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A Brain-Based Approach To Educational Pedagogy

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2020

## A BRAIN-BASED APPROACH TO EDUCATIONAL PEDAGOGY

### Abstract

Students with Autism Spectrum Disorder (ASD) are underperforming their peers on state assessments. The purpose of this practical action research study is to explore how professional development, focused on brain-based research, informs educators' pedagogical design for students with Autism Spectrum Disorder (ASD). By combining brain-based teaching components, background in the neurology of the brain, and various learning theories, educators were provided filters for making educational decisions. Research was conducted at a rural elementary school in New Hampshire that serves 258 students in grades 3–5, with 51 students served through special education services. The researcher provided teachers and paraprofessionals with preintervention surveys, professional development training, coaching, and post-intervention interviews. The findings of the study concluded there were five themes that influence the use of brain-based teaching: Domain knowledge of staff influences applicability of material and skills; Consideration and strategy-based trainings are preferred; Staff need to process with groups and apply created strategies in the moment; Similar experience aids comfort level toward application; Educators need guidance in classroom management and instructional sequence design. The recommendations of the study show the need for schools to employ action research on the same topic within a larger setting and across grade level groupings; and extend the focus of the action research within the same institution addressing other disability similarities resulting in more common data.

University of New England

Doctor of Education  
Educational Leadership

This dissertation was presented

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## CHAPTER 1

### INTRODUCTION

In the past two decades, Autism Spectrum Disorder (ASD) has received attention in the fields of medicine and education due to the intricacies of the disability in relation to learning. ASD is characterized by social/behavioral deficits and executive functioning impairments (Vogan, Morgan, Lee, Powell, Smith, & Taylor, 2014). Students with ASD tend to lack impulse control leading to what can appear as not following directions or being rude as they act on impulses before judging them as socially appropriate (Vogan et al., 2014). These difficulties have increased in prevalence tenfold over the past 10 years (Chin, 2018). This increase is attributed to misidentification due to comorbidity and/or to the similarities between disorders such as ASD and Attention Deficit Hyperactivity Disorder (ADHD) (Hendriksen, Peijnenborgh, Aldenkamp, & Vles, 2015). This contributing factor drives the need for understanding how students affected by this disability learn and how to educate them as effectively as possible.

This action research study explored the problem of how teachers and paraprofessionals construct educational pedagogy to address the needs of students with ASD. Approaches currently involve specific school system design, altering lesson design, and the utilization of premanufactured scripted programs. A common system design is Response to Intervention (RtI), which utilizes tiers of interventions based on data derived from teacher and systematic scheduled assessments over preselected periods of time (Marzano & Waters, 2009). Universal Design for Learning (UDL) is a popular unit/lesson option involving how lessons and units of instruction are designed and implemented. UDL focuses on creating flexible learning environments by varying the medium of the material, instructional methods, and response methods to allow student flexibility (Rao & Meo, 2016). Scripted intervention options involve teaching skills that

use prescribed methods including phonetic reading programs such as Wilson Reading Systems and Edmark and broad-based literacy programs like Foundations and Read 180. Companies design these products to varying degrees and evaluate them under certain specific conditions as with most researched educational practices, raising the question of reliability when a school tries these approaches among students with disabilities or in less conducive environments.

The issue with large-scale educational change for students with ASD lies in the prevalence and vastness of the problem. According to the National Center for Education Statistics (2019), the percentage of students ages 3–21 with disabilities related to or prior to an ASD diagnosis account for 29% of the 6.7 million students with disabilities as of the 2015–2016 school year. With such a large representation, targeting a disorder such as ASD is difficult. According to Grzadzinski et al. (2011), ASD affects areas of the brain similar to other disorders and disabilities. Language, attention, and social deficits are associated not only with ASD. ASD presents similar symptomology, such as executive and social deficits, to other disorders and disabilities, such as Attention Deficit Hyperactivity Disorder (ADHD), in more than half the cases of students with ASD (Grzadzinski et al., 2011). Attentional deficits and behavioral regulation issues are found in both disorders, making programming for them similar but not exactly the same.

Factor, Ryan, Farley, Ollendick, and Scarpa (2017) discussed the issue that social anxiety and ADHD symptoms are also present in students with ASD and can serve as an accelerant or intensifier for social deficits. As symptoms aligned to a primary noted condition and often not addressed fully, comorbid conditions go overlooked or left unidentified (Hendriksen et al., 2015). This issue leads educators to make judgments based on a primary diagnosis that may not actually be fully correct. Students who shy away from or choose not to interact with others

socially may be avoiding anxiety, missing the cues, not wanting to engage socially with certain people, or avoiding work. This variance in causality means addressing the same issue differently, as the resulting behavior serves a separate function or is due to a lack of skill/awareness.

Educators tend to interpret social deficits, anxiety, and ASD symptoms in general terms as behavioral concerns (Gerber, 2005). Comorbidity exists, often not accounted for in diagnosis, between disorders such as ADHD, bipolar disorder, and even schizophrenia (Anttila, Bulik-Sullivan, Finucane, and Walters, 2018).

Teachers, especially those new to the field, have to balance management of a diverse and developmentally challenging environment with their own emotional regulation (Voss, Wagner, Klussman, Trautwein, & Kunter, 2017). They interact with students individually, in small groups, and in whole group settings throughout their day. Teachers and schools have rules and expectations based on the expected behavior of the population as written in codes of conduct handbooks and by teachers in individual classrooms. Teachers and paraprofessionals work in structured time allotments requiring lesson completion within a certain time and these situations involve unpredictable behaviors that require these educators to react quickly and in view of the students (Voss et al., 2017). In these fast-paced structured environments, there is little time to pull students aside and attempt to understand the complexities of why things occur. Students receiving services under the Individuals with Disabilities Education Act (IDEA) have plans that explain what their disabling condition is and what should be done to address it (New Hampshire Department of Education, 2019). Teachers are presented these plans and may not have been present when the data and original information that constructed the plan was presented (New Hampshire Department of Education, 2019). This limited access to and history with a student, coupled with the possibility of comorbidity and misdiagnosis, creates situations in which

teachers and paraprofessionals make quick judgments to enforce behavioral rules. If rules are enforced based only on the act of something occurring, without understanding why it occurred, the result may increase the probability of the behavior recurring. A student may exhibit a behavior under stress, such as social anxiety, then is asked to go to in-school suspension resulting in more social isolation. Students who cannot remain seated, who talk when they are not supposed to, interrupt, get angry without noticeable reason, and yell are simple examples of students exceeding common behavioral expectations, but not necessarily by choice. Students with disabilities such as ASD cannot stop behaviors and change them after one incident, especially if there may be an underlying issue underrepresented or unknown (Green et al., 2015; Kleberg, 2015; Voss et al., 2017).

Focusing on the brain areas that govern behavior, including the executive functioning areas, amygdala, and prefrontal cortex, limits the impact of underdiagnosis as educators move from symptomology to addressing the neurological cause of learning concerns (Zimmerman, Ownsworth, & Gullo, 2016). This action research study used a mixture of empirical resources and secondary sources to explore brain function, brain-based education, learning theories, and current practices in the hope of furthering the brain-based teaching literature to address a current educational problem.

This study focused on how teachers and paraprofessionals address instructing and accommodating students with Autism. Examining the brain-based functions, specific psychometrics provided by professionals through assessment, and focusing on major similarities within the brain means more effective initial instruction and accommodations. This sequence shifts the focus from a unified strategy approach to one focused on student characteristics, brain mechanism, and continual educator reflection (Cao & Li, 2018). Addressing brain function



versus skill deficit allows the emphasis to shift from reactive intervention to proactive prevention.

Disruptive behavior and academic failure are causes for low student engagement and alienation (Quin, 2017). As students sit in situations and feel under-stimulated, bored, or unable to follow discussions, negative feelings emerge (Quin, 2017). Teachers and paraprofessionals need to act early during the instruction period to reduce these responses. The first fifteen minutes of instruction are an educator's opportunity to increase memory encoding and aid in arousal regulation to increase student engagement before a student feels alienated or disengaged. Deciding on how to address these needs requires understanding of what leads to students not comprehending and feeling under- or overstimulated. Making changes to procedures and adjusting classroom management techniques is difficult.

Change requires effort and may end with wasted resources and frustration (Kotter, 2012). According to Levenson (2012), teachers and administrators are better off stopping practices, even when politically or culturally accepted, if they are not helping students learn. Opposition between neuroscience and education offers no clear path to follow. Addressing this tension means identifying a viable solution that does not take sides but allows for creativity by those involved (Papa, 2011). Teachers and paraprofessionals will not accept professional development that makes little sense in their current situation (Kotter, 2012). This study provided professional development in a manner that calls for thoughtful reflection by educators and relates to the natural reflective cycle of teaching.

## Statement of the Problem

Students with disabilities such as ASD are underperforming their peers on state assessments. New Hampshire reported that only 20% of students with disabilities in grades 3–11 were at or above grade level expectations on the 2015 Performance Assessment of Competency Education (PACE) assessment for both English language arts (ELA) and mathematics (New Hampshire Department of Education, 2015). The report stated that students without disabilities were at or above level on ELA (48%) and mathematics (49.5%). The current 2018–2019 PACE report does not provide special education data due to noted disagreements with score validity and reliability among metric designs (New Hampshire Department of Education, 2015). When comparing the metric using the original cut score method applied in 2015, students collectively increased 15% from 2015 to 2018 (New Hampshire Department of Education, 2015). Federal acts such as the original Elementary and Secondary Education Act (ESEA), No Child Left Behind (NCLB), and the rewritten ESEA have consistently looked to increase student achievement. Individuals with Disabilities Education Act (IDEA) of 1973 established a specific process for addressing the needs of students with disabilities.

Teams of educational professionals use Individualized Education Plans (IEPs) to determine which services, specialized education, accommodations, and state assessments the student needs to meet the same competency level as peers in the specified setting. Students who are academically scoring more than two grade levels behind, have low adaptive skills, and are cognitively functioning two and a half standard deviations below their peers qualify for alternative assessment (New Hampshire Department of Education, 2018c). State data accounts for authorized alternative assessments written in these plans. Regardless of the assessment selected, the point of public education is to create citizens who can function as independently as

possible. Students achieve success when they graduate showing they have learned the skills and knowledge required to attain a diploma. The average graduation rate as of 2016 for students with disabilities in the United States was “66.5%, which was an increase of 6.5% from 2010” (U.S. Department of Education, 2015, p. 1). The highest rates for not receiving a diploma or for dropping out were associated with intellectual disabilities and emotional disabilities (National Center for Education Statistics, 2019). Two key reasons for secondary and postsecondary failure are self-regulation and social difficulties (White et al., 2016). ASD is notable for its association with self-regulation and social deficits, and when coupled with the comorbidity of intellectual and emotional deficits, provides a viewpoint on the actual severity of the gap. Although efforts are continually enforced by federal and state mandates, financial incentives, and standardized assessment measures, there is still a significant performance gap between students with ASD versus nondisabled peers.

Educational research involves posing a question, determining needed data, and collecting it, then trying to formulate an answer that results in an increase in knowledge or improved practice (Creswell, 2015). Educational research typically provides information within these major areas: teacher preparation programs, impact of teacher activities on student success, and learning to teach in different settings (Creswell, 2015). This study sought to improve practice by focusing on how teachers and paraprofessionals instruct and accommodate in traditional and small group settings. Several research studies have been conducted on how to meet the needs of certain students, students with specific profiles, and how to create intervention systems in schools (Bender & Waller, 2011; Bethune & Wood, 2013; Chin, 2018; Dessemonteta, Martineta, de Chambriera, Martini-Willeminb, & Audrina, 2019; Finnegan & Mazin, 2016). This action research study narrowed the focus of the problem to how memory impacts reading

comprehension and arousal impacts behavior. The setting for the study reflected a typical educational experience involving known and unknown uncontrollable variables. This study was an incremental step in bridging the gap between neuroscience and educational methodology research in a manner that addresses a real-world problem.

Students with disabilities, such as ASD, learn to decode words and read fluently but may struggle with comprehension (Bethune & Wood, 2013). The skills of seeing and identifying letters and words involve recognizing symbols, while comprehension involves context recognition and adding definitions of words together to form a larger context (Murgaugh, Maximo, Cordes, O'Kelley, & Kana, 2017). There are programs and strategies designed to increase comprehension but no single or set of consistent, reliable strategies for all students has been identified (Finnegan & Mazin, 2016). Direct instruction, questioning, teaching how one sentence relates to another (anaphoric expressions), and cooperative learning have shown promise in increasing comprehension in certain circumstances with variables controlled (Finnegan & Mazin, 2016). Graphic organizers, designed to organize information, show promise in increasing reading comprehension in the classroom with some teachers (Bethune & Wood, 2013).

Educators have used practices based in research that yielded little positive impact for a percentage of their students in their classrooms (Cook, Tankersley, & Landrum, 2009). The concern with evidence-based practices (EBP) is that there is no research standard for quality or effectiveness to validate best practice (Cook et al., 2009). Programs designed and evaluated in isolated environments, not traditional settings, reduce the factors normally addressed through professional judgment (Cook et al., 2009). Teachers account for language barriers, social barriers, and mental health issues while trying to accomplish teaching content and reading

instruction, often in the same instructional period. Educators and all those involved with creating educational methodology must be provided professional development and time to reflect on how students with disabilities learn and respond to their environment differently so as to construct an effective educational plan (Papa, 2011). The professional development needed does not exist in a single program, strategy, or approach, but in understanding the similarities within them.

Brain-based education and the terms associated with its principles are not new nor do they differ significantly from other programs and practices (Sen, Basar, Askin, & Turan, 2015). Many research studies done on brain-based learning vary in design and their recommendations should neither be used nor coined as innovative approaches (Sen et al., 2015). Neuroscientists agree that there is a relationship between learning and the brain but also caution making generalizing educational strategies. This study sought to address the issue of achievement of students with ASD through offering teachers and paraprofessionals professional development so they can construct their own brain-based strategies for initial instruction and accommodations. By focusing on how the brain functions and differentiating instruction by combining specific educational theories, learning becomes contextually biological and autonomic. We learn from birth through death, and aspects of this process seem to just happen without conscious thought. Increased learning happens when this process is used consciously by educators.

### **Purpose of the Study**

The purpose of this practical action research study was to explore how professional development focused on brain-based research informs educators' pedagogical design for students with ASD in whole and small group academic settings. According to the New Hampshire Department of Education Consolidation Plan, the actual percentage of students with disabilities who graduated in 2017 was 74.49% (2018b). Comparing this data to the New Hampshire 2018 Part

B, the Results Driven Accountability Matrix provides a figure that states 80% of students with disabilities graduated (2018a). Analysis of these report metrics led to the observation that graduation rates have decreased from 2014 to 2017 for students with disabilities. Estimation as of May 2017, showed 71% of students with disabilities were graduating with a diploma in the United States, which is close in percentage to New Hampshire's graduation rate of students with disabilities (National Center for Education Statistics, 2019). If the percentage of students with ASD is 10% of the total students with disabilities, then adding categories of common comorbidity and misdiagnosis brings the probable total to about 30% (National Center for Education Statistics, 2019). This presents an argument that New Hampshire is not statistically different from the rest of the United States, showing a similarity between New Hampshire's graduation data and the United States on average (National Center for Education Statistics, 2019). The problem is real and using data can provide the urgency that fuels change (Kotter, 2012).

Teachers and paraprofessionals must know why, what, and how to change instruction or the act is impossible. "Why" and "what" can be learned and kept as a set of strategies, but "how" is addressed in the moment and requires application of learning. The reasons for failure of students with ASD varies as the disorder has a range of characteristics and creates academic struggles (Anderson, Carter, & Stephenson, 2018). The greatest concerns tend to be in communication and interacting appropriately in social situations (Anderson et al., 2018). Students with ASD, even those in the average intellectual range, tend to have verbal expressive and receptive difficulties even if they do not receive direct language services (Anderson et al., 2018). These students do not always take in the information or are not able to provide complex answers to questions, and data shows they are not learning at the same level. Students who struggle with arousal may have accommodations or be placed in less stimulating environments, resulting in too low a cognitive

load, reducing interest in learning, and increasing off-task behavior (Jackson, Kleitman, & Aidman, 2014).

Shifting the thinking of educators from an academic standard and skill deficit focus for educational planning to an alignment with how students' brains function starts with adjusting instruction to meet the way the brain processes information and manages input (Cao & Li, 2018). Knowledge varies from subject to subject, but how a brain learns and manages information stays the same. By examining how the brains of students with ASD input information to memory and handle internal and external distractors, teachers and paraprofessionals can adjust the curricula and content-based practices they use to positively influence student achievement.

Examining how to reach more students through brain-based professional development that results in increased effective initial instruction is a logical and innovative way to increase teacher effectiveness and student learning outcomes, resulting in increased graduation rates. Allowing the level of current educational achievement and graduation rates to continue means accepting the status quo as optimal, and that is not professionally viable when there is a logical and innovative means of addressing students' needs.

### **Research Question**

The purpose of this practical action research study was to explore how professional development, focused on brain-based function and learning theory, can inform the decision-making of teachers and paraprofessionals for students with disabilities. The research study took the literature on brain-based teaching and neuroscience and applies the concepts to specific functions associated with deficits in learning for students with ASD. By asking those who work with students directly during instructional periods to reassess why, how, and what they are doing engages them in a form of action research. Any process of change must start with addressing complacency and

creating a team of professionals with the right characteristics (Kotter, 2012). Complacency stems from low performance standards, absence of an acknowledged crisis, and a lack of resources. By sharing the problem, purpose, and possibilities through professional development, complacency can change to possibility by increasing the sense of urgency in those instructing students. Teachers and paraprofessionals have the positional power and credibility to begin the change process. Providing them with the expertise through professional development is crucial for them to guide the necessary change (Kotter, 2012). The following central question begins to change the instructional process by increasing expertise and gathering the collective attitude of the group involved in the instruction of students with ASD. The following central question guides this study:

To what degree does brain-based professional development change how educators alter educational practice, including initial instructional design and accommodations, for students with Autism Spectrum Disorder?

### **Theoretical Framework**

Three diverse theories provide the conceptual framework for this study: Cognitive Load Theory (CLT), examining the capacity of the brain; Biosocial Theory, how environment plays a role; and Dual Coding Theory (DCT), examining how the brain codes information. These theories represent how the brain processes input, places things into memory, and maintains efficiency while trying to not get overloaded. Biosocial Theory provides insight into how an organism reacts to stimuli in their environment and how that stimulus response interaction creates learning (Cavazzi & Becerra, 2014). DCT moves beyond the interaction of stimuli to how the brain codes verbal and nonverbal input into memory for future retrieval (Paivio, 2014). CLT seeks to explain the capacity of the brain's working memory to show at what point the brain is most efficient (Kalyuga, 2011). Disabilities affecting the brain differ in name, complexity, and



severity. No single theory accounts for the complex learning issues found in students with ASD. This combination of theories provides a solid filter for teachers and paraprofessionals to apply their understanding of memory and arousal to the educational setting. Educational pedagogy requires an understanding of mental processes and how these processes, if understood and accounted for, can innovate educational pedagogy (Morgan et al., 2017). Brain-based learning provides a solid foundation for merging brain function and educational pedagogy (Edelenbosch, Kupper, Krabbendam, & Broerse, 2015; Saleh, 2012; Sen et al., 2015; Waree, 2017).

Schools use tools to measure the cognitive abilities of students to determine educational disabilities. By examining the impact of cognitive deficits, such as executive functioning and social/behavioral responses, from a neurological standpoint, a compilation of strategies to address these inner workings can be identified. Organizing and selecting instructional techniques and accommodations through brain-based learning shifts the design from an outcome focus to a brain-based one (Waree, 2017). This study utilized this knowledge, in the form of professional development, to inform educators, resulting in change in educational practice when they program for students with ASD. As educators review their current pedagogy in relation to the brain's executive functioning, specifically working memory and arousal, this information can be used in the reflective practice of teaching. Though the filters of Biosocial Theory, Dual Coding Theory, and Cognitive Load Theory, teachers begin to answer questions about how learning occurs, and innovation can be achieved (Ertmer & Newby, 2013).

### **Assumptions, Limitations, and Scope**

This study required the use of assumptions as it looks for meaning in a nonexperimental setting in which variables are unknown or uncontrolled. The participants in the study represent a typical set of educators within the school building. Participant data holds teacher and

paraprofessional bias that represents normal interaction guidelines indicative of most classroom settings. Educator formal assessments reflect actual data already collected by the educator. The insights provided by the participants are based on this data.

The major limitation of the action research findings lies in its relevance to other settings. Using a specified rural school, with teachers and paraprofessionals educating students in grades 3–6 only, limits the transferability of the data. However, the nature of the design and research question of the study still allow transfer to other settings. These limitations make the data limited in direct usage, but the nature of the methodology is still viable outside these limitations. The intervention focused on memory and arousal deficits found in students who have ASD. The participants of the study were the educators, teachers, and paraprofessionals who take part in designing specialized educational pedagogy for students with these identified areas of disability. The participants reflect common Individualized Educational Plan (IEP) team members who normally take part in this type of planning process.

### **Significance of the Study**

Knowledge about a topic increases what a person can do about that topic. This action research study sought to provide a replicable model for using professional development to inform educator practice and ultimately address the issue of low academic performance and low graduation rates among ASD students, approximately 15% below peers, and the continued practice of educating students in isolation instead of with peers due to their perceived behavioral concerns (National Center for Education Statistics, 2019; New Hampshire Department of Education, PACE Report, 2015; U.S. Department of Education, 2015). As educators become action researchers, their practice becomes reflective, making the idea of continued performance growth a reality (Menter, Elliot, Hulme, Lowden, & Hall, 2011). Because teams, not individual

educators, create student individualized educational plans, educating the team responsible for the education planning with similar knowledge and terms further promotes a team approach (U.S. Department of Education, 2005).

This type of intervention applies to other impacted cognitive abilities, not just memory and arousal, which broadens the scope and perspective of future action research. By selecting other disabilities and disorders similar to ASD and targeting what function of the brain is similar in causing difficulties, the theories utilized here could create filters for additional action research. As individual teachers and members of the educational team use brain research, the collective impact can grow between teams at the same grade level. Eventually, the overall system may transform in such a manner that individual class and grade level action research informs larger systemic approaches and guides professional development needs. As students achieve more in elementary education and the system evolves, the success rate of students, not just in school, but in postsecondary endeavors also increases. Higher graduation and success rates lead to more students participating in society and getting jobs.

### **Definition of Terms**

The following definitions supply terms used and explained in the text.

**Activated long-term memory.** Information paired with associations and stored with unlimited capacity (Liefoghe, De Houwer, & Wenke, 2013).

**Attention Deficit Hyperactivity Disorder (ADHD).** “Disability associated with deficits in neuropsychological measures of [executive function] (EF), such as planning, spatial and verbal WM, response inhibition, and vigilance” (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005, p. 1336)

**Arousal.** The physiological state and set of behaviors associated with a person being in an alert state (Kleberg, 2015).

**Autism Spectrum Disorder (ASD).** Neurological disorder associated with impairment in social interaction, social situations, and behavior (Autism Speaks, 2019).

**Biosocial Theory.** Model, derived by M. M. Linehan, used to look for causes of Borderline Personality Disorder through how a person handles environmental interaction such as arousal (Crowell, Beauchaine, & Linehan, 2009).

**Cognitive Load Theory (CLT).** “Our working memory can store only about seven elements of novel information at any time (Miller 1956) while using about two to four of those elements” (Rittschof, 2010, p. 108).

**Developmental delay.** A catch-all category that can be used until age 10 for students exhibiting deficits in “cognitive development; communication development; social or emotional development; or adaptive development” (New Hampshire Department of Education, 2019, Table 1100.1).

**Direct access memory.** Information categorized but not necessarily incorporated into schemas through practice and has limited storage capacity (Liefoghe et al., 2013).

**Disability.** Term used for the disabling condition used to identify a student under special education (New Hampshire Department of Education, 2019).

**Disorder.** Medical term used to show that a person has a mental or physical condition that is not considered normal or within normal limits (Merriam-Webster, 2019).

**Dual Coding Theory (DCT).** DCT means that humans code or assign labels to things within their environment using verbal and nonverbal cognitive skills (Paivio, 2014).

**Executive Functioning (EF).** “The executive functions are a set of processes that all have to do with managing oneself and one's resources to achieve a goal. It is an umbrella term for the neurologically based skills involving mental control and self-regulation (Cooper-Kahn & Dietzel, 2017).

**Extraneous load.** Involved when learning sequences are disjointed, involve information not related, or mediums that shift the focus for the individual's attention away from the “task specific learning” (Kalyuga, 2011, p. 3).

**Initial instruction.** A term used in this study to describe the first fifteen minutes of direct instruction by either a teacher or paraprofessional within a class period. This timeframe includes the introduction or review of information provided during a previous lesson.

**Response to intervention (RtI).** “. . . a multi-tier approach to the early identification and support of students with learning and behavior needs. The RtI process begins with high-quality instruction and universal screening of all children in the general education classroom. Struggling learners are provided with interventions at increasing levels of intensity to accelerate their rate of learning” (Buffum, Mattos, & Weber, 2012, p. 12).

### **Conclusion**

Utilizing brain-based professional development to address the problem of students with disabilities such as ASD is based on the idea of brain-based teaching, but offers an innovative approach to solving a current issue in classrooms and helps bridge the current gap between neuroscience and educational practice (Edelenbosch et al., 2015). Through action research the reflective process of teaching can be positively influenced by leadership and provide the means for teachers and paraprofessionals to better prepare and construct effective educational pedagogy, specifically the instruction during the first fifteen minutes and the accommodations

that must be in place to increase access to the learning environment as a whole. This focused aspect of pedagogy aligns well with memory and arousal as learning sessions tend to open with either a larger concept or tie to a previous lesson. Students who miss this initial instruction can feel lost for the remainder of class, which exacerbates the problem by increasing anxiety and decreasing engagement (Orekhova & Stroganova, 2014). In this study teachers and paraprofessionals reflect on how this brain-based information could influence their actions, providing qualitative data into how the educators see this knowledge increasing student achievement on formative assessments.

This study identified the impact that brain-based professional development can have on how teachers and paraprofessionals initiate instruction and accommodate students. Chapter 2 reviews the literature supporting the conceptual framework. Chapter 3 discusses the methodology of the action research study, including participants, setting, and the type of data collected. Chapter 4 discusses the findings, including the participant profiles, survey questions, and interview questions. Chapter 5 concludes the study with the interpretation of the findings, implications, recommendations, and concluding thoughts. Appendices are located at the end to provide a sample of the permission letter, questions posed to participants, blank survey, and the professional development information shared with participants.

## CHAPTER 2

### LITERATURE REVIEW

The following literature review provides a structure for viewing an innovative approach for designing educational pedagogy from a brain-based focus. The literature stems from the fields of neurology, psychology, and education. The process of learning is seen as behavior, not a result of action by an educator. Beginning with the desire to address the perceived gap between the success rate of students with disabilities and their nondisabled peers, instruction quickly became the focus. Reducing the target population from all students to a category with similarities to other disorders and disabilities provided more focus. Understanding the comorbidity among disorders and disabilities coupled with the variance in methods of identification made the selection of ASD a logical one. Common dominant learning challenges were identified by examining the neurology of students with ASD, then compared to the disabilities and disorders that had high comorbidity. Research into the achievement gap, review of a popular systematic intervention, and review of current practices provides the scope of the problem and the need to move away from isolated educational research for the solution. Correlating the neurologically defined struggles of students with ASD to brain-based learning shifted the thinking to attacking the learning difficulties from a neurological standpoint. By applying learning theories that dealt with learning from a biological and functional organic viewpoint, filters for applying the brain-based information were established.

The literature review provides both primary and secondary sources for the purpose of covering the vast amount of information and past research in a manner more focused on the distinct purpose of this action research study. The literature spans the fields of psychology, neurology, and education. This research stems from the University of New England online

library, state educational websites, Education Resource Information Center (ERIC), National Center for Educational Statistics (NCES), and educational books and journal articles focused on addressing academic needs in schools. Through examining sources focused on how certain brain functions are associated with learning, others on how learning is a biological response to stimuli, and how the brain cognitively processes information, this study provides a lens for examining learning from a collective viewpoint.

As students learn in diverse environments with uncontrolled variables, this literature review utilizes a combination of primary studies in controlled environments and secondary studies comparing the effectiveness of techniques in certain environments. This creates a new filter for examining what teachers and paraprofessionals should consider when designing educational pedagogy in traditional settings. Working memory and arousal impact students' reading comprehension and maintenance of appropriate behavior in class (Morgan et al., 2017; Orekhova & Stroganova, 2014). The theories provide filters for teachers and paraprofessionals to use in conjunction with their curricular sources, training regarding learning and retention of information, and how to teach students to maintain acceptable behavior in class. Educators can then apply this knowledge in a continual reflective process of teaching, collecting data, reviewing impact, adjusting, and teaching again (Menter et al., 2011). The literature that follows provides a brief understanding of brain function, learning theories, current educational practice, and possibilities for specializing and innovating educational practices moving forward.

### **Brain-Based Learning**

In recent years there has been an increased focus on understanding how learning and the brain relate in practice (Edelenbosch et al., 2015). Unfortunately, there have been arguments between neuroscientists and educators on how best to approach the idea (Edelenbosch et al.,



2015). The brain-based teaching approach (BBTA) is an innovative approach to bridging the gap between neuroscience and educational practice (Edelenbosch et al., 2015). The BBTA focuses on three aspects: lowering threat levels and increasing challenge; immersion into the learning environment; and allowing students to take in, think about, and understand information. By breaking down these aspects into tasks or opportunities, educators can make sure each of these is present in each learning opportunity. By selecting key details from the BBTA and correlating them to specific brain functions, this study evaluated the influence of professional development about brain-based learning designed to help teachers and paraprofessionals innovate initial instruction and accommodation designs for students with ASD.

Five specific pieces are required for learning: emotions aid in understanding learning processes; threats inhibit learning; meaning comes from patterns and associations; attention and perception increase active processing; and memory is for attaining facts, skill sequences, and making sense of experience (Edelenbosch et al., 2015). An executive functioning focus on memory and arousal addresses these pieces.

### **Executive Functioning**

Executive functioning helps humans organize actions for the purpose of completing a task (Cooper-Kahn & Dietzel, 2017). Intelligence measures mental capability and is measured by using tools aligned to individual brain capacities, which result in a set of scores (Sattler, 2008). Executive functioning is the guiding force that allows individual brain functions to work in varying designs to achieve a goal (Cooper-Kahn & Dietzel, 2017). Students must use multiple parts of their brains at one time to function in the classroom and learn new material and skills. Focusing on the executive pieces allows learning to stem from the collective functioning of these pieces and not just the individual components.

“Executive function and self-regulation are the mental processes that enable us to plan, focus attention, remember instructions, and juggle multiple tasks successfully” (Harvard University, 2019, para. 1). Executive functioning is a set of three major functions of the brain: working memory, mental flexibility, and self-control. Working memory controls one’s ability to take in and manipulate pieces of information in the moment and for a limited time (e.g., remembering a phone number). Mental flexibility refers to being able to sustain and shift attention to different demands and tasks. Self-control refers to a person’s ability to resist acting and to decide what things must be achieved sequentially (Harvard University, 2019). Working memory, a significant factor in learning, is a primary function of the neuronal activity within the prefrontal cortex, and stores significant past representations (Lara & Wallis, 2015). This information provides evidence to make the connection between encoding of stimuli and working memory (Lara & Wallis, 2015).

### **Comorbidity**

As the brain guides all actions it makes sense that any disorder or disability that is associated with learning, emotion, behavior, language, and neuromotor weaknesses must share some similarities within the brain. When professionals place symptoms under the primary condition and symptoms are not addressed fully, comorbid diagnosis does not occur (Hendriksen et al., 2015). Comorbidity among intellectual problems, ADHD, and ASD is a common occurrence (Hirabaru & Matsuo, 2018). Comorbidity between ASD and anxiety-based disorders is also common (Hirabaru & Matsuo, 2018). When misunderstanding and/or underestimation of cause leads to the use of various strategies without understanding, the instructional choices made by a teacher or paraprofessional risk not working as intended. Brain-based learning allows a shift away from addressing the specific differences in strategies to targeting similarities within the

brain, making instruction in large groups more effective by these educators. As ASD shares comorbidity with other types of disabilities, selecting a key brain area impacted by ASD, such as executive functioning, allows studies for other disorders and disabilities to be relevant to the information presented here. Additionally, this comorbidity creates the ability to correlate future action research that focuses on similarities in brain function among other disabilities and disorders.

### **Executive Functioning in ASD**

Executive functioning deficits are a neurological symptom of ASD (Ozonoff & Jensen, 1999). There is a high correlation of deficits in cognitive flexibility, planning, and working memory in these individuals (Ozonoff & Jensen, 1999). Children with ASD also present with deficits in their ability to sustain attention on demand, inhibit their response to stimuli, and shift between stimuli or foci of attention (Ozonoff & Jensen, 1999).

In addition to studies of executive deficits within children with ASD, executive functioning deficits are closely correlated to ADHD (Anagostou & Weele, 2018; Krakowski, 2018). This similarity allows research on executive functioning deficits in students with ADHD to relate to students with ASD. The ability to plan, remember things, and inhibit actions are significantly higher in some children/adolescents than others, providing a characteristic for identifying students as ADHD (Willcutt et al., 2005). In addition, attention sustainability, reaction times, commission/omission errors, and visual memory are less developed in students with both ASD and ADHD when compared to individuals with ASD but without ADHD (Ahmadi et al., 2013). The structure of the brain and set of characteristics exhibited by both students with ASD and ADHD reinforce the use of information regarding inattention, hyperactivity, and impulsivity (Anagostou & Weele, 2018; Krakowski, 2018).

In comparing the executive deficits between individuals with autism and ADHD, more than half the students diagnosed with just one or the other disorder individually possessed both characteristics and symptomologies (Leitner, 2014). These correlated deficits include attention (sustained and divided), working memory, and fluency. In addition, both groups required more time to complete working memory tasks and provided fewer responses in a set amount time for fluency tasks (Craig et al., 2016). Flexibility, planning, and response inhibition were additional deficit areas that overlapped; however, cognitive flexibility deficits were more pronounced in ASD. Students with ASD are impacted by a cadre of issues, and the similarities to other students, such as those with ADHD, allow a broadening of research options when addressing these issues.

### **Brain Function**

The human brain consists of parts working both independently and in unison. Over the years studies have alluded to the fact that when more areas of the brain are engaged during learning, chances are higher that long-term memory will result (Bender & Waller, 2011). There is no clear executive functioning profile for students with ASD; however, a cadre of deficits are prevalent (Zimmerman et al., 2016). Regardless of the profile, low or high functioning, memory is an issue (Chantiluke et al., 2015; Griffin, 2015). Arousal, sensory modulation, and attention are all areas associated with ASD (Chin, 2018; Grzadzinski et al., 2011; Orekhova & Stroganova, 2014). Understanding how memory is accomplished and arousal is regulated are major factors in designing appropriate instruction and accommodations.

### **Memory**

Memory is long-term storage and temporary processing of information, collectively forming working memory load. Germane load on the brain consists of what is actually needed to be learned, whereas intrinsic load involves the brain's capacity to hold on to how individual

pieces are put together to form larger ideas and concepts (Kalyuga, 2011). Repetition and practice develop larger capacities in the brain due to increased pathways. The use of certain mediums increases the encoding of information. Van Merriënboer and Sweller (2005) reaffirmed the idea that the average individual can hold only about seven things in their mind while only manipulating and focusing on about four pieces of input and/or information. The average memory represents active thinking and responding, either consciously or not. Long-term memory has no limitation on coded information (van Merriënboer & Sweller 2005). Reducing cognitive load increases working memory capacity by reducing extraneous, or external, demands, and intrinsic, or internal, demands increase the capacity to code more information into long-term memory. The more information that ends up in long-term memory, the less space is occupied during the learning of novel information.

Studies have found that biological organisms respond to stimuli in their environments (Brindle, Moulding, Bakker, & Nedelkovic, 2015; Green et al., 2015; Scarpa, 2015). The responses are more reactionary than planned in response to a known event, providing the idea that learned responses require little formative thought (Green et al., 2015). Liefoghe et al. (2013) examined the concept that one task activates by the responses of another. This provides an understanding of how the intrinsic memory forms. Eating, coughing, and walking are aspects of long-term memory utilized without conscious thought. According to Kessler & Merian (2010, as reported in Liefoghe et al., 2013), increased load reduces or stops the learning of new responses gained through instruction, whereas those created by a stimulus response style activation remain intact. If learning happens through stimulus response, then it is retrievable when the brain is under increased load.

Memories that are not easy to recall, have not been studied, or are not part of a larger picture of information fall into the category of direct access (DA) memory. This information is categorized but not necessarily incorporated into schemas through practice. The more the brain practices these responses, in single and multiple designs, the faster the reaction time of retrieval resulting in an increase of long-term memory instead of direct access memory (Campoy, 2017; Liefoghe et al., 2013). While DA memory has limits, activated long-term memory (ALTM) does not (Campoy, 2017; Liefoghe et al., 2013). An increase in pairing and practice means less DA memory. How much it takes to shift material depends on the information, the amount of practice, and the individual's attention during instruction. ALTM activations are also less susceptible to being lost during periods of high cognitive demand, which decreases overall stress and allows the brain to manage other things (Liefoghe et al., 2013). To achieve proper capacity and efficiency of memory, an understanding of the inner workings of memory is essential.

### **Arousal**

Arousal is the physiological state and set of behaviors associated with a person being in an alert state (Kleberg, 2015). Understanding how the brain establishes this state, returns from it, and how its associated behaviors impact learning is crucial to establishing effective educational practices. The autonomic nervous system maintains a single state of arousal and shifts that state up or down (Cavazzi & Becerra, 2014). This system is a natural defense and the perception of negative stimuli or an abundance of a singular stimulus activates the response innately. More than 50% of students with ASD have an extreme reaction to the stimuli they process through their senses, called sensory over-responsivity (SOR) (Green et al., 2015). This means that when a person with ASD experiences an unwanted stimulus, such as denial of something or a loud sound, their level of response is extreme. Students with ASD are often not in balance, as the

subset of the autonomic nervous system, the sympathetic nervous system, is maintained at a heightened state, meaning they stay at a higher rate than a typical person, making a little more stimulus harder for them to handle (Cavazzi & Becerra, 2014). Behavioral writeups and assessment checklists record these differences during the special education evaluation process. Gerber (2005) argues that schools identify the needs of students based on how well they respond to stimuli that align with the expectations of the school or classroom or the tolerance of staff.

Social situations including verbal stimuli, visual stimuli, and even physical stimuli, such as proximity or touch, are common. Orekhova and Stroganova (2014) discuss the growing body of research that has linked arousal to social deficit symptoms. During social interactions, emotion tends to come into play. Adjusting to the changing state of an interaction requires arousal and its function in adjusting emotion and temperament (Scarpa, 2015). Reactivity refers to a person responding to an emotional stimulus, but regulation is how one alters that response to the changing situation (Scarpa, 2015). When a student with ASD reacts differently and cannot modulate appropriately, they stand out publicly as they have exceeded the tolerance of the group.

Social anxiety involves the innate reaction students with ASD have in relation to social interactions. In this case, a student with ASD would experience an autonomic response to social situations, as they have a low social motivation and desire to fit in or meet social norms (Factor et al., 2017). Unfortunately, this state of individuality can often lead to increased victimization due to bullying or harassment, which in turn creates a pattern of reinforced anxiety responses (Scarpa, 2015). If anger results and eliminates the negative stimuli over time, this stimulus response may be generalized and habituated. Sensory over-responsiveness (SOR) and sensory-processing sensitivity (SPS) create a two-fold issue for students with ASD, as they are naturally at risk for overresponding to initial stimuli but also are at risk for how they respond to stimuli,

resulting in higher chances of anxiety and depression (Brindle et al., 2015). As students try to pay attention and learn material, they must also deal with these deficits which impact the available effort for learning.

### **Psychometrics**

Diagnostic assessments focus on determining an individual's strengths and weaknesses in specific areas, such as cognition, emotion, and behavior. These are often standardized assessments in which the individuals' scores represent their normative age level. School settings use these forms of assessment to determine learning, behavioral, and/or social-emotional concerns for individual students. It is often this data that helps direct a team of educators and other stakeholders toward specific skill areas and interventions that would be beneficial to meet a learner's needs (U.S. Department of Education, 2018). Instructional designs and accommodation details are derived from these instruments, and influence the help provided to students in various learning environments. Students may require remedial skill training to account for slower skill development, memory aids, accommodations to reduce the impact of external stimuli, more time to process, or other basic skills. The following assessments are used to inform these decisions in conjunction with team member input (New Hampshire Department of Education, 2019).

#### **Executive Assessment**

Executive deficits often are determined via informant scales or performance measures (Bailey, Andrzejewski, Grief, Syingos, & Heaton, 2018). Throughout the developmental years, scores represent the capacity and efficiency of these skills from birth to maturity. As executive functioning begins in the early developmental stage, it is highly accelerated during late childhood and early adolescence (Bailey et al., 2018). The Behavior Rating Inventory of Executive Function, Second Edition (BRIEF-2) is a set of Likert scale-based questions, to be completed by



teachers, parents, and the individuals themselves. The reliability of the instrument comes from a national representation of 3,600 case samples (Gerard, Isquith, Guy, & Kenworthy, 2015).

Questions within the BRIEF-2 address observable behaviors in the areas of inhibition, self-monitoring, shift, emotional regulation, initiation, organization, and working memory. The widespread use of this tool and the link to academic achievement led to its selection in this study (Bailey et al., 2018).

### **Intelligence Assessment**

Certain assessments establish an intelligence quotient or overall cognitive score. The Weschler Intelligence Scales for Children, Fifth Edition (WISC-V) is an example of a cognitive assessment used to determine an individual's verbal reasoning, nonverbal reasoning, working memory, and processing speed abilities (Sattler, 2008). According to Weschler, intelligence is a person's total cognitive ability to interact with their environment and all things that may provide stimuli (Sattler, 2008). The Differential Abilities System, Second Edition (DAS-II) is another example of a cognitive assessment measuring verbal ability, nonverbal ability, working memory, spatial ability, and processing speed (Sattler, 2008). The Woodcock Johnson-IV is a cognitive abilities test that uses ten basic tests and up to 8 additional tests to establish the cognitive functioning of a person (Reynolds & Niileksela, 2015). The instruments mentioned above capture an individual's ability to perform the components of Weschler's view of intelligence. These assessments help provide a comparison of cognitive functioning associated with how a student's brain is working, by specific region or function, in relation to the typical student.

### **Academic Assessment**

School staff determine educational impact when considering if a difficulty in learning is associated with an identifiable disability. Schools require that teachers assess students during the year. These assessments are both formative, happening during the learning process, and summative, at the end of a learning sequence (New Hampshire Department of Education, 2005). The combination of the assessments and grades identify how different a student's academic achievement is from his or her peers or national norm (New Hampshire Department of Education, 2019). Additional standardized assessments are essential in determining skill and academic ability deficits in learners (New Hampshire Department of Education, 2019). Examples of these types of assessments used are the Woodcock Johnson fourth edition, and the Weschler Individual Academic Test third edition, among others. The Woodcock Johnson fourth edition consists of subtests designed to assess basic academic skills and little content knowledge as well (Reynolds & Niileksela, 2015). The Weschler Individual Academic Test third edition "includes 16 subtests to measure listening, speaking, reading, writing, and mathematics skills" (Sattler, 2008, p. 267).

### **Emotional/Behavioral Assessment**

Increasing the social emotional learning (SEL) of children and young adults has become a focus for schools (McKown, 2017). Unfortunately, a limitation in the scope and depth of the available assessments, often focusing only on certain aspects, reduces effectiveness (McKown, 2017). There are a range of rating scales and structured interviews used to identify varying levels of emotional and behavioral functioning. SEL skills change in quantity and in effectiveness of use during child and adolescent development (McKown, 2017). In determining social and

emotional typicality and concerns, the Behavior Assessment System for Children (BASC) is a tool that assesses levels of functioning in the areas of emotional response, behavioral response, and the likelihood of an underlying disorder or disability (Merenda, 1996, p. 229). Teams use these assessments to determine what behaviors are based on a disorder or disability versus enculturation or choice. This helps teams understand how the student processes emotional and behavioral interactions.

### **Use of Assessments in Education**

Different disability categories, as stated in the Standards for the Education of Children with Disabilities section 1107, require different assessments by specifically qualified examiners (New Hampshire Department of Education, 2019). Teams of educators and specialists, as outlined in Chapter 1100 of the same document, meet to discuss the results of these assessments and the combined impact on a student. In the case of ASD an academic, adaptive, communication, and health assessment are the minimum required assessments (New Hampshire Department of Education, 2019). This does not mean that other assessments such as a cognitive or intelligence test cannot be used or considered in determining eligibility or how to help a student learn in general. In schools, school psychologists and other specialized personnel provide these assessments to students. In using these types of assessments, information can be provided as to how intelligence and emotions play a role in the child's learning.

### **Biosocial Theory**

Biosocial Theory proposes that biological organisms, human in this case, interact with their environment, which includes other human beings, and behavior is a response to this set of stimuli (Cavazzi & Becerra, 2014). There is no single behavioral theory that is associated with ASD. To identify a theoretical foundation to describe the interaction between student and

environment, this study starts with the research-based interventions that show the most promise in addressing behaviors. By examining Dialectic Behavior Therapy (DBT), based on Linehan's Biosocial Theory, two factors emerge for treating emotional and behavioral dysregulation. The first is the need for therapy, such as Cognitive Behavior Therapy (CBT), and the second is skill response acquisition. Therapy is its own entity and beyond the scope of this study. According to Brown (2016), biosocial theory is the theoretical underpinning of DBT. Biosocial theory is strongly associated with understanding Borderline Personality Disorder (BPD), a psychiatric disorder (Crowell, Beauchaine, & Linehan, 2009). Biosocial Theory links disorders that cause change in mood, energy level, and activity level, such as bipolar disorder, to susceptibility to hyperactivity and hyperarousal that have gone unchecked since childhood (Cavazzi & Becerra, 2014). More than half of the students with ASD have been known to have one or more psychiatric disorders that go unidentified, making Biosocial Theory a viable filter (Simonoff, Pickles, Charman, Chandler, Loucas, & Baird, 2008).

The base factor of BPD, how a person regulates arousal, shares characteristics with those found in ASD. According to Biosocial Theory, the stimulus response interaction sits within the autonomic nervous system (Cavazzi & Becerra, 2014). Within this system there are two opposing factions—parasympathetic and sympathetic—the first trying to maintain a stable calm system and the second looking to mobilize the person during activity. It is in this balance that the theory can aid in filtering instructional design. When Dialectic Behavior Therapy (DBT) is associated with Biosocial Theory and the idea that students may have undiagnosed underlying psychiatric disorders, a new theoretical synthesis emerges. Gross and Thompson (2009, as cited in Brown, 2016) described that a person brings attention to a situation once relevant, then appraises the situation and responds based on that appraisal. This process also has a temporal

factor as individuals respond early and late to stimulus (Brown, 2016). The first reaction by an individual tends to be immediate based on their perception in the moment. Later, they respond to whatever pieces remain after initial processing and filtering. The initial response does not always end in learning, but is processed later, thus impacting the initiation and reinforcement of learning. Students with ASD are impulsive and tend to respond quickly, then respond later after processing is completed. As these students tend to have a higher base arousal level than their peers it is crucial to understand how these two response activations occur (Cavazzi & Becerra, 2014).

### **Socially Acceptable Behavior**

What is socially acceptable? This idea varies from situation to situation. The one main factor is that to be social means a person must interact with their environment. Social skills in this context are a compilation of a person's emotional and behavioral responses to stimuli in their environment (Brindle et al., 2015; Green et al., 2015; Jackson et al., 2014). The following body of literature examines what social skills are and the interaction required by individuals within their environment.

Social skills are a compilation of interpretations and actions that people use when engaging with others within the environment (Factor et al., 2017). In school these social skills involve adhering to behavioral norms. The information a person receives from their environment has many forms and is processed by innate responses, such as squinting at light, or through learned outcomes such as saying hello when meeting someone for the first time (Green et al., 2015). ASD and other disabilities, especially ADHD, share similarities in how they affect individuals. Thus, it is crucial to examine research on self-monitoring through studies that explicitly target this brain-based limitation instead of looking at a specific disability. According

to Alsalamah (2017), students with ADHD engage in tasks such as talking more than is acceptable, interfering in social interactions, and acting impulsively when it is not socially acceptable to do so. These issues in childhood can lead to an absence of relationships and make learning opportunities for social, academic, and functional skills difficult to develop.

Complexities of social interactions lead back to the idea of a person trying to remember social rules while listening to words and formulating responses. This amount of load taxes the brain and can make the interaction difficult for the person to follow (van Merriënboer & Sweller, 2005).

People grow and develop the skills they need to learn and they must exhibit increased complexity of those skills with little time for practice and repeated exposure. This causes increased difficulties for those who are exhibiting socially isolating behaviors. Changes in peer culture and settings, as well as an increase in expectations of behaviors are associated with natural maturation through adulthood (Carter et al., 2014).

### **Environmental Input**

A common issue for students with ASD is the handling of input from the environment (Brindle, 2015; Green et al., 2015; Jackson et al., 2014). How one manages input from the environment such as light, sound, temperature, and visual motion is referred to as Sensory Processing Sensitivity (SPS) or simply sensory processing (Aron & Aron, 1997, as cited in Brindle et al., 2015). Social situations, especially in schools, involve more than two voices, bells, lights, movement, and heat differences, which add to the total amount that an individual must process. Research has shown that students, such as those with ASD, who have SPS suffer from negative psychological symptoms, such as stress and anxiety (Sheaffer, Golden, & Averett, 2009). The impact of SPS on individuals can vary. Two major concerns that directly impact social situations are unpleasant arousal and mental overload (Sheaffer et al., 2009). Arousal is

the heightened state resulting in excessive laughing or the feeling of your skin crawling. Both aspects are distracting and make one appear socially awkward. The mental overload aspect directly impacts processing of information by increasing the overall cognitive load. Gratz and Roemer (2004), as discussed in Sheaffer et al. (2009), state that emotional regulation can reduce the impact of SPS. They proposed six processes associated with emotional regulation: awareness of the problem, response protocol, negativity levels, lack of regulation skills, and goal setting (Shaeffer et al., 2009). Addressing these areas is crucial to overcoming the effects of SPS and allowing social skills to develop effectively.

### **Dual Coding Theory**

Dual Coding Theory (DCT) simply means that humans code or assign labels to things within their environment using verbal and nonverbal cognitive skills (Paivio, 2014).

The idea of intelligence has transformed and shifted over the years and is now seen as a combination of handling verbal and nonverbal information (Paivio, 2014). This researcher rejects the idea that human intelligence is based on the function of individual subsystems and not a collective action of the subsystems, as human beings function holistically and cannot simply use one function at a time within their environment.

Dual Coding Theory develops the idea that individuals identify items through referential processing, the defining of something as it relates to other things, which begins in the earliest stages of development (Paivio, 2014). Adding haptic coding and placing these encodings in verbal and nonverbal forms, the schemas thus created enhance memory acquisition while lowering cognitive load. This idea allows learning such as specific emotions to be tied to names and actions within a contextual framework. Instead of trying to simply pull out the name to remember the action, a person could pull out the action or the feeling to remember the name.

DCT, from a reductionist standpoint, means there is no need to do all of one thing or another when a bit of both could work just as well (Clark & Paivio, 1991). This applies when providing music and movement steps to a learning progression requiring the auditory and haptic aspects of the theory. Again, explicitly connected learning increases intrinsic load, while nonconnected learning increases extraneous load. Regardless of the medium, cognitive load is not limitless.

Through examining these theoretical constructs and applying them in unison, instructional implications can be made with purpose and intent (Anfara & Mertz, 2015). An understanding of how to balance intrinsic and extrinsic load is gained by better understanding the capacities of memory. Dual Coding solidifies the need for different mediums during instruction. Biosocial Theory provides a solid foundation for how interactions with an environment can alter arousal and attention. Combining these filters allows a holistic view of educational pedagogy.

### **Cognitive Load Theory**

Understanding that any brain function has limits requires the review of Cognitive Load Theory (CLT). According to Kalyuga (2011), Cognitive Load Theory states that the brain's working memory has limits in both capacity and duration. According to Ginns and Leppink (2019), cognitive load can be viewed as all of the processes that require the use of working memory, ranging from comprehending visual or auditory information to correlating things and solving problems, real or imagined, in the present, future, or past. This means that an average human's working memory, used for all higher cognitive functions, must allocate resources and space, which in turn means prioritization to assure learning.

Cognitive Load Theory provides the concept that learning involves working memory holding information during processing for storage in long-term memory. According to Baddeley and Hitch (1974), as cited in Sepp, Howard, Tindall-Ford, Agonstinoh, & Paas (2019), working



memory is a term used to describe the manner in which humans access information, hold it, and manipulate it in order to accomplish a relevant task. According to Kalyuga (2011), cognitive load theorists agree that load separates into intrinsic and extrinsic categories. Intrinsic load means the combination of specific knowledge and any interactions between pieces of knowledge in larger contexts, such as knowing the forms of water and how they fit into the water cycle (Kalyuga, 2011). Extraneous load involves all the other things that the brain must process that are not causally related to the learning task explicitly (Kalyuga, 2011). Extrinsic load can include coloring the states on a map while trying to learn the names of the states, as the coloring is not directly being applied to the memorization of the names. Within this idea, this study utilizes a combination of tasks regarding working memory and long-term memory to provide a larger conceptualization of how memory works in its simplest form so it can be applied by educators.

Remembering that intrinsic load is positive is important, as it allows information to be attended to and processed. In examining the differences in memory, total load is still a factor; there can be too much of a good thing. Multimodal mediums (Sepp et al., 2019), extraneous tasks (Kalyuga, 2011), element interactivity (Paas, Renkl, & Sweller, 2003), and practice (Kalyuga & Singh, 2016; van Merriënboer & Sweller, 2005) all require consideration when discussing memory and load. These considerations regarding working memory do not represent the total list of research and consideration in the current literature. The focus on load allows the researcher to see how reducing one aspect that impacts working memory efficiency could affect how teachers present information. Additional areas for future studies involve individual and combined research opportunities to show exponential impact.

## **Extraneous Load**

Extraneous load stems from disjointed learning sequences, erroneous information, or mediums that shift the focus of the individual's attention away from the task at hand (Kalyuga, 2011). This means lesson structure, sequence, and design can create more load than required to meet the objective of the lesson. Broad definitions that involve understanding similarities of other items and focusing on writing style instead of content present more items to consider than are directly relevant to the present task at hand. As students with ASD struggle with handling sensory stimuli such as people talking off to the side, bright lights, and internal thoughts unrelated to the task, the idea of intrinsic load must be considered by teachers and paraprofessionals during instruction as these items can be environmentally accommodated. Time can also be seen as an extraneous load factor when visual representations are referred to but not currently present, as this involves trying to picture something out of context (Kalyuga, 2011).

## **Multimodal Instruction**

Multimodal instruction involves presenting information and task initiation prompts in verbal, visual, physical gestures, and/or whole-body movement (Sepp et al., 2019). What individuals see, hear, smell, touch, and experience through whole body movement involves cognitive processes. According to Sepp et al. (2019) different mediums elicit different attention foci which are processed interdependently and thus are given more attention, resulting in a higher chance of being remembered. Multiple stimuli on the same element of learning represent intrinsic load; however, if these are not explicitly linked they can increase extraneous load, reducing overall cognitive capacity.

Multimodal instruction provides educators with tools to balance the needs of the curriculum with the learning needs of the student (Kennedy, Deshler, & Lloyd, 2015). Although

students with ASD suffer deficits in brain functions, it is not clear if this transfers to multimodal instruction (Lerner, McPartland, & Morris, 2013). Students with ASD utilize a mixture of previously acquired knowledge retrieval, and automatic and cognitive strategies based on interpreting situations as they unfold (Lerner et al., 2013). The Cognitive Theory of Multimedia Learning (CTML), provides a student-centered approach for addressing learner needs by leveraging visual and auditory input from the environment (Kennedy et al., 2015). There are three specific cautions when using multimodal techniques, as they influence memory and arousal directly: limit narration, provide visual/verbal cues to focus attention, and limit extraneous imagery (Kennedy et al., 2015). In addition, students with ASD who have processing speed concerns in one modality may have the same processing deficit in another medium (Lerner et al., 2013).

### **Element Interactivity**

Element interactivity is the process of memorizing a definition but not actually knowing what all the words making up the definition mean. The idea of element interactivity begins to form when rote memory tasks for vocabulary are applied to concepts. When specific information must be understood in order for a larger, more intricate system to be understood, it is considered high element interactivity (Paas et al., 2003). Depending on the learner's style, trying to provide the larger picture of learning while describing the individual pieces creates extraneous load, as the larger picture or pieces lack relevance in the moment. More familiarity with a topic can increase element interactivity for individual learners.

### **Expertise**

In determining the difference between intrinsic and extrinsic load and to focus on the learner's experiences, practice can become synonymous with expertise or experience. Routines

that are practiced and create schema are not bound by limitations in working memory, as with unrelated items (van Merriënboer & Sweller, 2005). The construction of associations and practice of tasks in proper learning sequences encode information into memory in a way similar to domain specific schema (specific association) and nondomain related schema, (loosely related). When this sequence occurs, meaning leads to expertise (Kalyuga & Singhe, 2016).

### **Current Pedagogy**

Schools are large entities that have departments and staff that interact and often overlap in the work they perform. This section of literature examines one of the most common designs for structuring and selecting intervention systems in schools. Mandated by regulations and needed to access information throughout life, reading is a paramount skill (Common Core Standards, 2019). As this skill set is prominent, there is tremendous research on the topic, and it is commonly agreed upon as an urgent skill that can be selected as a common reference point when relating to brain-based functioning (Dessemonteta et al., 2019; Finnegan & Mazin, 2016; Ngyuen, Leytham, Whitby, & Gelfer, 2015; Wright & Cervetti, 2017).

### **Response to Intervention**

Schools have the duty and responsibility of meeting the needs of all students. Over the past decade, the concept of intervening systematically when students struggle has taken center stage. The format called Response to Intervention (RtI) centers on the idea that the collective knowledge and talents of teachers are stronger than the individuals themselves (Buffum et al., 2012). This systematic approach is the cornerstone of the delivery model for many schools throughout the United States. According to Buffum et al. (2012), Tier One is the core instruction everyone receives in class, with Tier Two accomplished as small group interventions, and Tier Three reserved for specialized instruction typically for students with identified disabilities.

Historically, specialized instruction happens outside the regular classroom and often in lieu of it. The original authors stated that the resulting practices and programs created using their concepts and ideas did not agree with their intended ideals or aspirations (Buffum et al., 2012). Canned programs (predesigned lesson plans via instructional programs) and pullout services provided in lieu of Tier One and even Tier Two instruction create problems in the larger learning environment. Buffum et al. (2012) also noted that RtI needs to “be a set of on-going processes to improve teaching and learning” (p. xiv).

According to Tileston (2011), after establishing an awareness and sense of urgency, a school staff must ask itself three questions during the next phase of creating an RtI system: Do we have the proper assessment tools? Do teachers and paraprofessionals have the background knowledge they need? Are they trained appropriately? These questions are paramount to understanding the problem. This study asks educators to look beyond the achievement data and academic skill deficits to the root of the problem, but the questions remain unchanged.

Response to Intervention provides two ways schools can address this situation, either from a standard protocol or a problem-solving model (Tileston, 2011). In standard protocol, students with similar profiles and learning deficits are provided standardized approaches in the belief they should benefit in a similar fashion, while a problem-solving model seeks to identify a problem and the root cause, then select appropriate interventions (Tileston, 2011). Schools with more resources or smaller numbers of students identified with learning deficits may have more flexibility in choosing options. This study embraces the idea that leadership is being used to innovate practice through change and a shift from standards protocol to problem-solving.

## Reading

Studies on reading comprehension over the past two decades have yielded insights into reading. Students with ASD often develop fluency, or the ability to decode words quickly and accurately, but struggle to understand complex sentences (Bethune & Wood, 2013). According to Finnegan and Mazin (2016), researchers have not identified evidence-based practices that consistently work to increase reading comprehension in students with ASD. Reading the word and knowing the definition is not enough.

Wright and Cervetti (2017) systematically reviewed 36 studies that focused on vocabulary development as an intervention. When thinking about vocabulary development, some may remember spelling lists or content specific words in science, social studies, or other classes. Over the years, educators taught isolated word meanings and strategies for managing large unknown words to improve reading. Unfortunately, the work by Wright and Cervetti (2017) uncovered little to no evidence for using these practices to improve general reading comprehension. They did identify some evidence that spending time processing the meaning of words instead of simply writing and memorizing definitions (especially if taught in context to the passage in which it is used) showed moderate impact on reading comprehension. To have discussions regarding anything requires asking and understanding questions.

An inability to use background information and difficulties processing linguistic information at the sentence level links the discrepancy between decoding and comprehension ability in students with ASD (Bethune & Wood, 2013). The primary medium in most classrooms is linguistic, making this issue complex as teachers and paraprofessionals try to define words and meanings in a simple sentence. Students with ASD need to listen and be able to answer questions, not just of the teacher but regarding the words they are learning. When discussing

reading in most classrooms, the idea of comprehending text results in teachers and paraprofessionals asking *Who, What, When, Where, and Why* questions. These simple questions describe events and relationships between things, including location and temporal associations. Complex vocabulary tends to encompass more complex meanings, especially when used in context, such as the word *independence*. A student defining *independence* may struggle beyond simply changing the word itself to a synonym if asked to relate the word to the document known as the Declaration of Independence.

### **Specialized Pedagogy**

The purpose of this section is not to select strategies but to help open the mind to the possibility of how increased understanding and focus on the ways a student's brain works can influence innovative practices. The information presented in this section of literature provides a set of possibilities as examples of how brain-based functioning can directly impact accommodations within the learning environment and the impact that the brain focus can have on instructional practice.

### **Access Implications**

Access is often a term associated with accommodation or differentiation in the field of special education. Accommodation means to alter a physical space, item, or sequence of events but not what is being learned or subsequently measured for proficiency (National Center for Educational Outcomes, 2016). Differentiation is a term associated with the ways that educators alter their educational practices, materials for instruction, or assessments (Fogarty & Pete, 2011). This section of the study focuses on accommodating the needs of students, as accommodations are a factor in determining appropriate differentiated instruction for students.

Students with ASD tend to have a “weak understanding of theory of mind, executive functioning, and central coherence that likely is a root cause to low reading comprehension” (Finnegan & Mazin, 2016, p. 189). Understanding the perspective of the writer, the connections within the literature and the larger picture, the information represents limits for an individual’s ability to comprehend information beyond simple recall of explicit details. Although interventions can work differently for many individuals, it is crucial to select one that works in relation to the brain of the person. Finnegan and Mazin (2016) concluded that, out of 15 different studies, the use of graphic organizers showed the largest positive impact on reading comprehension. This can be correlated to the fact that students with ASD naturally learn better through visuals. Filtering this research through the theories of Dual Coding and Cognitive Load helps to explain why the graphic organizer shows promise, but also how organizers, if constructed with too much complexity, increase load through erroneous information.

Research in multimedia provides a stronger correlation to the impact of graphics on understanding print. The systematic review of Omar and Bidin (2015) found that graphic-supported text led to deeper comprehension for students with ASD. Using graphics can summarize a tremendous amount of language into a simple representation. The use of color, either as ink or an overlay, can improve the decoding of written text (Omar & Bidin, 2015). The issue with color and graphics is providing too much in a tiny space and the need to reduce the collage effect. When words stick out due to the contrast with the background, such as black letters on a white background, especially when in a larger font, say 12–16 points, details emerge and become defined (Omar & Bidin, 2015). The more pronounced the visual the easier it is for the student to filter out valuable information and code it correctly.



## **Practice Implications**

The following literature is provided to help provide an example of how utilizing the different theoretical constructs and knowledge regarding brain function can be applied in a simple form. This study does not attempt to provide the best practices for the students but attempts to shift the thinking of the educators. The idea of representing information visually, beyond writing the word, can provide correlations and connections. Venn diagrams and cause/effect visuals provide stimulus-response activations through the visual perceptual aspects of the brain, reducing load and increasing memory, as previously discussed. According to Vogan et al. (2014), students with ASD rely on seeing images more than their verbal skills to encode information. This can substantiate the reasoning why decoding skills tend to be higher than comprehension, as decoding is a visual skill. Educators who use visual cues can increase the student's ability to find and encode information more quickly and accurately (Bethune & Wood, 2013). Although these studies focused on slightly different aspects of reading comprehension, they can be used collectively to create an intervention for students with ASD. Teaching vocabulary meaning in context by utilizing graphic organizers during instruction can increase reading comprehension by increasing the word level knowledge of the student, but that alone is not adequate.

Engaging in any environment requires that an organism respond to stimuli in a manner that allows it to thrive and maintain interaction. Humans are organisms, and the learning environment must allow them to interact at that level. Accommodating the environment for students when they struggle is both humane and necessary for the student to stay in the environment and for the environment to stay stable. However, individuals grow and desire independence, and adult guidance becomes a struggle. Teaching students with ASD the skills to

manage themselves in an environment allows independence and growth. Teachers and paraprofessionals must be able to provide guidance and prompting for the skills to promote practice in the environment at a rate conducive to learning. The authors Linehan and Wilks (2015) stated that any training must include six target areas: “emotional vulnerability to cues, internal and/external events . . . response tendencies . . . experiential responses and action urges, nonverbal and verbal expressive responses and actions, and aftereffects of the initial emotional ‘firing,’ which can include secondary emotions” (para. 18).

### **Leader and Learner Behavior**

Determining barriers to change is not a one-size-fits-all discussion. Institutions face similar challenges, such as budget cuts, low socioeconomic levels, changing populations, and staff shortages. The problem is not in determining which issue is causing the most problems, but what barriers are the most crucial to overcome at any given point. All institutions have culture or ways they react to change, both internally and externally. Research on change and leadership has been on the rise over the past two decades.

This study utilizes the work by Hersey and Blanchard (2016), which focused on determining the collective maturity level of the institutional members. Their work on Situational Leadership is at the center of this study. All situations differ, as do the people involved, making leadership a fluid entity and not a stagnant approach. Situational Leadership focuses less on an overall belief system and more on a set of behaviors executed by the leader in response to various situations. Behaviors toward other humans rely on the receiver to be able to respond in kind, referred to as maturity (Hersey & Blanchard, 2016).

Intent in its practical sense is outcome-driven and requires action. This type of leadership provides an almost if-then scenario to the execution of leadership. Situational Leadership

provides a maturity scale to correlate the respective management behaviors with follower readiness (Hersey & Blanchard, 2016). The authors provide levels of maturity summarized as incompetent, lacking ability, competent but not confident, and ready to learn as a means of outlining staff ability in the moment to change. The authors then provide a set of leadership behaviors to associate with the level of maturity: tell, sell, participate, and delegate, used in order as the staff moves through maturity levels (Hersey & Blanchard, 2016). When maturity is low, more telling is used, and as maturity grows the leader adjusts to the competency by delegating to competent individuals. The problem with this style is it requires the leader to move through the levels personally, which often cannot be the case. When this occurs, the followers mature faster than the leader, and animosity and unrest ensue.

### **Theoretical Framework**

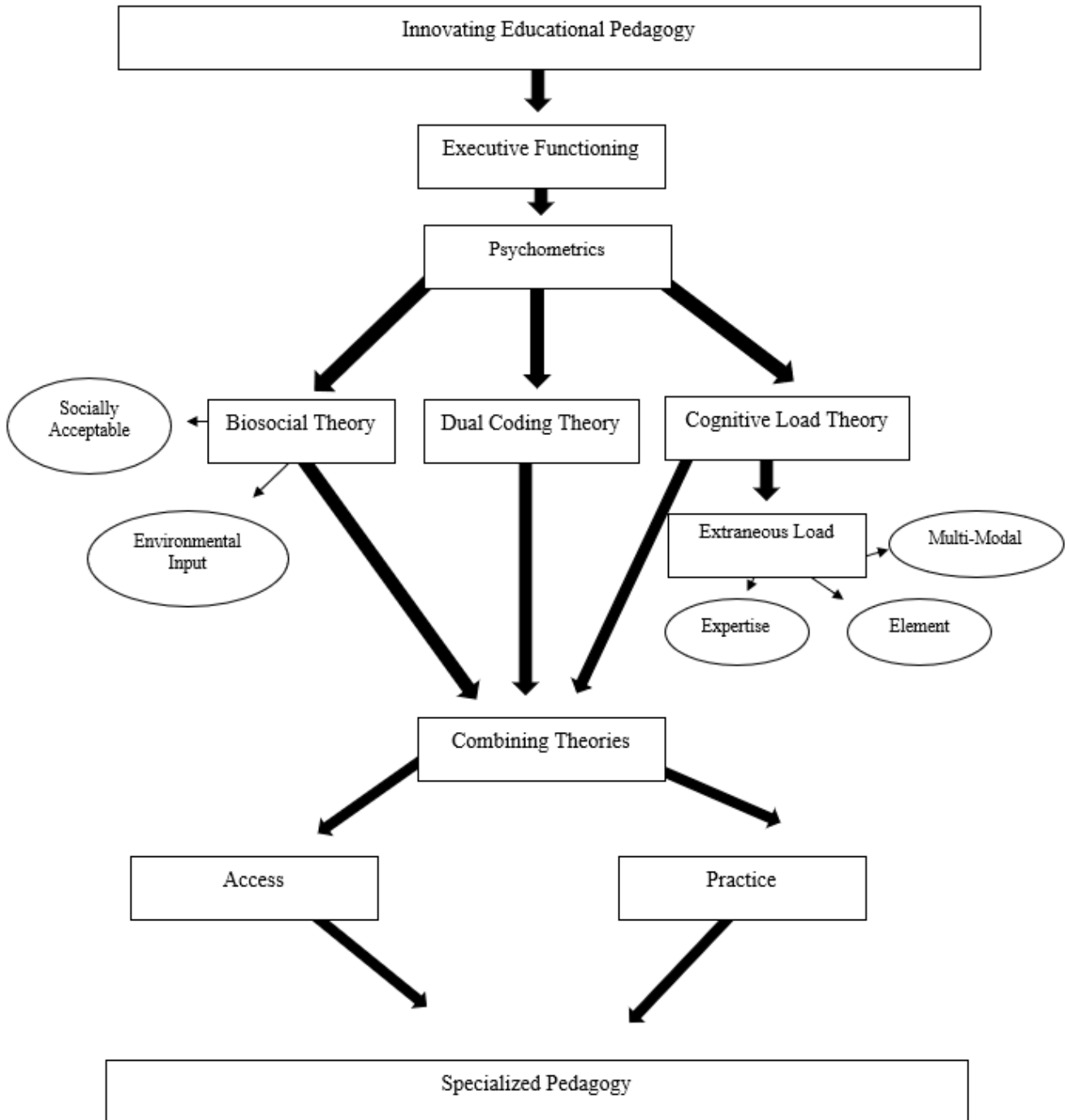
This action research study sought to identify the impact of shifting the thinking of educators when selecting educational pedagogy from one perspective—academic skill deficit and simple acquisition methods—to a comprehensive approach that requires multiple lenses of interpretation. The researcher examined three theories: Cognitive Load Theory, examining the capacity of the brain; Biosocial Theory, how environment plays a role; and Dual Coding Theory, examining how information encodes. Ertmer and Newby (2013) provided a convincing argument for why practitioners must link theory to educational pedagogy due to the complexities involved. One theory simply cannot address the vast needs and complex interactions between humans and their environments. When applying theory, two questions require continual answering: How does learning occur? and What factors influence the structure required for learning? (Ertmer & Newby, 2013). Disabilities affecting the brain differ in name, severity, and causes. ASD is often associated with difficulties in learning acceptable rules regarding interactions in public,

acceptable habits, and handling internal and external stimuli while in social settings (Factor et al., 2017). Executive functioning differences vary and impact the overall functioning of students (Pellicano, 2012). Educational pedagogy requires an understanding of how the brain learns, how we assess it, how core brain functions work in unison during learning, and how these can innovate educational pedagogy. By examining the impact of cognitive deficits, such as executive functioning and social/behavioral responses from a neurological standpoint, strategies are compiled to address these forms of inner workings.

Executive functioning processes work in unison to allow the learning of new material and the use and execution of prior knowledge and skills (Cooper-Kahn & Dietzel, 2017). Executive functioning deficits correlate to the neurological symptoms of ASD (Ozonoff & Jensen, 1999). Adolescents with ASD and other comorbid disorders and disabilities have a higher prevalence of deficits in planning, spatial memory, verbal memory, and response inhibition as compared to their nondisabled peers (Willcutt et al., 2005). Schools use tools to measure the cognitive abilities of students to determine education disabilities, providing knowledge of the status of these abilities. This study seeks to use this knowledge to inform educators, which may result in a change in educational practice when they program for students with ASD and ADHD.

As educators review their current pedagogy in relation to the brain functions of executive functioning, specifically working memory and arousal, a change in thinking can begin. Through the filters of Biosocial Theory, Dual Coding Theory, and Cognitive Load Theory, an innovation allows educational pedagogy to become specialized. The resulting innovation in educational pedagogy will result in increased student achievement. Figure 1 is a visual representation of the theories working together in a linear manner. First, the aptitude of the specific brain functions is studied and measured. Then, the three theories are used to filter the information into categories

that represent aspects of the student's interaction in the learning environment. These categories are discussed in isolation and then combined to represent the impact they have on educational practice and accommodations. Lastly, the educators adjust the current pedagogy to better align with the student's brain function.



*Figure 1.* Theoretical Framework. This figure illustrates how innovative pedagogy is attainable through a focus on executive brain functioning when it is filtered through specific learning theories.

## Conclusion

ASD represents a disorder associated with learning and behavioral needs. ASD, due to its spectrum of possible symptoms, misdiagnosis, and high comorbidity with other disabilities, represents the complexity of factors facing teachers and paraprofessionals as they try to determine pedagogical designs for students. With graduation rates for student with disabilities well below acceptable limits of 60%, the need for action is paramount (U.S. Department of Education, 2015). The vast research and programs available vary in design, intensity, and focus, yet none have risen to the challenge of meeting the needs in schools. Shifting the focus from academic skill deficits to why the deficits are present as they relate to brain function creates a root cause analysis. Through the lens of Cognitive Load Theory, Dual Coding Theory, and Biosocial Theory, brain function becomes a filter for instructional pedagogy resulting in the ability to adjust practice one child or class at a time. Memory and arousal are just two general areas of concern but provide a plethora of factors for educators to consider. Showing educators how to look differently at students and analyze the impact of that action provides a basis for future research studies, not just at the individual student level but also at the class or even school level. Nationally, viable studies present with too many limitations to make them practical in the moment unless applied and coupled with other research and learning theories.

## CHAPTER 3

### METHODOLOGY

Top down change efforts and federal and state mandates such as Race to the Top, No Child Left Behind Act, IDEA-B, and Common Core Standards have not closed the achievement and graduation gaps between students with special needs and those without disabilities (National Center for Education Statistics, 2019; New Hampshire Department of Education, 2015; U.S. Department of Education, 2015). Action research approaches the problem from the lowest level possible, that of individual practitioners and the students they are educating. Action research involves practitioners conducting problem-solving inquiries in their own settings and sharing that information with others in their environment (Menter et al., 2011).

This study proposed that by addressing the knowledge and skills of the teacher and paraprofessionals through professional development focused on how the brain of students with ASD functions, the reflective teaching process becomes aligned with how a child processes learning instead of simply which skills are the weakest academically (Menter et al., 2011). The conceptual framework provides the directional change in thinking sought by this study. Beginning with providing the understanding of how ASD impacts brain function, then applying theoretical filters, the participants examined ways to alter their current practices. These efforts may result in improved student performance on formative assessments.

Action research, procedurally similar to the reflective teaching process, makes it less invasive and more aligned to practitioner needs than other forms of research. Action research involves the researcher acting as a participant while moving through the process of reflection, planning, and acting in a continuous cycle (Menter et al., 2011). This study focuses on examining the impact of specific professional development in brain-based functioning on how



educators plan pedagogically. Teachers plan lessons, collect data, review the outcomes, then use the information to assess the students' learning and their own instructional success in a reflective cycle or process (Menter et al., 2011). The similarity of certain aspects of these two cyclic processes, specifically the research and plan aspects of action research and the evaluate, reflect, and plan aspect of the reflective teaching cycle, makes the use of action research more natural and related to the current practices of teachers and paraprofessionals. This in turn encourages and increases the chance of long-term pedagogical change. This research study focused on the impact that brain-based research may have on how educators design pedagogy for students with ASD.

### **Intervention**

The primary focus of the professional development intervention of this study was determining the impact of aligning practice and accommodation to executive functioning in the brain (see Appendix A). This alignment involves providing parameters or filters by which teachers and paraprofessionals can account for brain functions while aligning the intricacies of the brain to practical educational pedagogy. The filters of Biosocial Theory, Dual Coding Theory, and Cognitive Load Theory provide the basis for understanding how memory and arousal are part of the biological learning process. The participants used the knowledge to apply to their own situations, thus addressing their current problems in the natural environment. If change in education is going to occur, then an alteration in thinking must happen for the individuals responsible for its implementation and fidelity. Action research seeks to address real problems and must show people how behavior and attitude changes relate to actual results (Kotter, 2012).

Fifteen staff completed a survey focused on how they approach the design of curriculum, instruction, and assessment. This intervention lasted for two 90-minute sessions provided on

different days to allow the processing of information. During the intervention, the participants engaged in an overview of the brain functions and their impact on reading and behavior (see Appendix A). A preintervention survey provided participants a medium to understand their viewpoint of curriculum, instruction, and assessment. A two-day coaching session provided help to solidify understanding and processing of the information. The reflection process lasted one week, during which time the educators were able to apply any of the information on their own accord. After the intervention, these educators considered if and/or how the information could apply to their current or future practices. The participants engaged in a post-intervention interview designed to allow them to share their reflection on how the information affected their initial instruction design and/or accommodation practices.

### **Research Site**

The research site selected was a public school serving students with and without disabilities in grades prekindergarten through 5, but only grades 3–5 were included in this study, as these grades have a resource room program that supports students with disabilities in the general education setting. This school is set in a rural community and serves only students from within their own district and one small town nearby that sends about a dozen students a year through a tuition agreement. The school is not racially diverse, with a population that is 97.0% white, 1.0% Hispanic, and 2% made up of two or more races (New Hampshire Department of Education, 2018d). The school provides computer and other technology access to students in every class. This site represents participants willing to move forward as the district is undergoing changes in practice and design focused on quick improvements in overall effectiveness within the large classroom setting.

This school provides regular education programming as does any other public school in New Hampshire. The school staff shared that they utilized a resource room program for students who struggle with behavioral concerns due to disabling conditions or disorders. At the time of this study, the school was undergoing meaningful change efforts during this year, including adding and revamping co-teaching models, reduction in pullout services, and general staff reductions across the board, as reported by the superintendent. The school serves a total of 439 students, with 248 in grades 3–5, and 199 students served through special education in total, with 51 served in grades 3–5 specifically. The resource room provides a Tier 3 program, which means it provides support to students with behavioral needs, including those served under special education, but also students who have disorders such as anxiety and ADHD not served under special education. Increasing performance within the classrooms, increasing inclusion of students in traditional classrooms, and reducing the costs of education is the focus of the new superintendent and current school board.

### **Participants**

This action research focused on educators in public schools serving students in grades 3 through 5 as participants and includes teachers and paraprofessionals who make up the education implementation teams for students with disabilities. This group consisted of five teachers and eleven paraprofessionals working in large and small groups. Participant selection was based on the total population working in the school program, which services students with disabilities in the regular education settings. The participants reflect the total population of teachers and paraprofessionals who are involved with educating students who access special education services but are not part of a self-contained program. Participants encompassed educators with experience ranging from first year educators to educators with sixteen years of experience. The

entire participant pool was utilized to increase the number of participants to a viable level to provide adequate data for analysis.

### **Data Collection Methods**

This action research study collected data to address the particular problem of increasing educators' ability to construct educational pedagogy more aligned to students with ASD. The qualitative action research study followed five stages: identify the participants needed, gain access/permission to the participants, identify what information is needed to answer the research questions, identify the instruments and storage protocols, and administer the instruments (Creswell, 2015). This researcher collected information at three stages as professional development was enacted for educators addressing student performance in their settings.

Surveys aided in describing the current beliefs and decision parameters of participants (Merriam & Tisdell, 2016). By using this approach, participant responses provided a larger amount of data quickly. First, the preintervention survey, conducted online through REDCap, provided a baseline for the participants' insights into curriculum, instruction, and assessment design and implementation. Analysis of this data involved scoring and identifying themes. This study sought to engage participants as co-researchers as they engaged in the action research process (Creswell, 2015).

During the two instructional sessions, the researcher provided information focused on combining current neurology research, brain-based teaching practices, and learning theory. On-site coaching sessions followed the instructional sessions, during which participants asked, if necessary, for more clarity, guidance on instructional adjustments, or aid in structuring accommodations. Observations during coaching provided additional data for the analysis phase.

Interviews provided post-intervention data. The researcher asked if and how the participants considered the added information. This researcher used data analysis and synthesis to determine the changes in educational pedagogy which occurred.

## **Surveys**

The preintervention survey focused on the educators' opinions in three areas associated with the study: curriculum, instruction, and assessment. There is a trend in New Hampshire schools, such as the one represented in this study, to move away from scripted curriculums, allowing teachers more autonomy in addressing educational competence. Not all schools in the state or the nation follow such practice. The introduction of the survey consisted of an overview of the study. The preintervention survey provided for participant permission in the introduction after the overview. By asking participants to reflect on their current practices and beliefs, the participants provided a baseline to compare any change created during the study. Table 1, Preintervention Survey Question Overview, provides the focus areas of the questions in the survey. The specific question regarding change established the willingness of the participant to accept the knowledge. See Appendix C, Preintervention Survey Questions.

The post-intervention interviews addressed the same material posed in the preintervention survey so responses can show change more directly. Questions addressed the level to which perceived functionality the theories and knowledge on the brain influenced the overall educational pedagogy. See Appendix D, Post-intervention interview questions for the full list of survey questions.

Table 1

*Preintervention Survey Question Overview*

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<b>Survey Area</b>	<b>Reason for Question</b>
Curriculum	Provides an understanding of how the participant chooses the focus for the lessons they are delivering.
Instruction	Provides an understanding of how the participant views the effectiveness of their current practices.
Assessment	What role formative and summative assessments play in the educational process.
Change	Overall participant reflection on their readiness for change and how that readiness impacts the leadership behavior needed for providing the intervention during the study.

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### **Semistructured Interviews**

All participants who agreed to the survey were asked if they would participate in the interviews after the intervention and provided consent at that time in writing. The fifteen participants who volunteered engaged in the confidential, semistructured interviews as outlined in Appendix D: Post-intervention Interview Questions. The semistructured interview provided a narrower set of questions, while still maintaining neutrality in gathering information from participants (Bloomberg & Volpe, 2016)). The interview focused on how these educators see the process of selecting targets, selecting delivery methods, selecting accommodations, and how they see formative assessments. Appendix D: Post-intervention Interview Questions includes a complete question list. The post-intervention interview analysis and coding provided themes and terms for analysis and comparison to the previous interview survey data. The comparison provided data on if, how, and why participants altered their educational pedagogy. The

interviews also provided the educator's opinions, through reflection on formative student assessments, on the educational impact these changes had on student performance.

The theories of Biosocial Learning, Dual Coding, and Cognitive Load provide a broad lens for examining how students with disabilities learn within the general learning environment as well as providing parameters for making educational decisions on pedagogy (Cavazzi & Becerra, 2014; Kalyuga, 2011; Paivio, 2014). Analyzing the semistructured interview questions for how these educators changed or stayed the same applies to the effectiveness of the brain-based research on improving educational practice but also the probable impact embedded professional development has on improving education. Synthesizing the information into generalities applies to the situation directly and provides the site with a means for examining current and future efforts. By analyzing and synthesizing the staff responses to brain-based professional development and the staff's overall ability to shift thinking in relation to increased knowledge, the staff and leadership can evaluate whether more action research of this nature would be beneficial in the reflective teaching process.

### **Data Analysis and Synthesis**

The analysis and synthesis of the data was conducted at two stages during the study. The participants completed the initial preintervention survey through the online REDCap survey software. The researcher conducted the intervention trainings in two 90-minute presentations on separate days covering memory and arousal. The researcher recorded observations during the coaching timeframe. The researcher used auditorily recorded post-intervention interviews and transcribed them off-site. Preintervention survey and post-intervention interview data was compared by total participants, then collectively by subgroups. The compiled information was

saved in an Excel spreadsheet on the thumb drive. All the survey data was coded and analyzed by both numeric score and for themes.

### **Participant's Rights**

Participation in the study was voluntary and participants were permitted to opt out of data collection methods or withdraw from the study at any time. The researcher removed all participant names, institution's name, and all identifying information. Participants' decision to contribute had no impact on their current or future relations with their employer or the University of New England. The results of this research are being used for a doctoral research study at the University of New England. The study may be submitted for further publication as a journal article or as a presentation. The researcher will maintain an electronic copy of the consent form for at least seven years after the project is complete before its destruction. The consent forms are stored in a secure location off school property that only the researcher has access to and will not be associated with any data obtained during the project. All electronic data was stored on a thumb drive.

After reading the overview of the study, participants provided informed consent before beginning the preintervention survey. Participants were asked to reflect on information during the professional development intervention, but sharing information was voluntary. Any discussions with the researcher during the study were observational data. Participants reviewed transcripts for accuracy, and copies of the study are available to participants upon request.

### **Issues of Trustworthiness**

This action research study was based on the impressions and data collected by actual participants, clearly linking the study to reality. The nature of the study and the methods utilized provide the basis for credibility. The study used surveys and interviews provided in good faith by



participants. The conceptualization of the study and data collection methods provided a solid foundation to analyze the use of the intervention, increasing the dependability of the study. Action research focuses on ways to address real problems in an environment. The theories, literature, and methods used are easily transferrable to other educational settings trying to examine educational pedagogy. These elements collectively provide evidence that the study has an acceptable level of trustworthiness.

### **Conclusion**

This study proposed that by addressing the knowledge and skills of the teacher through professional development focused on how the brain of students with ASD functions, the reflective teaching process becomes aligned with how a child processes learning instead of simply which skills are the weakest academically (Menter et al., 2011). Practical action research is similar to the reflective teaching process, making it less invasive and more aligned to practitioner need than other forms of research. The central question for the proposed research project asked, To what degree does brain-based professional development change how educators alter educational practice, including initial instructional design and accommodations, for students with ASD?

The research site selected was a rural public school that serves students with and without disabilities in grades prekindergarten through 5th. This action research study used voluntary educators who served students in grades 3 through 5 as participants and included teachers and paraprofessionals who made up the educational planning teams for students with disabilities. Special education guidelines represented the major population criteria. Students in grade 3 are typically 8 years old, which means the disability category of developmental delay would require recoding before the next three-year eligibility meeting (New Hampshire Department of

Education, 20019). Students in grade 5 represent the highest grade in an elementary-only school. This precursor disability assessment is used to identify students with characteristics like those with ASD, who are not currently identified under ASD (New Hampshire Department of Education, 2005). This action research study collected information at two stages: preintervention and post-intervention. The analysis and synthesis at both stages, preintervention and post-intervention, utilized theme-based coding procedures tracked in Excel. There are no identified issues of trustworthiness.

## CHAPTER 4

### RESEARCH FINDINGS

The purpose of this qualitative practical action research study was to explore how professional development, focused on brain-based research, informs educators' pedagogical design for students with Autism Spectrum Disorder (ASD). Initially, seventeen participants were surveyed for this study. Fifteen participants agreed to the post-intervention interview, which consisted of eight questions. Three demographic questions identified subgroups for analysis: role, experience, and education. The remaining sixteen focused on questions aligned to three theoretical frameworks in the study: Dual Coding Theory, Biosocial Theory, and Cognitive Load Theory. The surveys were conducted using the Research Electronic Data Capture (REDCap) confidential online data collection tool.

The professional development intervention provided the participants with knowledge regarding the Brain-Based Teaching Approach (BBTA), a neurological understanding of memory and arousal, as well as theoretical filters for making educational pedagogical considerations through the lenses of Dual Coding Theory, Biosocial Theory, and Cognitive Load Theory. The intervention conducted on-site over two sessions lasted ninety minutes. Individual participant interviews conducted one week after the intervention lasted 20–30 minutes. During this window, the researcher was on-site for four days and was available to answer questions and aid in the processing of information. Only three participants sought out the researcher during this time, which focused on further discussion regarding memory capacity and multimodal instruction.

The study used on-site, one-on-one interviews with participants. The application Recorder (2019) aided in transcription of all interviews. After reviewing the converted

transcripts, the audio files provided a reference for accuracy. The application's conversion software was mediocre and required adjustments to the converted text files. The interviews involved eight questions. These questions were designed to elicit the opinions of the participants on their understanding of the information presented, their beliefs on the use of the information toward adjusting professional practice, and their opinion on the effectiveness of the training design to help them make the information actionable. The interviews took between thirteen minutes and twenty-nine minutes to conduct. The variance in time was a result of the participant's understanding of the material and their ability to convey their thoughts verbally.

The analysis of the data included comparing the participant pool survey data, all 17 participants, by the following subgroups: role, experience level, and education level. The survey information was examined based on the mode, or most common, answer for the subgroup. The first read through identified informational units by participant. This information involved selecting phrases from each interview question for each participant. The second round of review involved narrowing and expanding the units to form codes. The codes combined to generate themes. These themes required a comparison to the survey answers to see how they aligned. After adjustments, the final five themes emerged. The final analysis involved comparing the central question to the themes resulting in emergent themes.

### **Participant Profiles**

The participants in the study are either teachers or paraprofessionals and range in experience and education. The teachers represented ranged from educators who had worked in multiple schools in more than two districts to teachers who had worked in the school for only one year. The variance in experience, coupled with a difference in experiences in different schools made this small set of participants quite diverse. The population provided a slight gender

mix with four males and 13 females. The analysis of the subgroup did not involve gender, as it did not seem appropriate for the purpose of the study. Table 2, Summary of Participant Profiles, presents the demographic information for each participant.

Table 2  
*Summary of Participant Profiles*

Participant Identifier	Role	If surveyed (S) and interviewed (I)	Experience in years	Education level
1	Paraprofessional	S, I	2	Employer only Professional development
2	Paraprofessional	S	11+	Associates degree
3	Teacher	S, I	11+	Bachelor's degree certified
4	Teacher	S, I	11+	Master's degree
5	Teacher	S, I	11+	Master's degree
6	Teacher	S, I	11+	Master's degree
7	Teacher	S, I	11+	Master's degree
8	Paraprofessional	S, I	1	Bachelor's degree non- certified
9	Paraprofessional	S, I	3	Bachelor's degree non- certified
10	Teacher	S, I	11+	Bachelor's degree certified
11	Teacher	S, I	4	Master's degree
12	Paraprofessional	S, I	2	Employer only professional development
13	Teacher	S, I	1	Bachelor's degree certified
14	Paraprofessional	S, I	5	Employer only professional development
15	Teacher	S, I	11+	Bachelor's degree certified
16	Paraprofessional	S, I	2	Employer only professional development
17	Paraprofessional	S, I	7	Employer only professional development

### Survey Question Data

The initial survey questions represent the theoretical framework and associated concepts presented in the study. Dual Coding Theory and its component parts made up eight questions, Biosocial Theory informed five questions, and three of the questions were based on Cognitive Load Theory. These questions, found in Appendix D, provided a baseline to document educator understanding of brain-based education. This alignment provided the mechanism of comparing the survey data to the interview data. Preceding sections provide a comparison of this information in context.

The REDCap system provided a means for exporting data into an Excel format. This data was then added to another spreadsheet manually so it could be represented by cohort. Subgroups were combined to provide a minimum of four respondents in each group. The subgroups presented represent these compressed groups. The subgroups selected for the survey data were teachers, paraprofessionals, those with experience of four years or less, those with experience of five or more years, and education level. The education level was broken into four subgroups: employer-provided professional development, associates/bachelor's degree non-certified, bachelor's degree certified, and master's degree or higher. Discussion with human resources and personal experience as an administrator led to the creation of these subgroups.

The responses to the questions were originally gathered using a 5-point Likert scale ranging from not likely, somewhat likely, likely, most always, and always. Due to the limited number of respondents, these responses were collapsed to three: not likely, somewhat likely, and most likely. This allowed for a minimum of four respondents per question. The survey questions were placed in tables and mined for the answers representing the mode. Mode was chosen as the base statistic as it represented the most common answer.

## Survey Results

The results of the preintervention survey are separated by subgroup among the participants. The various subgroups provided a baseline and comparison between the answers on the survey for the nine teachers to the eight paraprofessionals, see Figure 2, Participant Roles. Most teachers and paraprofessionals identified that the brain codes information into memory faster with different mediums working in unison. Most paraprofessionals felt using one medium at a time worked best, opposite that of the teachers. More paraprofessionals than teachers felt incremental repeated practice positively influenced habit formation. Most teachers and less than half of the paraprofessionals felt student motivation was a major factor in learning. Most teachers and paraprofessionals felt distraction was a major concern for learning. Most teachers and paraprofessionals believed that learning was similar for most students; however, they also noted it varied by learning style and medium preference.

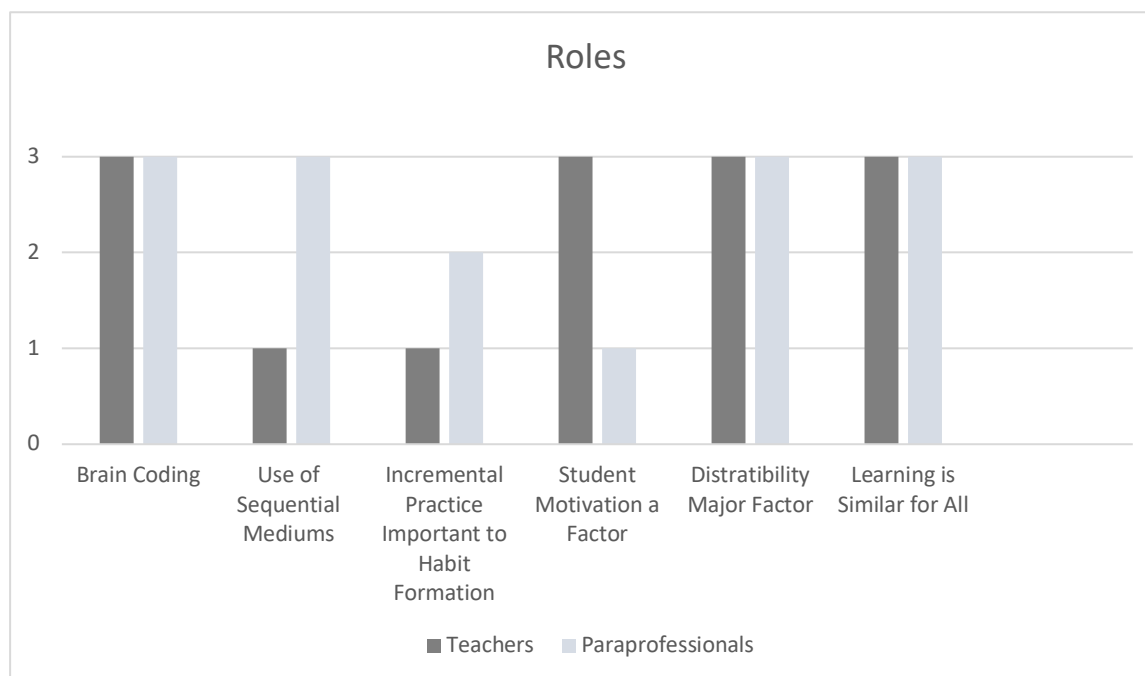
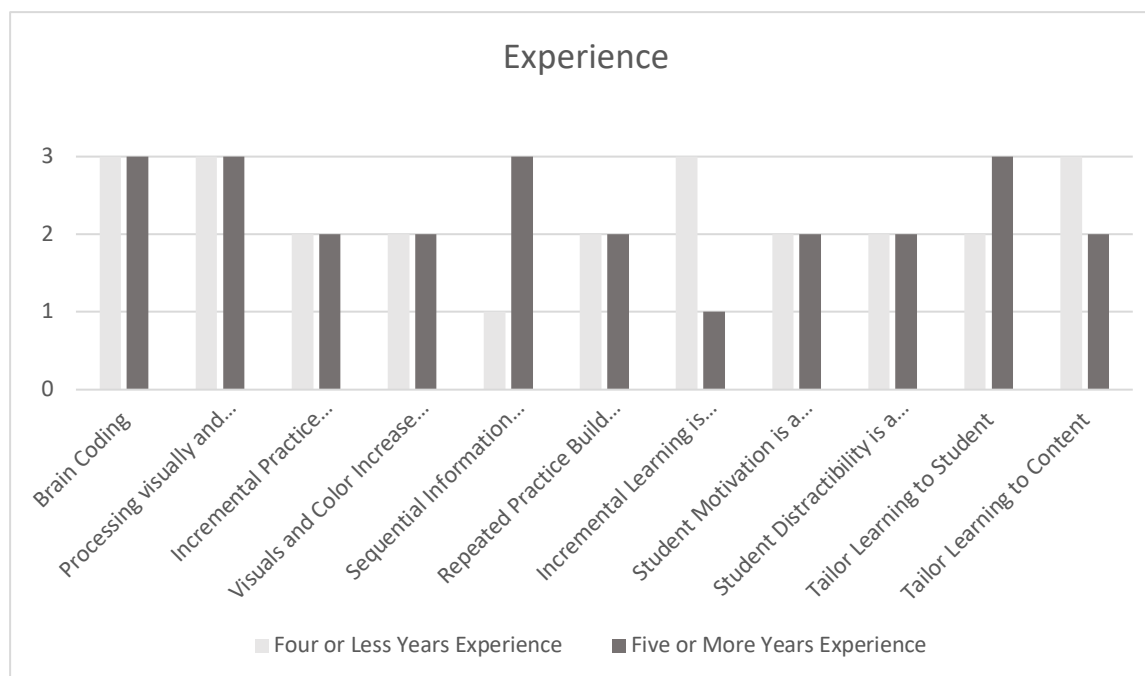


Figure 2. Participant Roles

Experience was separated into two subgroups, see Figure 3, Participant Experience Level. The first subgroup are participants with four years or less and those with five or more years' experience. Most teachers and paraprofessionals identified that the brain codes information into memory faster with different mediums working in unison. Most educators, regardless of experience, stated that the brain processes information faster verbally and auditorily. Over half the groups stated that visuals and colors may help in memory processing. The educators with five or more years felt more strongly that information must be presented sequentially for students to process faster. Both subgroups felt repeated exposure was likely to increase the learning of habits. Those with four years or less experience felt incremental learning was less necessary, while those with five or more years felt very strongly that the incremental learning of habits was necessary. The median answers for motivation represented a split among both experience subgroups showing no strong belief either way. Both experience level subgroups felt distraction could be a major factor in learning. Just over half of the educators with four or less years' experience felt that tailoring learning to the student was necessary, while closer to three quarters felt that tailoring to the content was also necessary. Those with five or more years' experience felt more strongly toward tailoring to the student and less toward content.

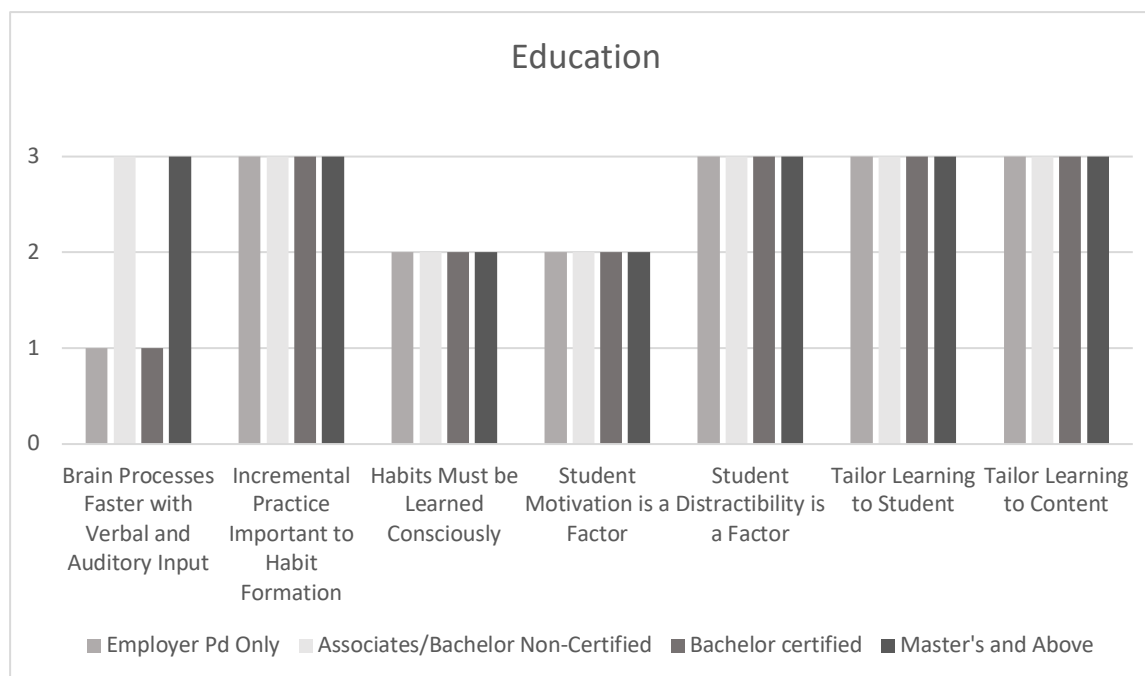




*Figure 3. Participant Experience Level*

The third subgroup represents the participants grouped by education, see Figure 4, Participant Education Level. The subgroup has four levels. The data provided baseline information for those with only employer-provided professional development, associates/bachelor's degree non-certified, bachelor's degree certified, and master's degree or higher. The information in this subgroup did not follow a linear path. The data did not show that education level had an impact on the understanding and opinions of how the brain learns. Those participants with bachelor's degrees and teacher certification felt it was less likely that the brain processed information verbally and auditorily as well as visually, compared with those with masters' degrees. When examining those with employer-only professional development to those who had associates and bachelor's degrees without a certification a similar pattern emerges. A majority of all subgroups felt that habits were learned through incremental repeated practice; however, they also were split on whether students could learn to do these habits innately without conscious thought. Like the other subgroups, this group felt that motivation was a factor, but that

distraction was more likely to negatively influence learning than motivation. All subgroups identified that learning must align to the student and the content or skill taught. Interview answers showed that the balance of these two pieces, although desired and important to participants, was not easy to achieve. No specific reasoning was provided; however, answers on other questions provide an interpretation that class size and management of time are barriers.



*Figure 4.* Participant Education Level

### Interview Question Data

This researcher conducted the post-intervention interview in person. The 15 participants who agreed to a post-interview were asked 12 questions initially. When necessary, follow up questions elicited deeper responses. The surveys were recorded using a transcription application and saved to a Micro SD card on the device. These audio recordings were converted to text and reviewed. Participants were provided a copy of the text version of the interview to review for accuracy, checking after initial editing by the researcher to eliminate verbal place holders and

software anomalies such as doubling words or phrases. These codes and transcripts were stored on a secure thumb drive.

### **Interview Question 1**

How might or did the idea of a brain-based teaching approach influence your thoughts on adjusting practices? This question focused on the tenets presented in the training. The five selected tenets were: Emotions aid in understanding the learning processes, threat inhibits learning, meaning comes from patterns and associations, attention and perception increase active processing, memory is both for facts/skills and making sense of experience (Edelenbosch et al., 2015). Participants were asked to reflect on these as presented. Most participants stated that the ideas themselves were not new, although the wording and presentation provided were more succinct and simplified. Two stated that the school district had provided training in the past five years on poverty and trauma which presented similar ideas (Participant 4 and Participant 6). Participant 4 stated, “we do a lot of the responsive classroom in the morning.” Several participants noted that the district brought in the curriculum *Open Circle* which dealt with emotions and how they affect learning and behavior (Wellesley, 2020).

Most of the responses regarding this question were focused on threats inhibiting emotions. Participant 2 stated the following about the kids in his class. “When they are emotional, it determines what I can even do with them on a daily basis and how successful they’ll be with what I asked of them.” Participant 4 reflected on the impact of ignoring the tenet regarding threats by stating, “pushing them past that is not going to do you really any good and you’re better off just giving them what they need at that point.” No participants went deeper into any other tenets. When prodded they stated they needed more information to actualize the general tenets. This belief that the tenets are needed but not new and the expressed feeling that

other trainings provided the same general understanding provided unit level data leading to the code of focused training. The combined units gave rise to the code of educator domain knowledge.

### **Interview Question 2**

How might or did the knowledge of comorbid diagnosis and underdiagnosis influence any educational decisions? This question elicited a mixture of responses varying from the concept being new to those who had heard it before but lacked substantive actionable knowledge. Participant 1 stated that using “similar strategies between students, regardless of their diagnoses, to help with their memory or emotional regulation” was common in special education. Participant 2 stated, “we do that already.” All the participants who noted they accomplished this idea prior to the training referred to emotional and behavioral practices exclusively. The term multiple diagnoses were misconstrued with comorbidity by three participants. This again provided data relating to a lack of domain knowledge in staff. The survey data showed that half the participants believed learning was similar for most students. However, most of the participants felt it needed to be specifically tailored for each student. Participant 3 felt that “knowing that there's so much going on that you can take one general diagnosis, say they're on the autism spectrum disorder, or they are ADHD, but know in reality there's a lot more going on.” Most other participants echoed this sentiment. Again, the lack of actionable ideas and understanding provided support for more knowledge and training on how to make concepts into functional strategies.

### **Interview Question 3**

After discussing the idea that the brain codes information in at least three ways—auditory, visual, and even emotional—could you see how it may influence your instructional

choices? Survey information showed that over two-thirds of the participants viewed the use of visual, auditory, and kinesthetic information and mediums as being most likely to increase processing. This preconception lasted through and after the intervention. Teachers immediately moved to multimodal instruction, as did a couple of paraprofessionals, when addressing this question. Participant 13 referred to coding as “a filing cabinet,” which stores information as it comes in by distinctive characteristics. The rest of the participants mentioned using visual and verbal mediums for directions. Participants 12 and 13 specifically noted that it “is needed” and a “new way” to look at information. Participant 13 attempted a writing exercise with a student using emotional memories to draw out details for a narrative writing piece with success. The participant stated the student barely wrote any details prior. Only one participant listed dual coding strategies beyond the use of different mediums for instruction. One participant’s previous training on using the senses to construct meaning adjusted their practice prior to the training to include using the senses to code information by smell, sight, touch, and sound. This lack of understanding of how information is coded and retrieved in the brain, beyond visual versus auditory or tactile processing provided coding data, supports the need for more knowledge and skill in addressing coding. Experience rose as a meaningful factor in making the idea of coding actionable during the interviews.

#### **Interview Question 4**

Does the idea of Direct Access Memory, limited to four to seven pieces of information when a student is truly focused, influence any thoughts on instructional design and accommodations? All participants found this piece of the training to be the most influential. Participant 4 said, “I was able to connect it to myself and then I was able to connect it to the kids.” Participants realized they have the same number of slots and connected it to the students.

Two participants noted that it increased their “sympathy towards kids.” No participants noted any strategies from before the training. Two participants began using a couple of simple strategies to account for the limited slots. Participant 6 limited her own output because her sound “adds slots when they have to hear us continually squawking.” Another began to allow minutes in the morning because they realized “as I work with the kids and understanding that there may be one, two, or three already filled up as soon as they come to the door” (Participant 3). The fact participants used the considerations to make strategies supports breaking the brain-based information into more concrete terms. Additionally, all but two participants noted a desire to learn more and spend more time discussing memory. This combination provided data to support more knowledge and group discussion time as part of professional development.

### **Interview Question 5**

With long-term memory having almost no limit and being resistant to stress, could you see how it may be used in your class? Most participants found this area confusing or stated they needed more help understanding the practical application. The survey provided data showing the participants that the majority believed students could learn incremental pieces as part of a larger set without active thinking. Participant 10 related the idea of commuting to work; “I don't even remember the drive because I had done it so much that I just didn't have to process it.” However, the interviews yielded no strategies or examples beyond simple behavioral and social compliance routines. One participant explained she has seen older students enter the work force without academic and social stimulus response routines. These students are “everything in Direct Access Memory and they're getting overloaded” (Participant 7).

The idea that students need to have this ability that reduces the number of direct memory pieces was unanimous in the interviews. The use of the concept varied a bit. Participant 8 said, “I

think it will work well for like classroom routine if kids just know the expectations every single day.” This was one of the behavioral focuses mentioned. It stemmed from the participant’s not knowing “how you could do it unless doing [something] like math facts” (Participant 8). Another stated, “I don't quite know how to connect it” (Participant 12). Part of this disconnect clearly lies in a lack of conceptual understanding. There is a clear need to discern between behavior, emotion, and academic skill learning. These educators see a need but lack the understanding to overcome perceived barriers. Participant 13 said, “I think it's true, but I think it takes a lot to get that because these kids have a really hard time getting a lot of this stuff into long-term memory because they're distracted.” This idea that management of the classroom may play a role as it pertains to distractibility was also mentioned by participants discussing multimodal teaching. The management and instruction codes in this question resonated to a sizeable degree in many interviews.

### **Interview Question 6**

The idea of biosocial theory was conveyed in the training. The premise was that people are organisms and react to stimuli in the environment consciously and unconsciously. Does that idea and the pieces discussed regarding Maslow’s hierarchy and stages of the brain influence your thinking regarding management strategies or accommodation ideas? This question was difficult for all the participants to answer. The responses showed the group understood the concept that individuals interact with their environment. However, participants did not provide evidence of usability. Four participants mentioned understanding that organisms interact and react but linked this solely to behavior and classroom management strategies. One participant noted, “I think it should influence how we handle the behaviors but I'm not sure how” (Participant 13). This same participant also noted, “The social piece is so huge, it inhibits quite a

few of them from getting to that cerebral level of being able to learn.” The understanding was clear, but the professional development activity did not provide enough conceptual understanding to begin the process of creating strategies. The findings show more understanding is needed in this area. Since most participants linked it to behavior and two to classroom management, it provided support for the creation of that theme as well.

### **Interview Question 7**

After being presented with the idea of cognitive load, that memory has limits in ability and duration that can be influenced by stimulus in the environment, does that influence your instructional ideas or management strategies? The group primarily focused on how stressors in the environment shut down students emotionally and create frustration. Participant 1 said he sees the impact of cognitive load “in the forms of shutting down, being distracted, and angry sometimes.” The participants unanimously agreed that load is “definitely something that we need to be aware of” in the classroom (Participant 1). The impact of cognitive overload was described by Participant 1 when he stated, “If the overload happens, you got to dull that current load before you can try to move on to anything else, because if you just keep stacking it, it's just going to add pressure and nobody likes pressure.” The group did not provide any instructional strategies or even conceptual ideas regarding academic information or mediums that might reduce the issues. One participant referenced the use of relational coding but stated they would need more training in that area. Three participants noted they use accommodations to address cognitive load. Participant 3 said, “They need time to process, time to cool down, and once they're calm you can start to process and go through things.” Participant 4 stated, “I don't have very strict due dates on things for them like papers.” Also, Participant 4 shared that they address processing by “giving them more time because they have certain kids that work a lot slower and take a lot more time to



do things.” Participant 6 echoed the use of slowing down the pace by adjusting due dates. One participant did share a concern that adjusting a student’s load might cause a sense of unfairness in other students, which aligned more to an understanding of instructional application than student misperception. The cognitive load piece of the training did not result in a movement in practice by any participants. Comparing the interviews to the survey data showed their beliefs had not changed due to the training. The need for more knowledge and time to process the knowledge into strategies is evident in this area.

### **Interview Question 8**

The training supplied you with considerations that you could apply to certain situations as you saw fit. Other training methods provide you with set strategies that you apply when the situation dictates. Which works better for you to make things actionable? This question was designed to elicit how the different aspects of the training, including medium and group design, may influence participants’ understanding and use of the information. All but two participants stated that the consideration style of presentation was more helpful. However, all the participants noted that having strategies was necessary. Participant 15 believed that having “some ideas on how to implement” would guide the participants and allow “them to see how it's successful and what works and what doesn't helps you with another student later on down the road that may be similar.” Most of the participants noted a need for ongoing trainings or refreshers throughout the year. Participant 14 stated a need for “ongoing talk with people about considerations and strategies to share what they think about it.” This participant also noted that the conceptualization format allowed for freedom to customize and it engaged the participant in active thinking during the training. Participant 14 shared the thoughts they had were ones such as “what do I already know or what materials or things that I have already can I use to help me do

that?” All the participants shared a feeling that there was more professional development time needed and specifically “time to practice,” as noted by Participant 11. Sharing thoughts and collective inquiry were undertones in most interviews. The desire for processing and the sharing of experiences provided vital data in selecting themes.

### **Interview Results**

The interviews were read through two additional times during the coding process. The first read through provided unit level information. The information was selected based on the participant’s ability to understand and apply or not apply the knowledge provided, as well as thoughts on the training design. The original 382 units were combined during the second read through of the material, yielding 83 codes. Similarities of answer and opinion were placed together regarding knowledge, attitude, and application of and toward the material or training design. These 83 codes were then examined separately to create five themes. To what degree does brain-based professional development change how educators alter educational practice, including initial instructional design and accommodations, for students with Autism Spectrum Disorder? This central question was compared to the initial codes, emergent themes, and survey data to derive the final themes listed in Table 3, Key Emergent Themes.

Table 3

#### *Key Emergent Themes*

- 
1. Domain knowledge of staff influences applicability of material and skills
  2. Consideration and strategy-based trainings are preferred
  3. Staff need to process with groups and apply created strategies in the moment
  4. Similar experience aids comfort level toward application
  5. Educators need guidance in classroom management and instructional sequence design
-

## Key Thematic Findings

### Key Thematic Finding #1

**Domain knowledge of staff influences applicability of material and skills.** The staff provided answers showing that the ideas and tenets of the BBTA did not appear new, but the primary focus for most participants was on just the two tenets dealing with threats and emotion. This was directly related to their mention of district training on poverty and trauma-informed teaching practices over the past few years. Additionally, five teachers provided information that a current district curriculum for teaching social and behavioral skills was recently implemented and shared similarities to some of the tenets and brain research. Participants noted that many teachers and staff did not have the background or understanding of memory, multimodal instruction, and behavioral training through stimulus response that is necessary to act on these considerations or create strategies of their own. There was a clear desire noted in the interviews for more training in these areas, as well as a clear misunderstanding of some of the information. The misunderstanding of the information was likely due to the shortness of the professional development intervention training. Participants noted that the information would need to be broken down into smaller and more actionable pieces and provide smaller group time to process and apply the information among peers.

### Key Thematic Finding #2

**Consideration and strategy-based trainings are preferred.** All participants noted that the training, which focused on considerations rather than skills, found that they could apply them and that the considerations were more helpful than just strategies. However, the participants noted that sequentially combining the consideration type training, in small segments, with a skill development session would make the information more applicable. This would allow them to

move from a big picture consideration to subskill concepts, and finally to skill development and application scenarios.

### **Key Thematic Finding #3**

**Staff need to process with groups and apply created strategies in the moment.** All staff provided feedback stating that they must work together in grade level or multi-grade level teams, including teachers and paraprofessionals, to take any consideration or predesigned skill and make it their own. Several teachers and paraprofessionals noted that they were often provided professional development that would end up with a list of additional things they must fit, naturally or by force, into their daily teaching routines. These teachers stated they often do not use them or do not use them with fidelity since they do not fit with their current teaching plan. Paraprofessionals and teachers agreed that they must have common language and understanding of how the concepts become a strategy, which is why this smaller group work was crucial, in their opinion, to make this information applicable in the classroom and school setting.

### **Key Thematic Finding #4**

**Similar experience aids comfort level toward application.** Many staff noted that they were still processing the information and did not have time to vet it or think about how to apply it. The staff who did try and apply the considerations stated that they had tried other things in the past. Several paraprofessionals work in the resource room and had worked in more difficult programs during their careers. These individuals presented a comfort level with the emotional, social, and load tenets because they noted it was similar to approaches they had heard and tried in the past. There was a noted contrast to the new teachers and paraprofessionals, who had more limited experiences, as they found the ideas very new and were confused about how pieces could fit together in the classroom setting.

### **Key Thematic Finding #5**

**Educators need guidance in classroom management and instructional sequence design.** Half the participants noted that teachers are under tremendous pressure to accomplish certain curriculum, teaching strategies, and to meet the needs of students with individualized learning plans and Section 504 accommodation plans. Staff noted that they are not aware of how much they can add to extrinsic load and overall cognitive load. Several participants noted that as a whole staff, they felt adults were so busy they often only intervened in a reactionary approach to a student's cognitive overload, rather than proactively to mitigate the issue. The increased instructional consideration led many to feel that smaller group instruction would be needed, but that multimodal instruction and social mediums took too much time to fit into the instructional day. Additionally, many participants noted limitations for long-term memory, relational coding, and multimodal instruction that involved time for student processing, preparation time, and possible classroom management issues due to lacking self-regulation and social skills on the part of the students.

### **Summary of Findings**

To gather a coherent view of the information, a review of the survey and interview data was necessary. The survey data provided insight into the general knowledge and opinions of staff regarding how students process information, code information, learn habits, handle internal stressors, and considering the role of educational pedagogy in meeting those needs. By comparing subgroup data to the total participant pool the most prevalent mindset of the whole group is gleaned. The interview data was used to show a comparison between prior and post opinion after gaining new knowledge.

The results of the data regarding how students process information had most subgroups falling in the 50%–76% of multimodal instruction being a reality, especially through visual and verbal means combined. The group as a collective ranged between 53%–76% stating it is somewhat likely to be true. The interview data presented indicates that most staff were resistant to using multimodal instruction due to limitations in time, resources, and knowledge regarding techniques. The belief is present but varied from feeling it is important to making it happen is difficult.

Examination of the questions pertaining to the use of repetition and practice to teach provided results that were consistent among all teachers with associates or higher degrees. These groups represented just over half of the participants and felt that most students could attain learning with the new knowledge gained. The interview questions regarding biosocial theory and long-term memory provided similar results. Just over half of the participants felt routine and practice were valuable tools; however, during the interviews most found they did not understand how to use stimulus response scenarios and practice to build habits. Many felt that the student's limitations with focus and state of emotional and behavioral distress made this less likely to be achieved.

The survey questions regarding the distractibility of students provided data showing that the subgroups and total participant group, over 80%, felt that students were distracted most times during instruction, but 71% felt students could refocus if motivated to do so. The interview questions regarding environmental stimuli, Maslow's hierarchy of needs and the processing of information from the serpentine brain to mammal brain provided data showing that all staff felt environmental concerns were a major concern. All participants agreed the Maslow hierarchy of needs was an issue; however, most participants did not realize the hierarchy impacted focus and

drive. Lastly, how the brain processes thoughts were new to all staff and was seen as a crucial factor. This comparison shows that the level of student distraction is high, but there is no solid understanding of how to address the issue in class.

The survey data aligned to instructional design showed the majority felt that instruction should be tailored to the individual student and the specific content, skill, or habit being learned. The interviews provided data showing that balancing individual needs and content requirements impacted individualization due to lack of time and classroom management concerns. This shows that teachers and paraprofessionals see the need for individualization but find it difficult to accomplish in the classroom setting.

The problem that drove this study was based on the academic performance gap between students with ASD and their nondisabled peers. The comorbidity of ASD with other disabilities broadened the concern and the scope of the problem. It is evident that teachers and paraprofessionals find that multimodal instruction, teaching habits, improving the coding of information, managing distractible students, and balancing their requirements and desires to reach students are all factors influencing instruction. Students who learn and act outside of the educator's training and experience struggle due to their learning disability, and the teachers and paraprofessionals experience difficulties as well.

The purpose of this practical action research study was to explore how professional development that is focused on brain-based research informs educators' pedagogical design for students with ASD in whole and small group academic settings. The results show a need to provide more specific neurologically aligned trainings that allow staff to move from concept to skill. Staff realize they have gaps in knowledge they deem necessary and important to fill. Staff members have provided data that professional development must be embedded into their daily

reflective teaching cycle. Teachers and paraprofessionals see the same issues and understand they must have shared experiences and common knowledge to help students in a unified manner.

To what degree does brain-based professional development change how educators alter educational practice, including initial instructional design and accommodations, for students with Autism Spectrum Disorder? The study provided professional development, which did, in a few instances, inform instruction design and accommodation considerations. The insights gained from the data show that brain-based professional development has a role in informing educational pedagogy.



## CHAPTER 5

### ANALYSIS OF FINDINGS

This action research study utilized qualitative data to determine if supplying teachers and paraprofessionals knowledge regarding BBTA and the workings behind memory and arousal could increase their ability to meet the needs of students with disabilities in school. This chapter presents an analysis and synthesis of the findings derived from surveys and interviews conducted with teachers and paraprofessionals in a rural New Hampshire school. Each participant has worked or currently works with students with ASD or other students with similar symptomologies of ASD. Seventeen participants were surveyed before the professional development intervention and fifteen of those seventeen were interviewed after the intervention. In this chapter the researcher reviews the central question of the study and aligns each of the five key thematic findings to the central question. The researcher also evaluates the implications of these findings toward addressing the needs of staff. The researcher then discusses the limitations of the study to provide context to the results. The researcher also identifies recommendations for future research in addressing educational practice problems through action research.

#### **Central Question**

To what degree does brain-based professional development change how educators alter educational practice, including initial instructional design and accommodations, for students with ASD?

#### **Key Thematic Findings**

1. Domain knowledge of staff influences applicability of material and skills.
2. Consideration and strategy-based trainings are preferred.
3. Staff need to process with groups and apply created strategies in the moment.

4. Similar experience aids comfort level toward application.
5. Educators need guidance in classroom management and instructional sequence design.

### **Interpretation of Findings**

The participants who were surveyed and interviewed provided valuable insight into the struggles that educators have in meeting the demands placed on them when trying to address the needs of students (Creswell, 2015). The surveys provided the current opinion and understanding of the educators, and the interviews provided insight into how the educators processed the information during and after the training. By allowing the participants to process the information, then interviewing them from a practical application standpoint, their views on usefulness and applicability in the moment became evident. Action researchers seek to understand a problem using data (Creswell, 2015). The data provided in this study and the analysis presented in this section begin this process and guide the next steps.

Schools must educate a broad range of students (U.S. Department of Education, 2018). Students with disabilities such as ASD present particular challenges because they struggle with brain-based learning challenges such as social/behavioral deficits and executive functioning deficits (Vogan et al., 2014). The participants in this study clearly purvey that increasing their knowledge regarding why and how these students struggle is necessary. Educators and all those involved with creating educational methodology must be provided professional development and time to reflect on how students with disabilities learn and respond to their environment differently to construct an effective educational plan (Papa, 2011). The professional development needed does not exist in a single program, strategy, or approach but rather in understanding the similarities within them.

The school administration felt that there is a functioning Response to Intervention (RtI) model. After discussion with staff, it was clear that they had times set in the schedule for intervention but were lacking the reflective portion. According to Tileston (2011), after establishing an awareness and sense of urgency, a school must ask itself three questions during the next phase of creating an RtI system: Do we have the proper assessment tools? Do teachers and paraprofessionals have the background knowledge they need? Are they trained appropriately? Not having the needed background knowledge impacts their ability to understand the problem and identify their needs (Participants 1, 4, 6, and 8).

Participants noted that multimodal instruction, although necessary, had too many limitations. Multimodal instruction provides educators with tools to balance the needs of the curriculum with the learning needs of the student (Kennedy et al., 2015). Providing the participants with this knowledge clearly addresses a deficit in skills they feel are necessary. The data provided presents an argument for understanding what to consider, or how things work, as well as the skill to implement the strategies. Knowledge must be provided in context for educators to use it with fidelity.

The use of consideration and strategy-based trainings refers to helping the teachers and paraprofessionals understand why the brain functions the way it does, in this case in relation to memory and arousal (Jackson et al., 2014; Paivio, 2014). Allowing this knowledge to be applied to situations through role play and discussion for the purpose of creating a context can further inform when and how it may be applied. The participants provided insight into the need for them to build habits and lists of strategies and to increase their ability to reflect on a situation, then after analyzing it, select an appropriate environmentally conducive strategy. As noted prior, action research and the reflective teaching process are similar. Teachers and paraprofessionals

must reflect, plan, and act to meet the needs of the diverse student population (Menter et al., 2011). Reflection starts with knowledge, moves to considering options, and finally moves to knowing how to strategically intervene.

Teaching and learning are not done in controlled environments. This study alluded to the need for teachers and paraprofessionals to work collaboratively when trying to address pedagogical concerns. When the educational staff were asked how to make the information provided more applicable, all noted more time needed with colleagues to discuss and process the information. Also noted by most participants was time to create or modify strategies as a group. This theme of collaborative need ties in with the theme regarding experience. Prior experience in initiatives and new strategy implementation correlated strongly with those who tried to apply the information after the training. Those who noted hesitation stated that they needed more time to process the information or to see how it would fit in. Any process of change must start with addressing complacency and creating a team of professionals with the right characteristics (Kotter, 2012). Complacency must first be addressed by understanding why an individual or individuals are not attempting change. Teachers and paraprofessionals have the positional power and credibility to begin the change process. Providing them with the expertise through professional development is crucial for them to guide the necessary change (Kotter, 2012).

Teachers and paraprofessionals must balance the diverse needs of their classroom and the management of a diverse and developmentally challenging environment with their own emotional regulation (Voss et al., 2017). The landscape for a teacher can change month to month based on initiatives from administration and students moving in and out of their classrooms. Five participants specifically referenced the information on direct access memory (our ability to focus on four to seven bits of information) as not only a new concept but a limitation for educators

themselves. Humans engage in environments consciously and unconsciously, coding information, retrieving knowledge, and learning skills throughout the day. These functions are impacted by arousal issues (Jackson et al., 2014). Teachers and paraprofessionals will not accept professional development that makes little sense in their current situation (Kotter, 2012). These educators who see all of their work as separate and disjointed have an increased extraneous load and increased cognitive load due to lack of expertise. The idea of practice, repetition, and cognitive load can be applied reflectively by practitioners to their own situations. Domain knowledge influences a practitioner's ability to understand a problem, even if it is their own or their team's, and not just the students they teach (Hersey & Blanchard, 2016). Participants noted that behaviors in the classroom setting and addressing emotional needs makes instruction difficult at times. Teachers and paraprofessionals work in structured time allotments, requiring lesson completion within a certain time, and these situations involve unpredictable behaviors that require these educators to react quickly and in view of the students (Voss et al., 2017). Varied knowledge and experience impact each individual teacher, making his or her needs as varied as the students.

### **Implications for Practice**

The participants of this study work in a rural elementary school in New Hampshire. Although states control educational policy, federal guidelines do influence educational decisions and practices for individual states (New Hampshire Department of Education, 2019). Schools must try to meet the needs of students in the core classroom. If schools, such as the one used in this study, want to increase the learning outcomes for students with ASD and others with comorbid aspects, they must begin by examining learning via brain research through embedded professional development that allows practitioners to collaborate. Educators begin their careers

with a foundation of knowledge, but also must increase that knowledge to meet their current need (Creswell, 2015). District and building administration need to help improve practice by aiding or directing staff to attend professional development and initiate agreed upon practices (Kotter, 2012; Papa, 2011).

This research study provides a solid argument for continued professional development in brain-based learning, but not necessarily the BBTA model. Chapter 2 noted an opinion by researchers that BBTA provides information already found in other approaches. This concern was confirmed by participants in this study. Although it provides current information, the design and format in the BBTA model was a solid medium for moving from theoretical idea to practical considerations through additional neurological understanding. The participant data in this study documented what types of information are needed to increase further domain knowledge, and provides insight into the structure of that professional development. The study also provides direction for professional development and supervision focused on holistic time management, resource allocation, and instructional design that combines practices that reduce extraneous load and cognitive load of teachers and paraprofessionals.

### **Limitations**

The limitations of this study are found in five areas: type of research, size of participant pool, focus of the study, type of data collected, and duration. Action research is designed to address a specific problem within an environment. This innate limitation with action research makes the specific data more difficult to apply to other settings. The participant pool in this case involved seventeen surveyed educators and fifteen interviewed educators, which is a small sample. Additionally, the participants worked primarily in grades three through five. This limited range does not account for developmental differences. This research study focused on students

with ASD and comorbid diagnosis explicitly with respect to memory and arousal concerns. This limited focus does not account for every other disabling factor possible in a classroom setting. Application to other known deficits would not be practical. However, the BBTA, neurological information, and implications of practice are transferable to the same population of students for the same purpose regardless of study site.

The study utilized both survey and interview data collection methods. The design and type of survey limited the responses but also, once compressed, limited the intended range of responses. No strategies were attempted, or data collected to identify the impact of the training on student achievement which could be attempted in a longer study. The amount of information presented, and limited time of the study is presented as a limitation because it impacts the processing time of the participants.

### **Recommendations for Future Research**

Educating students with disabilities creates the need for understanding how to educate those students within the actual environments where they are educated. Programs are designed and tested in isolated environments, not traditional settings, reducing the factors normally addressed through professional judgment (Cook et al., 2009). Conducting research within the traditional educational environments, to account for the broad factors influencing students and teachers collectively increases the ability to apply the findings to the classroom setting. The following two recommendations for future research may help to increase the practical application of research in public schools.

First, employ action research on the same topic within a larger setting and across grade level groupings, such as kindergarten to second grade, third through fifth grade, and sixth through eighth grade to identify grade level or developmental differences among students. This

would increase the participant pool and subsequently increase the validity of the data collected. Schools allocate resources to address the needs of students and data on what teachers state they need to address the needs. Action research alone is not enough. The literature and practices involved must bring theory down to an actionable set of practices and include continuable action research supporting the reflective teaching process. This allows educational practitioners to reflect on data conceptually, then apply pre-learned strategies or create strategies from the considerations provided by theory.

Second, extending the focus of the action research within the same institution addresses other disability similarities resulting in more common data. This larger body of data allows the district to create its own action research meta-analysis. This information could guide future professional development opportunities that are requested by practitioners and relevant to their populations directly, both within a building and in the buildings that feed other buildings, such as elementary to middle school, then high school. Administrators need to lead using data from their own industries if innovation is to occur (Kotter, 2012). Action research allows practitioners to use empirical studies to vet their own data in order to solve on-going needs (Menter et al., 2011).

### **Conclusion**

The key themes identified in chapter four support the findings and implications noted in this chapter. Chapter five reviewed the central question and related the data derived in chapter four to the themes resulting in implications for practice. The need for continual reflective teaching through action research at the building level is clear. The complexity of balancing domain knowledge, collaborative reflection by groups of practitioners to move from consideration to strategy, increasing shared experiences, and understanding how to balance role demand and student demands must be accounted for to meet the needs of students with ASD.



New Hampshire's data on the success of students with ASD and other disabilities is not significantly different from the national average (National Center for Education Statistics, 2019). This provides a basis for using this information and approach across schools and states. However, this chapter outlined the limitations of this study that need to be understood and accounted for when applying the results and practices presented. Addressing how brain-based professional development can change how educators alter educational practice for students with ASD to increase their success in schools is not a New Hampshire-only problem. This study provided insight to addressing educational practice and added considerations for additional research focused on increasing the body of knowledge regarding learning.

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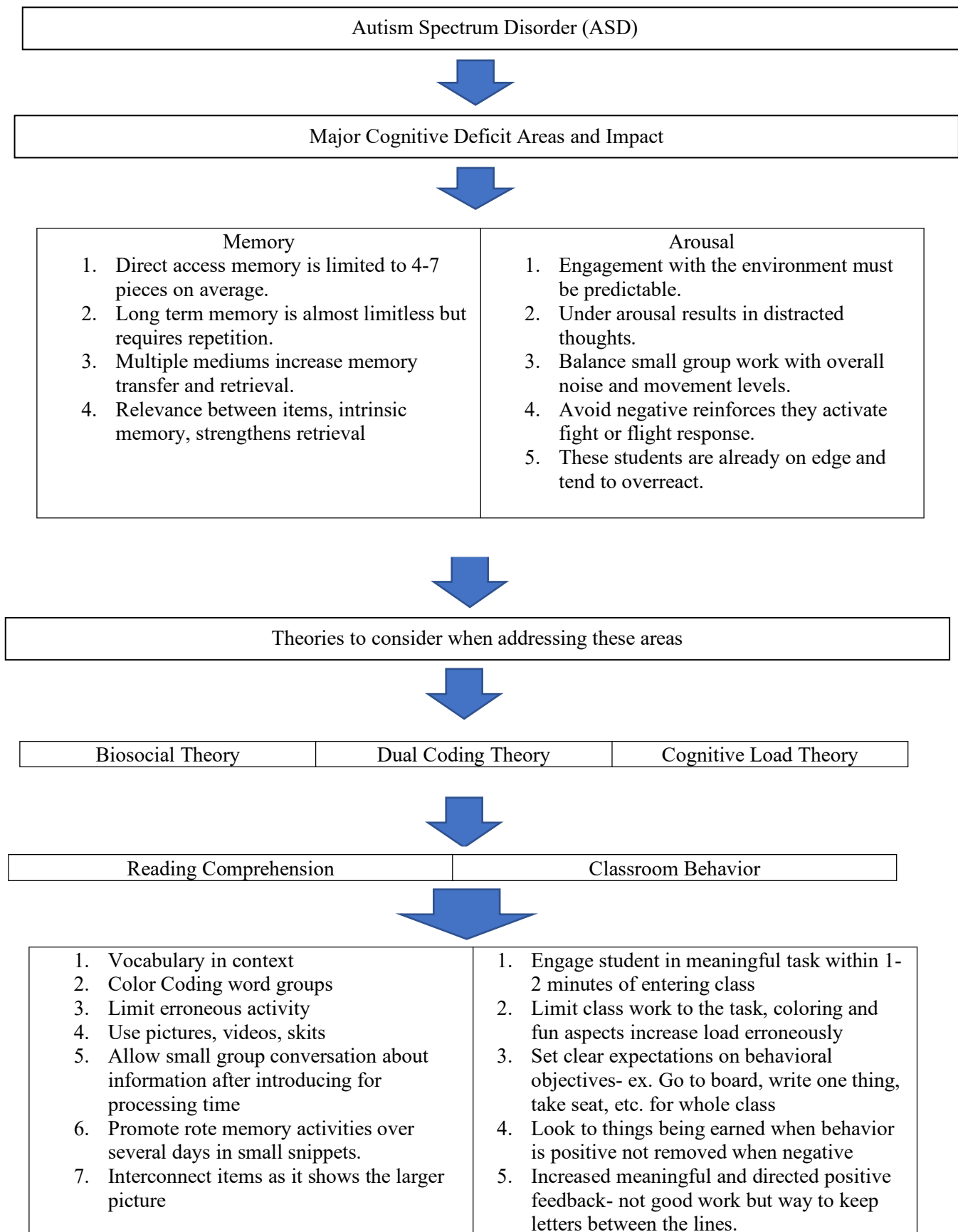
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Appendix A  
Brain-Based Professional Development Presentation



Appendix B  
Site Permission Letter

**Research Proposal**  
**University of New England Doctoral Program in Educational Leadership**

This proposal serves as the request to conduct research in the Newport School District.

**Name of Researcher**

My name is Troy Kennett and I am a graduate student at in the doctorate program Educational Leadership at University of New England.

I am conducting a research study designed to explore how professional development focused on brain-based research informs educators' pedagogical design for students with Autism Spectrum Disorder (ASD) and comorbid disorders/disabilities such as Attention Deficit Hyperactivity Disorder (ADHD), Learning Disabilities, Emotional Disabilities, etc. in academic settings in New Hampshire.

**Method of Study**

The method of study I will use includes confidential surveys for initial participation selection, preintervention, and post-intervention. Up to 20 staff may be selected to participate in the one and a half to two-hour professional development intervention.

**Benefits to the school or district**

Although there are no direct benefits to you or the Milford School District for participating in this research, it is my hope that the findings of my study will provide insight that will help your teachers and paraprofessionals increase their effectiveness in delivering instruction to students with disorders and/or disabilities affecting memory and arousal.

**Proposed Project Period**

The research proposed research period is from January to February 2020.

**Participation**

All participants will be asked to sign an informed consent to participate. All participants will be informed of the purpose of the research and I will be responsible to obtain consent from each participant. Participants will be informed that their participation is completely voluntary. Participants can choose to answer only the questions with which they feel comfortable and can discontinue participation at any time. Some of the data may be used for future research purposes consistent with the original purpose stated in the consent

document. The final data will be stored for a period of no longer than two years, after which it will be destroyed.

There is a risk of loss of privacy as those attending the professional development cannot be kept confidential. However, no names or any other identifying information will appear in any published reports of the research. The research material will be kept in a secure location, and only I will have access to the data. At the conclusion of the study, all audiotapes of interviews will be deleted and any other identifying information from the transcripts will be removed.

### **Certification**

This letter is to certify that information obtained from research will not include names of interviewees, schools, districts, student names or personal information.

### **Site Approval**

\_\_\_\_\_  
Printed Name of Approver

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Approver

## Appendix C

## Pre-intervention Survey

Likert Scale:

1 = not likely    2 = somewhat likely    3 = likely    4 = most likely    5 = always likely

Question	Score	Comment
The brain processes and memorizes information faster using verbal or auditory sounds.		
The brain processes and memorizes information faster using visual information such as colors and pictures.		
The brain processes and memorizes information faster through using both mediums together, but one at a time.		
The brain processes and memorizes information faster through using both mediums together at the same time.		
Students learn specific skills/habits through repeated exposure.		
Students learn specific skills/habits faster when they are presented incrementally.		
Students learn skills/habits faster when they are presented as smaller pieces of a larger habit.		
Students can learn to do things to use skills that do not require active thinking.		

Students can learn as many things at once as they are motivated to learn.		
Students can only learn a couple things at a time.		
Students can learn different amounts of information/habits/skills based on how they are taught (visually, verbally, using manipulatives)		
Students can be distracted while learning, to the point they learn less.		
Students can resist distractions if they are motivated to do so.		
Learning is a similar process for each student.		
Instruction must be tailored to the specific student.		
Instruction must be tailored to the content/skill, or habit being learned.		

Appendix D  
Post-intervention Interview Questions

**Interview Question 1**

- (BBTA) How might or did the idea of a Brain Based Teaching Approach influence your thoughts on adjusting practices based on brain input the current task designs?

**Interview Question 2**

- (BBTA) How might or did the knowledge of comorbid diagnosis and underdiagnosis influence any educational decisions?

**Interview Question 3**

- (Dual Coding) After discussing the idea that the brain codes information in various ways (auditory, visual, and even emotional), could you see how it may influence your instructional choices?
  - What are your thoughts regarding the use and limitations of multimodal instruction?
  - What are your thoughts on if practice is helpful, in which situations might it be or not be?

**Interview Question 4**

- (Dual Coding) Does the idea of Direct Access memory, limited to 4–7 pieces of information, when a student is truly focused, influence any thoughts on instructional design, and accommodations?
  - How might relational coding play into this quantity?

**Interview Question 5**

- (Dual Coding) With long-term memory having almost no limit and being resistant to stress, could you see how it may be used in your class?
  - How might the idea of stimulus response activation impact that?
  - Where does practice fit into creating this?

**Interview Question 6**

- (Biosocial) The idea of biosocial theory was used in the training. The premise was that people are organisms and react to stimulus in the environment consciously and unconsciously. Does that idea and the pieces discussed regarding Maslow's hierarchy and stages of the brain influence your thinking regarding management strategies or accommodation ideas?
  - If so, how?
  - If not, why?

**Interview Question 7**

- (Cognitive load) After being presented with the idea of cognitive load, memory has limits in ability and duration, which can be influenced by stimulus in the environment, does that influence your instructional ideas or management strategies?

**Interview Question 8**

- The training that was provided supplied you with considerations that you could apply to certain situations as you saw fit. Other training methods provide you with set strategies that you apply when the situation dictates in the manner you were taught. Which works better for you to make things actionable?

- Does having the teachers and paraprofessionals together improve the experience. Why or why not?
- What would improve the information provided, the training method used, or your ability to take the information and make it more actionable?