

Findings

Definitions

The majority of articles considered included a definition of the term *dyscalculia.* Many definitions simply defined *dyscalculia* in generic terms, such as a mathematics learning disorder (Behzadi, Rahimi, & Mohamadi, 2014), mathematical learning disability (Wilson et al., 2006) or as “poor mathematical skills” (Boets, De Smedt, & Ghesquiere, 2011, p. 1075). Some definitions

highlighted the discrepancy between achievement and intellectual ability (Ashkenazi, Rosenberg-Lee, Tenison, & Menon, 2012; Mussolin et al., 2010). One definition highlighted difficulty with math calculations (Mogasale, Patil, Patil, & Mogasale, 2012), while one listed four subskills affected by dyscalculia: number sense, math fact memorization, calculation, and math reasoning (Schulte-Korne, 2014). None of the definitions mentioned difficulties with math problem solving, while many touched on students' difficulties with number sense or computation. Hence, the definitions seemed to pinpoint difficulties that are more procedural rather than conceptual.

Some definitions, however, more specifically defined *dyscalculia* in terms of neuroscience, as involving "difficulties representing and manipulating numerical information nonverbally and visuo-spatially, in learning and remembering arithmetic facts and in executing arithmetic procedures" (Rotzer et al., 2009, p. 2859), or "presumed to be due to impairments in brain function" (Kucian et al., 2011, p. 782). Interestingly, these articles highlighting dyscalculia in terms of neuroscience spanned disciplines.

Concept Areas

Across all three databases and 39 articles, researchers focused on different skills and concept areas on which their results were based. Although a few articles did not expound on the targeted skills, the vast majority of researchers focused on tasks involving basic number sense and computation, specifically addition, subtraction, multiplication, estimation and memorization of math facts. This finding is consistent with the definitions used by researchers: Skill areas focused on procedural, rather than conceptual knowledge. One article found in the PsychInfo database focused on number line acuity (Friso-van den Bos et al., 2015) and another article found in the Medline database focused on the Approximate Number System (Noël & Rousselle, 2011). Few articles focused on higher order math skills, such as spatial number representation and math reasoning (Kucian et al., 2011) and math tasks involving working memory (Maehler & Schuchardt, 2011; Rotzer et al., 2009). Only one article focused on the skill of word problems (Gonzalez & Espinel, 2002). None of the articles investigated math skills involving division or algebra.

Participants

Across all three databases and 39 articles, there were a total of 6,026 participants, although three articles (Noël & Rousselle, 2011; Schulte-Körne, 2014; Tünde, 2009) did not specify the number of participants. The grade levels for participants mainly ranged from K through 4 with only 406 participants in grades 5 through 9 (Mazzocco, Feigenson, & Halberda, 2011; Shalev, Manor, Auerbach, & Gross-Tsur, 1993; Tünde, 2009). Nineteen studies did not specify the grade levels for the participants. The majority of the articles did not provide details of the demographic and socioeconomic status of the participants.

Assessments

A multitude of assessments were used to diagnose dyscalculia across the three databases and the 39 articles. Assessments were used to measure IQ (González & Espinel, 2002; Maehler & Schuchardt, 2011, Shalev, Manor, Auerbach, & Gross-Tsur, 1998) arithmetic skills (De Visscher & Noël, 2014; Shalev et al., 2001), numeracy skills (Julio-Costa et al., 2015; Shalev, 1997; Shalev, Manor, Amir, & Gross-Tsur, 1993;), and poor school performance screenings (Cowan & Powell, 2014; Mazzocco, Feigenson, & Halberda, 2011; Mogasale, Patil,

Patil, & Mogasale, 2012). Additional assessments were utilized to assess reading (Shalev, 1997; Shalev & Gross-Tsur, 1993; Shalev, Manor, Amir, & Gross-Tsur, 1993), spelling (Shalev, 1997), writing (Mogasale, Patil, Patil, & Mogasale, 2012; Shalev & Gross-Tsur, 1993; Shalev, Manor, Amir, & Gross-Tsur, 1993), and working memory skills (Archibald, Cardy, Joanisse, & Ansari, 2013; Cowan & Powell, 2014). Some studies relied on medical assessments and fMRIs (Boets, De Smedt, & Ghesquière, 2011; Rotzer et al., 2009). Word problems were assessed in only one study (González & Espinel, 2002). Most of the studies relied on more than one measure to diagnose dyscalculia. Out of a total of 39 articles, four did not list the specific assessments used (Gitanjali, 1995; Karande, Doshi, Thadani, & Sholapurwala, 2013; Niklas & Schneider, 2014; Noël & Rousselle, 2011).

Purpose

Four common themes that emerged from the purposes of the articles on dyscalculia were 1) factors that cause/predispose students to dyscalculia, 2) measures/tools used to identify dyscalculia, 3) subskills that characterized dyscalculia, and 4) interventions for supporting students with dyscalculia.

1) Factors that cause/predispose students to dyscalculia:
- Familial disposition of dyscalculia (Shalev et al., 2001)
- Comorbidity of dyscalculia with LD and ADHD (Mammarella et al., 2013; Shalev, 1997)

2) Valid measures/tools that were used across articles to diagnose dyscalculia:
- IQ-performance discrepancy (Maehler & Schuchardt, 2011)
- Approximate Number System (Weber fraction measure) (De Visscher & Noël, 2014; Mazzocco, Feigenson, & Halberda, 2011; Piazza et al., 2010)
- Cognitive model (Shalev, Manor, Anir, & Gross-Tsur, 1993)
- Brain differences (Ashkenzai, Rosenberg-Lee, Tension, & Menon, 2012; Kucian et al., 2006; Mussolin et al., 2010; Noël & Rousselle, 2011; Rotzer et al., 2009)

3) Subskills that characterize dyscalculia:
- Domain general factors associated with dyscalculia/Cluster analysis (Archibald, Cardy, Joanisse, & Ansari, 2013; Cowan & Powell, 2014)
- Arithmetic skills deficits (Ashkenzai, Rosenberg-Lee, Tenison, & Menon, 2012; Friso-van den Bos et al., 2015; Mogasale, Patil, Patil, & Mogasale, 2012)
- Working memory deficits (De Visscher & Noël, 2014; Kajbaf, Lahijanian, & Abedi, 2010; Rotzer et al., 2009)

4) Interventions that have been successful in supporting the learning of students with dyscalculia (Behzadi, Rahimi, & Mohamadi, 2014; Beygi, Padakannaya, & Gowramma, 2010; Gitanjali, 1995; Wilson et al., 2006)

Intervention

Only 4 out of 39 studies included classroom-based interventions for dyscalculia to support participants' mastery of mathematical skills. Researchers used the Concrete-Representational-Abstract (CRA) sequence to teach computation (Beygi, Padakannaya, & Gowramma, 2010). Others used computer-assisted learning targeting spatial number representation, number sense tasks, mathematical reasoning, and mathematics fact fluency skills (Käser et al., 2013; Kucian et al, 2011; Wilson et al., 2006), which were identified as

effective interventions. One study also explored the user engagement models for intervention software (Käser et al., 2013). More details about these interventions can be found in the implications for practitioners section.

Discussion

There are critical implications for researchers and practitioners associated with this search and review of articles on the topic of dyscalculia. First, dyscalculia has been studied by a limited number of researchers across different countries. For example, of the three articles included in this review that were contributed by researchers in the United States, two articles included overlapping authors (Mazzocco, Feigenson, & Halberda, 2011; Mazzocco, Murphy, Brown, Rinne, & Herold, 2012). Israel and Switzerland, the countries contributing most of the articles considered, had many overlapping authors across articles. Standards established for identification of evidence-based practices suggest that experimental effects must be replicated across different researchers (Horner et al., 2005); specifically, Kratochwill et al. (2013) recommended “at least three research teams with no overlapping authorship” (p. 33). This standard indicates the need for further research to establish the knowledge base of dyscalculia worldwide.

Additionally, there is very little consistency of definitions of dyscalculia within each discipline, not to mention across disciplines (i.e., educational, medical, and psychological). Furthermore, the majority of the studies focused on elementary school students (K-5) and basic, procedural math skills. Math skills involving division or algebra were not investigated in any of the articles. Higher order math skills, math tasks involving working memory, and word problems were targeted in only a few studies. Although it must be acknowledged that there is intervention research involving students with math disabilities, interventions targeting dyscalculia were almost nonexistent (less than ⅛ of all articles considered).

Based on the results of this analysis, researchers across disciplines need consensus on a working definition of dyscalculia. Research needs to be broadened to include all students affected across K-12 settings and across all math concepts and strands. Since NCTM incorporates both process and concept standards, the correlation between dyscalculia and these standards needs to be investigated (NCTM, 2000). In addition, as states and school districts implement Multi-Tiered Systems of Supports (MTSS), an integral part of the Every Student Succeeds Act (ESSA), described as “a layered continuum of evidence-based practices and systems” (Colorado Department of Education, 2015, p. 1) more intervention-driven research is necessary to help teachers determine appropriate supports for students with dyscalculia at every tier of instruction.

Implications for Practitioners

The CRA sequence and computer-assisted learning emerged as the two, main evidence-based math interventions for students with dyscalculia. CRA has been widely researched for teaching place value (Bryant, Bryant, Gersten, Scammacca, & Chavez, 2008), addition and subtraction (Flores, 2010; Flores, Hinton, & Strozier, 2014; Sealander, Johnson, Lockwood, & Medina, 2012), multiplication (Flores, Hinton, & Schweck, 2014; Flores, Hinton, Strozier, 2014; Mancl, Miller, & Kennedy, 2012), fractions (Butler, Miller, Chrehan, Babbitt & Pierce, 2003; Misquitta, 2011) and algebra (Maccini & Hughes, 2000; Witzel, 2005; Witzel, Mercer, & Miller, 2003) to students with dyscalculia. The CRA sequence is embedded in the explicit instruction framework.The explicit instruction framework involves the use of

demonstration, modeling, and guided practice followed by independent practice and immediate feedback (Witzel, 2005). For CRA sequence, the teacher guides the student through a mathematical concept and its corresponding computational process through the use of manipulatives and visual representations that illustrate the concept along with numbers. Abstract representations or numbers are presented simultaneously with the concrete and representational phases. Concrete and representational phases serve as prompts until the student develops the ability to comprehend and compute at the abstract level (Agrawal & Morin, 2016).

Computer-assisted learning that provides targeted practice is a powerful support for students struggling with spatial number representation, number sense tasks, mathematical reasoning, and mathematics fact fluency skills. Game-based approaches are one effective way to actively engage and motivate students, while also providing immediate feedback (Ahmed & Mutalib, 2015). Virtual manipulatives can also be used to actively engage students in learning (Shin et al., 2017). Instructional applications that can be accessed on smartphones or tablets can also be helpful for some students with LD (Bryant et. al., 2015). In choosing software, there are certain things a teacher must keep in mind: the program should 1) be theory based (e.g., taking into account the natural progression and development of math abilities and conceptual understanding); 2) provide motivation and reinforcement for students; and 3) adapt and adjust according to student performance, which can vary widely across students with LD, in order to meet the specific needs of students (Käser et al., 2013). When choosing software, it is critical that teachers screen any form of computer-assisted learning to ensure that it meets these criteria.

Limitations

This search was conducted as an overview rather than an exhaustive review of the literature. Along with the limitations implicit to the research on dyscalculia and discussed in the previous section, seven articles were not available because they were published in another language, and only the abstract was provided in English (Behzadi, Rahimi, & Mohamadi, 2014; Bolla, 2014; Kajbaf, Lahijanian, & Abedi, 2010; Niklas & Schneider, 2014; Rappo, Alesi, & Pepi, 2014; Shalev, Manor, Amir, & Gross-Tsur, 1993; Tunde, 2009). Although there is a research base for mathematical intervention for students with mathematical difficulties, these studies do not specifically use the term *dyscalculia* and were not included in this analysis.

Conclusion

Although dyscalculia was initially defined 40 years ago, defining dyscalculia is still ongoing and identification of dyscalculia is still in its infancy. There is a lack of consistency and gaps across and within fields related to concept areas, participants, assessments, and purposes and interventions in dyscalculia research. More research is needed related to these topics, specifically research that includes students from a broader age and grade level, and concept areas as well as practitioner research and a need for sharing of effective intervention strategies for students with dyscalculia.

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Support Services for College Students with Autism Spectrum Disorder

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Abstract

An increasing number of students with Autism Spectrum Disorder (ASD) are enrolling in higher education. Universities are seeking to develop programs to meet this need; however, little research is available on best practices. This review of the literature identifes four key areas for supporting success in higher education for students with autism: transition, individualization, autism training for professors, and social interventions. The research indicates a deficit in support, especially in the area of social processing issues. While insight can be gained from existing research, evidence based best practices have yet to be established to help disability service offices to create programs which will promote success in higher education for students with ASD.

Keywords: autism spectrum disorder, ASD, college, disability support service offices, university.

Introduction

Students with Autism Spectrum Disorder (ASD) desire to pursue higher education, resulting in increased enrollment in college programs (Camarena & Sarigiani, 2009; Griffin, McMillan, & Hodapp, 2010; Zager & Alpern, 2010). However, little research has been conducted in best practice accommodations to help them. Because an increase in ASD diagnosis will likely continue to lead to an increase in enrollment (Armstrong, 2011; Gelbar, Shefcyk, & Reichow, 2015; Matthews, Ly & Goldberg, 2015), it is vital that programs are developed around the country to meet the need. Since the major obstacles students with ASD face are founded in social issues (Pinder-Amaker, 2014), it is important that colleges implement effective accommodations to help these students experience success. Research indicates four key areas for supporting success in higher education for students with ASD, including effective transitions between secondary and post-secondary education (Kucharczyk et al., 2015), individualized accommodations (Shattuck et al., 2014), autism training for professors and peers (Gillespie-Lynch, et al., 2015; Gobbo, & Shmulsky, 2014), and finally social interventions (Neito et al. 2015). However, more research needs to be conducted.

What is Autism Spectrum Disorder? “Autism is a neurobiological disorder characterized by impairment in social interaction, communication, and repetitive stereotyped patterns of behavior” (Diagnostic and Statistical Manual of Mental Disorders, 1994). While students with ASD possess a normal or above normal IQ, social functioning is “lower than expected from the linguistic and cognitive abilities, which confuses peers” (Galler, 2013, p. 21). These experiences can lead to mental health issues, including anxiety and depression which occur due to their difficulties with social information processing. Social information processing refers to how people develop successful relationships in society (Fontaine, 2006).

Students who were diagnosed in the 1990s with Asperger’s (AS) or high functioning Autism Spectrum Disorder (HFASD) are now entering college at an increasing rate (Armstrong, 2011; Gelbar et al., 2015; Matthews et al., 2015). Students with ASD struggle with social situations, conversational skills, sensory overload, and intellectual challenges (Geller & Greenberg, 2010). These students are capable of earning a college degree, but they have often

been overlooked. However, the aspirations and strengths of students with ASD should be considered (Roberts, 2010). More research needs to be performed on ways to help students with ASD navigate the typical world university campuses and overcome their difficulties with social informational processing in the environment of higher education.

To meet the need, college campuses are developing programs for high functioning students with ASD (Griffin et al., 2010; Zagar & Alpern, 2010). They are developing programs including, but not limited to addressing "social challenges, testing needs (extended time or modification), the need for sameness, daily maintenance, keeping organized, disruptive behavior and sensory problems" (Camarena & Sarigiani, 2009, p.116). Nonetheless, many of these programs meet the needs for mitigation of secondary symptoms such as anxiety, but do not address the primary issue related to social informational processing. This could be for several reasons: it is not required by law (Claxton, 2016), lack of funding (Barnhill, 2014), or lack of best practices (Langford-Von Glahn, 2008; Smith, 2007).

There is a significant gap in the literature regarding the experiences and accommodations for students with ASD in higher education, and based on increased diagnosis, the population of students with ASD is likely to grow (Armstrong, 2011; Gelbar et al., 2015; Matthews et al., 2015). In addition, high functioning forms of autism, including those students who are more likely to pursue higher education, have not been studied as much as classic autism (Van Bergeijk, Klin, & Volkmar, 2008). While research in a few areas is promising, more research should be done in four areas to develop best practices: (a) transitions between secondary and post-secondary education, (b) individualized accommodations, (c) autism training for professors and peers, and finally (d) social interventions. A vital way to address this lack of information is to hear from the individuals who are affected (Galler, 2013).

Diagnosis for students with ASD has increased (Armstrong, 2011; Gelbar et al., 2015; Matthews et al., 2015) and research shows that an increasing number of these high functioning students are enrolling in higher education (Camarena & Sarigiani, 2009; Claxton, 2016; Galler, 2013; Griffin et al., 2010; Zager & Alpern, 2010). But little research exists regarding support services for these students. This review of the literature contributes significantly to the field of education and focus on areas for further study. First, high schools are not addressing educational needs of students with ASD sufficiently to prepare them for successful transitions (Mitchell & Beresford, 2014). Second, the individual aspirations and strengths of students with ASD should be considered (Roberts, 2010). In fact, Pinder-Amaker (2014) suggested including them in their Individualized Education Program (IEP) meeting in high school to provide them with the social skills, and self -efficacy to articulate their needs when they get to college. Third, stakeholders confirmed the importance and challenge of providing interventions which are both effective and reasonable for the individual needs of students with ASD (Barnhill, 2014; Claxton, 2016; Galler, 2013; Kucharczyk et al., 2015). Fourth, significant effort should be made to promote greater knowledge and awareness about ASD (Gillespie-Lynch, et al., 2015; Gobbo, & Shmulsky, 2014; Kucharczyk, et al., 2015; Leblanc, Richardson, & Burns, 2009). And finally, social accommodations, while not required by law, are important for student success (Neito et al., 2015; Riechow & Volkmar, 2009; Moore, McGrath, & Thorp, 2000; Mitchell & Beresford, 2014).

Transitions

In order to support positive transitions for young people with ASD and AS from secondary to post-secondary education, it is vital for university program administrators to understand the factors that make the transition successful (Barnhill, 2014; Claxton, 2016; Galler,

2013; Kucharczyk et al., 2015). Because of an increased diagnosis of ASD in young people, high schools and Individual Education Programs (IEPs) are serving more high functioning students who may pursue a college degree; however, these programs are not typically aimed at preparing students for college. These programs are often inadequate and researchers recommend the need for research based interventions, individualization, and training for teachers and peers (Kucharczyk et al., 2015). In addition to the needed training, Mitchell and Beresford (2014) found that parents were meeting the needs of students that are not being met in programs. Further recommendations include that 9th grade students with ASD be included in their IEP meetings throughout high school and that they be allowed to take college preparation and dual enrollment classes (Pinder-Amaker, 2014). College summer transition programs are offered as a best practice because they allow students to experience the physical and social aspects of the college experience before the academic demands begin (Barnhill, 2014).

Increased diagnosis of students with ASD has created a need for research that addresses how to provide the best education possible during high school. Kucharczyk et al. (2015) conducted 28 focus groups in four different states to examine the challenges and difficulties of providing evidence-based accommodations for high school students with ASD. One hundred and fifty-two participants, including parents, practitioners, and other stakeholders discussed the weaknesses in current practice and offered solutions. The authors produced three findings. First, the stakeholders believed that high schools are not adequately preparing students with ASD for college. Second, they acknowledged the importance and challenge of implementing feasible and responsible interventions. These interventions need to be individualized to the student. And finally, autism awareness training needs to be provided for both teachers and the school culture as a whole.

Mitchell and Beresford (2014) examined which interventions for students with ASD are successful in helping the transition to post-secondary education in England. Several important elements were found to help young people transition into higher education. First, it is important that secondary and post-secondary support staff be trained in the needs of students with ASD (Mitchell & Beresford, 2014). Second, because of social processing issues, expectations for support staff need to be clearly articulated (Mitchell & Beresford, 2014). The third important factor is parental involvement, specifically, the ability to know their students and to plan for any potential problems. The study also found that parental involvement was vital due to the lack of services offered to young people with an ASD diagnosis (Mitchell & Beresford, 2014).

In addition to the elements articulated by Mitchell and Beresford (2014), Pinder-Amaker (2014) recommended that a student in training position be added to the IEP team during students' ninth grade year of high school. The student in training position would be filled by the student and would allow them to become an active participant in IEP team meetings and, using best practices of role playing, coaching, and rehearsal, they would eventually take on greater responsibility for their education throughout high school. In doing so, it would allow for better individualized accommodations in college (Barnhill, 2014; Claxton, 2016; Galler, 2013; Kucharczyk et al., 2015) because the students would have a better understanding of their needs and experience self-advocating, which would increase their self-efficacy (Shattuck et al., 2014). Pinder-Amaker also recommended college prep and dual enrollment opportunities during 11th and 12th grade to provide students opportunities for more advanced learning.

Barnhill (2014) found that many colleges offer summer transition programs that improve student transition into the higher learning environment.These programs ranged from three days to six weeks and provided support to students to help them transition into college. Transition

from secondary education to post-secondary education is a significant area of concern for students with high functioning ASD. They need to be prepared for the transition in order to be successful (Barnhill, 2014; Claxton, 2016; Kucharczyk et al., 2015). Therefore, it is important to evaluate student preparation in secondary education and provide recommendations to improve student preparation for the post-secondary environment.

Individualized Accommodations

The need for individualized accommodations is the most widely emphasized quality of successful interventions discussed in the literature. The concept of a spectrum disorder makes this clear (Buron & Wolfberg, 2013). An individual's abilities are impacted differently as compared to others on the spectrum and the effectiveness of the disability services office is based on individualizing accommodations for students with ASD (Claxton, 2016). To further complicate matters, students with ASD are often undiagnosed or reluctant to seek help (Shattuck et al., 2014). Barnhill (2014) researched the programs of 30 offices of disability services from around the United States and found a variety of methods used in universities which can be examined for frequency and usefulness. Claxton (2016) provides perspectives from both students with ASD in college and the faculty who work with them and Pinder-Amaker (2014) supports individualization and includes providing mental health supports. Shattuck et al., (2014), Barnhill (2014) and Claxton (2016) each provide different insights on individualizing accommodations for students with ASD.

Shattuck et al. (2014) demonstrated the need for individualized accommodations for students with ASD because each student has different needs and many do not feel confident enough to ask for help. The study investigated the effect of self-perception on students with ASD in the areas of disability and self-efficacy. The data used in their study came from the National Longitudinal Transition Study 2 (NLTS2). This study was developed by SRI International under contract with the U.S. Department of Education. The study included 660 high school students receiving special education support, but only 190 of them attended college. The students responded with yes or no, indicating if they considered themselves to have a disability. In addition, as a measure of self-efficacy, the authors also asked a series of three questions: Can you “handle anything that comes your way”? How do you “get the information you need”? And can you “get school staff and other adults to listen to you”? Results suggested that approximately one-third of the students surveyed did not report themselves as disabled, with an even higher likelihood in the black population. The results of this study indicated that many students with ASD do not perceive themselves as having a disability and yet, do not feel confident enough to ask for the individualized accommodations that they need to be successful in college. As an application to the college environment, it was suggested that universities offer resources to all students rather than just as accommodations from the disabilities services offices where possible (Shattuck et al., 2014). This would allow students to individualize their own accommodations and reduce the stigma associated with a disability.

Barnhill (2014) found a variety of supports offered by the disability service offices, including focusing on individualized services based on specific students and asking students what they need. Barnhill surveyed disability services offices at 30 universities that provided support for students with ASD. In the various universities, they reported 13 accommodation and supports being offered to students with ASD, and the first four were used most often. These accommodations included:

> advisor, extra time on exams, alternate testing sites when appropriate, tutor, note taker, technology supports (i.e., Dragon naturally speaking, smart pens etc.), preparation for employment, reduced course load, copy of professor's notes, instruction in life skills (i.e., budgeting, laundry, sexuality, hygiene) social skills instruction, assigned peer mentors and priority registration. (Barnhill, 2014, p. 8)

Other accommodations included intervention for social situations and group work comprised helping the students develop problem solving solutions, to help them cope with the social anxiety, and role playing one-on-one interactions with their professors. In addition to the above accommodations, some offices provided in-house alternative format labs, individual planners, vocational assessment, academic tutoring twice a week, preferential seating, mental health counselors, test readers, instruction regarding medication and sleep, case management support which focused on executive functions skills, problem-solving planning, anxiety management, accommodations for sensory needs without penalty, additional clarification from the professor without penalty, and taking freshman seminar first semester, rather than second semester. All of these practices should be assessed and studied to determine best practices and universities should evaluate each of them for inclusion in their programs including offering some of these supports to all students who need them (Shattuck et al., 2014).

Clearly, these 30 offices of disability offer varied and creative supports to students. The literature also recommended offering a specific semester course for students with ASD and tracking student progress closely. Another recommendation is for collaboration teams, including the dean of students and the resident hall assistant to monitor student progress. Schools should provide individual and group counseling, a liaison between clubs and campus activities, training mentors, social skills classes which focus on time and stress management, as well as role playing of interactions for dealing with professors. Other accommodations included supportive high school counselors, escorting students to class during the first two weeks, providing visual schedule supports, and providing seminars for parents.

Furthermore, "colleges and universities clearly indicated that support services for students with AS and ASD are greatly needed. A comprehensive, flexible approach that is individualized based on student's unique needs appears to be integral to a successful program" (Barnhill, 2014, p. 12). Barnhill found that many of the universities did not track retention and graduation rates, specifically for students with AS and ASD. Therefore, it seems logical that data needs to be collected to evaluate the successfulness of their programs. Second, resources limited the accommodations colleges were able to offer, including finances and professionally trained support staff. Peer mentors were a critical component in three-fourths of the programs. They functioned as academic coaches, liaisons between the student and their professors, and social coaches. Peer mentors were typically graduate students from psychology, special education, school of psychology, applied behavior analysis or social work departments. Some of them were paid a stipend or through tuition discounts, others received internship credits. Barnhill (2014) highlighted a host of accommodations that are being offered to students with ASD across the country, many of them are available to the entire student populations. For example, the writing center and job counseling are resources available to all university students and therefore, as Shattuck et al. (2014) suggested, reduced the stigma associated with asking for help and allowed students to individualize their accommodations.

Claxton (2016) supported the importance of individualized support. Five themes emerge from Claxton's (2016) single case study included six student participants with autism spectrum disorder and four disability support services office faculty members. The first theme was

accommodations. Academic accommodations were most common, including additional time for testing, a quiet test environment, and a note taker. The benefit of these accommodations for students with ASD is mostly to help with stress. The pressure of being under a time limit with testing and notetaking, and over-stimulation in testing environments affects the student's ability to recall information.

The second theme was accountability. The factors of processing communication and previous experiences with misunderstanding assignments interfere with student's abilities to complete assignments on time. The participants of this study expressed a desire for more accountability, assistance with time management, and organization. Specifically, they requested a support person to individualize their experience, which flows into the next theme.

The third theme that emerged from the study was compassion/individuality. Just as in the studies by Shattuck et al., (2014) and Barnhill (2014), students expressed the perception that ASD does not manifest the same needs in each student.

The fourth factor was additional training and communication for professors. Since difficulties are based in understanding communication, rather than an academic deficiency, ASD is known as the hidden disability (Wolf, 2001). Students with ASD are often capable of the academic workload, but are hindered by their ability to understand the communication required to produce that workload and the development of anxiety from the social missteps of the past. Faculty with training in ASD would be better prepared to identify students' needs, individualize the response, and treat them with understanding, resulting in a safe learning environment. Claxton (2016) noted a reluctance among faculty to participate in professional development for professors working with students with ASD. It was also noted that while communication is the primary difficulty students with ASD face, additional responsibilities were placed on them to communicate with the professor, not just at the beginning of the semester, but for every test and assignment.

The final theme was regarding social issues, which effects student academic success as well. All the students in the study acknowledged difficulty with social issues and a desire for support in this area. However, social accommodations are not required by law (Claxton, 2016).

The characteristics of ASD and the psychiatric risks, along with the stress of transitions, and social demands are very challenging for students with ASD, their parents, and universities and need to be addressed on an individual basis (Pinder-Amaker, 2014). Pinder-Amaker made the case that better mental health and academic outcomes can be achieved by combining best practices from interventions associated with successful academic training, mental health outcomes for young adults, assimilating academic transition elements from high school, and higher education. Some of those best practices included a Universal Design for Learning (UDL) framework be applied for all students. This practice promotes the ability to reach all struggling students and build retention. In addition, best practices for mental health outcomes success include multi-systematic therapy, video modeling, and transition to independence process model.

Individualization is the most requested and widely discussed characteristic of successful interventions for students with ASD discussed in this literature. Due to the nature of a spectrum, some people on the spectrum, will experience some difficulties that others will not. The literature suggested that universities develop programs with many options (Barnhill, 2014) to best meet the needs of students and that the offices of disability services work with students to help them

identify their need and provide accountability (Claxton, 2016). The literature also suggested that many of those resources be offered to the student body as a whole when possible to reach unidentified students with ASD and reduce the stigma associated with diagnosis (Shattuck et al., 2014) and that mental health supports be included (Pinder-Amaker, 2014).

Training

Training for students with ASD, professors, and peers reduces stigma and anxiety associated with ASD (Gillespie-Lynch et al., 2015). Claxton (2016) found that interaction with professors was critical to student success in higher education and yet, professional development for faculty was limited due to a reluctance of faculty to participate. However, training has been shown to change faculty and peer perceptions (Gillespie-Lynch et al., 2015; Gobbo, & Shmulsky, 2014; Leblanc et al., 2009). As a result of training in autism, teachers made a conscience effort to provide structure and reduce anxiety in the classroom, which benefitted all students (Gobbo & Shmulsky, 2014). Gillespie-Lynch et al. (2015) and Leblanc et al. (2015) found that online training is efficient and cost effective. The first study indicated that a better understanding by their peers reduced anxiety in students with ASD and reduced stigma (Gillespie-Lynch et al., 2015). They provided online training for students without ASD in relation to their peers. The other study provided online training for teacher education students (Leblanc et al., 2009). Mitchell and Beresford (2014) found that teacher training was vital to successful transitions between secondary and post-secondary education.

Faculty have a tremendous effect on student's experiences in higher education (Gobbo & Shmulsky, 2014). Gobbo and Shmulsky's (2014) study evaluated the results of two focus groups consisting of experienced faculty, who met to discuss successful classroom practices for reaching students with ASD. Eighteen eligible participants were divided into two groups, one of five and the other of 13. The data was categorized and results indicated that student anxieties included difficulties with processing, understanding social situations, and anxiety. Responses were categorized into two instructional approaches: providing structure and reducing anxiety. Faculty suggested that reviewing and providing routine provided consistency and helped learners transition from one topic to the next. Explicitly stating behavior expectations reduces social anxiety and indiscretions by providing a positive experience for all and minimizing anxiety provoking situations. Teachers are most effective when they provide appropriate challenges and support, while recognizing when students are having difficulty in social situations, big picture thinking, managing anxiety, and organizing their behavior. In fact, minimizing anxiety, and providing a safe environment, as well as, providing structure will typically benefit all students in a classroom environment (Gobbo & Shmulsky, 2014). More training should be provided in reviewing and providing routine and explicitly stating behavior expectations to faculty working with students with ASD.

While faculty understanding is most critical in providing a safe learning environment (Gobbo & Shmulsky, 2014), peer training is significant as well. Students with ASD in higher education struggle academically with retention, partially due to social concerns (Gillespie-Lynch et al., 2015). Gillespie-Lynch et al. (2015) provided online training to college students and measured negative perceptions of students with ASD. Gillespie-Lynch et al. found that online training is inexpensive and efficient. Plus, it significantly decreased the stigma of ASD by providing increased knowledge to peers regarding autism. Further research should compare current knowledge based interventions to contact based interventions where students with ASD are partnered with a student without autism and universities should consider online training for all students (Gillespie-Lynch et al., 2015).

Leblanc et al. (2009) looked at the effect of autism training on a group of 105 beginning teachers regarding their perceptions and understanding of autism. While (Gobbo & Shmulsky, (2014) found that university faculty training had an impact on students with ASD in college by providing a safer learning environment, Lebalc et al. (2009) found that a small amount of professional development delivered in a teacher training program can significantly improve teacher's knowledge and perception of the best practices to use with students with ASD providing support at an even younger age. Research indicates that providing instruction on working with students with ASD in teacher training programs will reduce overall anxiety levels for new teachers, and reduce stress regarding the integration of ASD students into the self-contained classroom (Leblanc et al., 2009). Mitchell and Beresford (2014) found that teacher training in ASD is vital for successful transitions between secondary and post-secondary education by providing a basis for teachers and support staff to guide students in successful decisions for their future. Teacher training programs should evaluate and implement training for all new teachers regarding working with students with ASD.

The results of training for students with ASD, faculty, and peers provides successful results in reducing anxiety and the stigma of ASD (Gobbo & Shmulsky, 2014), as well as providing for successful transitions between secondary and post-secondary education (Mitchell & Beresford, 2014). In addition, online training is efficient and inexpensive (Gillespie-Lynch et al., 2015; Leblanc et al., 2009). However, it has not been used widely to support success in higher education for students with ASD (Claxton, 2016). More research should investigate effective ways to implement training and examine effectiveness.

Social Accommodations

ASD is characterized by social processing issues or how students form social relationships; therefore, non-academic concerns are the most substantial (Galler, 2013). Yet, accommodations for social issues are not required by law (Claxton, 2016) and research reflects a lack of information specific to college students (Langford-Von Galhn, 2008). However, applications can be made from other areas, including community outreach programs, modifications for younger children, computer assisted learning, current parental support, and applications from the workplace.

Neito et al. (2015) provided support for the importance of volunteer programs to promote leisure activities for students with ASD. The study reported on the impact perceived by families of people with ASD and the volunteers after participating in the program, which provided people with ASD company during leisure activities. The study examined the impact of the program on 159 family members of people with ASD and 230 volunteers who help them with social activities. The study reported 92.5% of families and 94.8% of volunteers expressed a very high or quite high overall satisfaction with the program. Universities are uniquely facilitated to develop such a program. They have the resources to provide training by highly qualified professionals, the ability to facilitate official accreditation for training, and they have access to quality volunteers. Such a program can bring a change of attitudes towards people with disabilities and influence the community as a whole, as well as provide future employment benefits to volunteers. It could significantly benefit the students of a university, both those with ASD and those without, the university itself, the faculty, and the community. Universities should consider developing similar programs to benefit their students, the community and the university.

Little research has been done with college students with ASD regarding social accommodations, however, applications should be implemented and tested from other areas to determine best practices. A study by Riechow and Volkmar (2009) provided best practices with younger children which may prove to be beneficial to college students as well. This study examined current research against specific criteria to identify proven methods for improving social skills in students with ASD. The reviewed studies were organized by Reichow and Volkmar by the age of the participants, including preschool, school age, adolescents, and adults. The authors then examined the methods of interventions and evaluated the studies based on criterion developed by Reichow. The authors' goal was to identify the best practices to help students with ASD improve their social skills. Reichow and Volkmar recommended social skills groups and video modeling for school age children. These methods should be implemented at tested with college age students as well.

While Riechow and Volkmar (2009) recommend accommodations with small groups of students and watching students on video, computer-aided learning (CAL) has also been used to accommodate people with autism. A study by Moore, McGrath and Thorp (2000) recommended CAL for four key impairments of autism: social skills, communication skills, rigidity of thought, and educational hypermedia. Social skills pose a challenge for even high functioning students with autism. The study recommended drill and practice programs for social rules and situations. Students with ASD could work on communication skills using simulated conversations as well as symbol systems, semantic, and syntactic levels of language and multimedia systems teaching nonverbal communication. Linked websites can expand student interest and overcome educational hypermedia. In addition, Moore et al. recommended multimedia simulations to expand student thinking. Simulations predicting peoples thought and emotions, using bubble dialogues and Sally Anne scenarios can help students with ASD overcome any limitations. Universities could offer access to these resources through a computer lab.

Claxton (2016) found students with ASD most often requested an accountability partner. Mitchell and Beresford (2014) found that parental involvement was vital for students, due to the lack of services offered to young people with ASD and that many parents were playing the role of accountability partner as well as other roles. Based on the roles that parents are now fulfilling in the lives of their students, student needs at the college level can be determined. Parents fulfilled the roles of seeking information, providing experiences relevant to options available for students, listening to students, and being a source of advice as well as emotional support. When students go away to college, they lose partial or complete access to these supports. In an effort to promote student independence and prepare them for employment, universities need to step in and fulfill these roles. One area parents especially felt they needed more support is in the role of a skills trainer for their student, both in social skills and in life skills. Colleges should look for ways to prepare students with ADS for the demands of college during the early weeks of the academic year (Mitchell & Beresford, 2014). In addition, they should provide opportunities for peer support including virtual networks (Mitchell & Beresford, 2014).

Many of the supports offered by the 30 offices of disability services in Barnhill's (2014) study do fall under social accommodations, including social skills instruction and assigned peer mentors, and yet, across the country, there is a huge need. Ackles et al. (2014) found, "Some of the unique supports typically needed by students with ASD are often not addressed within the traditional accommodations or college support services framework" (p. 7). Barnhill also found that social supports are tougher to maintain and more difficult to fund. By definition, autism is characterized by impairment in social interaction. Therefore, social interactions are the area in which students need the most support, and with it many of the other issues resolve themselves.

If universities are going to support students with ASD, social supports are a vital component to their success. Community outreach programs, modifications for younger children, computer assisted learning, and current parental support offer some promising practices which can be applied and investigated.

Conclusions

Research indicates four key areas for supporting success in higher education for students with autism: (a) transition (Mitchell & Beresford, 2014; Pinder-Amaker 2014), (b) individualization (Barnhill, 2014; Claxton, 2016; Galler, 2013; Kucharczyk et al., 2015), (c) training (Gillespie-Lynch, et al., 2015; Gobbo, & Shmulsky, 2014; Kucharczyk, et al., 2015; Leblanc et al., 2009) and (d) social interventions (Neito et al., 2015; Riechow & Volkmar, 2009; Moore, McGrath, & Thorp, 2000; Mitchell & Beresford, 2014). In order to support positive transitions for young people with ASD and AS, it is important that the transition from secondary education to post-secondary education be successful (Barnhill, 2014; Claxton, 2016; Geller, 2013; Kucharczyk et al., 2015). High school students with ASD are not being effectively prepared for college (Mitchell & Beresford, 2014). They should be included in their IEP meetings (Pinder-Amaker, 2014) to promote individualization and self-advocacy (Barnhill, 2014; Claxton, 2016; Geller, 2013; Kucharczyk et al., 2015) and more training should be provided for teachers and peers (Gillespie-Lynch et al., 2015; Gobbo & Shmulsky, 2014; Kucharczyk et al., 2015; Leblanc et al., 2009). Summer orientation programs are also effective (Barnhill, 2014). Mitchell and Beresford (2014) found that because of social processing issues, expectations from support staff need to be clearly articulated. And finally, parents are a vital part of a successful transition; however, that is often because of a lack of these services offered to students with ASD (Mitchell & Beresford, 2014).

The research also indicates that individualization of accommodations is a key to success in college (Barnhill, 2014; Claxton, 2016; Shattuck et al., 2014) and Pinder-Amaker (2014), suggested that mental health best practices be included in those options due to the secondary symptoms associated with ASD. Training for students, professors, future teachers, and peers reduces stigma and anxiety associated with ASD (Gillespie-Lynch, et al., 2015) and changes faculty and peer perceptions (Gillespie-Lynch et al., 2015; Gobbo & Shmulsky, 2014; Leblanc et al., 2009). In addition, online training is efficient and inexpensive (Gillespie-Lynch et al., 2015; Leblanc et al., 2009). However, it has not been used widely to support success in higher education for students with ASD (Claxton, 2016).

Students with ASD have social processing issues and non-academic concerns are most significant (Galler, 2013). However, the law does not require any accommodations in this area (Claxton, 2016) and the research reflects a dearth of information (Langford-Von Galhn, 2008). Yet, applications can be made from other areas including community outreach programs and modifications for younger children and the workplace. Neito et al. (2015) evaluated an outreach program in Spain which shows promise. Galler (2013) recommends, “video modeling, peer mediated approaches, social stories, comic strip conversations and self-management strategies to teach communication and social skills” (p. 133). Video modeling and social skills groups have been used effectively with school aged children (Riechow & Volkmar 2009) and should provide opportunities for peer support, including virtual networks (Mitchell & Beresford, 2014).

Students with ASD desire to pursue higher education and colleges are facing increased enrollment in this population (Camarena & Sarigiani, 2009; Claxton, 2016; Galler, 2013; Griffin et al., 2010; Zager & Alpern, 2010). Yet, the literature demonstrates a lack of information on

how to meet their needs, especially in the area of social processing issues. While application can be gained from existing literature, evidence-based best practices have yet to be developed to help disability service offices establish programs which will foster success in higher education for students with autism. More research needs to be done in this area.

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