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# Transdisciplinary Learning: Investigating the Effects of an Adult Learning Class with a Neuroeducation Perspective on Adult Learners' Identity, Perceptions of Learning, and Implementation Strategies

Matt Thul

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Transdisciplinary Learning: Investigating the Effects of an Adult Learning Class with a  
Neuroeducation Perspective on Adult Learners' Identity, Perceptions of Learning, and  
Implementation Strategies.

by

Matt Thul

A dissertation submitted in partial fulfillment of  
the requirements for the degree of

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in  
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School of Education

2019

**Transdisciplinary Learning: Investigating the Effects of an Adult Learning Class  
with a Neuroeducation Perspective on Adult Learners' Identity, Perceptions of  
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**Matthew Thul**

This dissertation is completed as a partial requirement for the Doctor of Education (EdD) degree at the University of Portland in Portland, Oregon.

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## Abstract

Research shows that educators' perceptions of learning are limited due to a variety of factors which include: a lack of neurobiological- and language acquisition-informed content and information incorporated within teacher preparation programs, educators' learning experiences grounded in familiarity, and confusions between common educational learning frameworks, andragogy and pedagogy (i.e., K-12), surrounding appropriate learning tenets and effective learning practices for different-aged learners. However, one transdisciplinary model, *neuroeducation*, incorporates learning literatures from cognitive psychology, neuroscience, and language acquisition and provides insight into the limitations of educators' perceptions of learning and effective instructional practice. This study investigates the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b) perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings.

A narrative inquiry design captured responses from two groups of participants' semi-structured interview questions demonstrating that a neuroeducation perspective of learning positively impacted adult learners' identity, altered their perceptions of learning for K-12 learners and for adult learners, led to implementation of visual-based learning strategies grounded in neuroeducation perspectives, motivated their colleagues to implement instructional changes, and positively impacted K-12 learners' social and cognitive growth. Findings from this study signify a need for neuroeducation perspectives of learning within all levels of public and private education.

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On a more personal note, I need to thank those behind the scenes. My now fiancé and soon to be wife, Xeng. You have supported me in so many ways. Thank you for staying positive for me, when to me all hope seemed lost; thank you for all those hours of silence you gave me, because you knew what it took to help me stay focused; thank you for giving me massages, because my back became twisted like a pretzel from sitting at the computer for *way* too long; thank you for taking me to the coast during those inevitable stressful time periods, to help me mentally regenerate. Also, thanks to my mom (Mary), dad (Mike), and brother (Mitch) for all your good thoughts, prayers, and support for me during this time of my life; I could not have asked for a better family. Lastly, thank you God for your wisdom, guidance, and love!

## **Dedication**

I would like to dedicate this work to my grandparents. Grandpa and Grandma Allan Wehrspann and Grandpa and Grandma Robert Thul. You all helped pave the way for us younger generations and I could not have asked for better grandparents. I pray that God blesses you all! Thank you!

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## **Chapter One: Introduction**

This chapter provides a background for the relationship between educators' perceptions of student learning and instructional practices used in the classroom and highlights the impact of educators' perceptions of student learning and instructional practices on students' learning. Factors which influence educators' perceptions of student learning include: educators' training such as teacher preparation programs, educators' education-related experiences such as previous influential educators or teaching to their own educational strengths instead of their students' strengths, in other words familiarity, and the learning tenets within the theoretical learning frameworks used within the educators' teacher preparation programs. Learning tenets of the theoretical learning frameworks commonly used in education stem from adult learning theories such as andragogy as well as child or K-12 learning theories, in other words pedagogy. This chapter introduces a transdisciplinary model called *neuroeducation*. The neuroeducation model used within this chapter and throughout this study overlaps research from cognitive psychology, neuroscience, and language acquisition and will be discussed further within Chapter Two. This chapter also presents the statement of the problem, the purpose of this study, and the significance of this study.

### **Factors Influencing Educators' Perceptions of Student Learning**

Educator perceptions of student learning influence the types of instructional methods used in the classroom and the likelihood of students' success (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard, Hoy, & Hoy, 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet, Guthrie, & Ng, 1998). Educators' perceptions of student learning are largely influenced by teacher preparation programs, educators' previous education-related experiences, and by the learning tenets within adult and child learning

frameworks used in the educators' teacher preparation programs; for example, andragogy and pedagogy. Furthermore, students have a greater likelihood of success when their educators have an understanding of their own perceptions of *learning* (Bruner, 2001; Sylwster, 1995).

**Teacher preparation programs.** Teacher preparation programs lack information representing neurobiological learning (Leibbrand & Watson, 2010). In other words, pre-service educators are largely not taught about the neurobiological processes of learning or its applications into the classroom (Leibbrand & Watson, 2010). Educators' overall understanding of learning and the process of learning are limited and this suggests educators do not really know *how* students learn (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993). Having a neurobiological understanding of the process of learning can help educators identify components of neuronal learning that are important for optimal student learning. For example, research in neuroscience shows that the neuronal circuits and networks within students' brains represent the students' semantic, previously learned experiences, in other words their functional language (Arwood, 2011; Pulvermüller, 2013); use of functional language, which represents students' previously learned experiences, can benefit students socially and academically (Green-Mitchell, 2016).

Various educators have used a neuroeducation perspective of learning to analyze student learning and success. For example, Green-Mitchell (2016) used a neuroeducation model to study the connection between 10 alternative school students' functional language acquisition and their pro-social and moral development. Four students had significant behavior problems and made up the core group, five higher achieving students made up the comparison group, and one student with both behavior and academic struggles made up the confirmation group. Green-Mitchell used visual-based learning strategies such as cartooning, writing, and pictures with shared social

events and activities, to assess students' functional language. Green-Mitchell's study showcased the deficit in the alternative school students' functional language as well as highlighted the social and academic benefits alternative students can gain when allowed to utilize their unique, functional language in classroom settings (Green-Mitchell, 2016).

Researcher Xiang Lam (2016) connected a conceptual understanding of semantic learning held within language theories and applied it to Chinese language learning. Xiang Lam's study included fifty-four high school students who were enrolled in a Mandarin class. Her study sought to reveal the students' cognitive abilities and processes towards learning Chinese characters by investigating students' mental images of the Chinese characters' meanings through visual coding. Image-making questionnaires which included drawing, writing, and reading tests were used to display students' cognitive abilities and processes towards the Chinese characters they learned. Data from the study was analyzed through a neuroeducation model (i.e., cognitive psychology, neuroscience, and language theories). Results from Xiang Lam's study displayed a development of students' ability to connect their own meaning to newly learned Chinese characters as well as found that visual-based strategies such as drawing, predicted better student performances, especially in writing (Xiang Lam, 2016).

Robb (2016) conducted a study which sought to align research between the fields of cognitive psychology, neuroscience, and language to better understand effective practices in literacy. Through her review of literature, Robb investigated the historical underpinnings of current literacy instructional practices used in education today. She then applied a neuroeducation perspective within her low-income, high English Language Learner-populated, first grade classroom. Neuroeducation instructional practices used within Robb's study included: student-lead stories, event-based learning, visual concept dictionaries, use of drawing to help

student writing, student-created projects, use of students' natural language to display learning, using visual flowcharts, and allowing students to ask *how* and *why* questions. Nine years of first grade data under a neuroeducation lens were analyzed. Results displayed more than 90% of students, in the ninth year, met or exceeded district standardized testing protocols compared to over 50% of students in the first year, meeting or exceeding district standardized testing protocols, suggesting the effectiveness of using the neuroeducation perspective as a lens to view learning and instructional practices related to literacy (Robb, 2016).

Jaskowiak (2018) conducted a study which used a neuroeducation model to analyze the connection between levels of language function and the acquisition of prosocial concepts in nine emotional and behavioral disorder (EBD) students and two students with a language impairment (LI). The study's results suggested that EBD and LI students displayed deficits in their functional language which was observed in students' antisocial, oral and cartooned responses to event-based pictures and within students' limited production of prosocial responses to event-based pictures. The study also displayed a gap in current behavioral curricula regarding language function and suggested the inclusion of prosocial concept acquisition towards students' prosocial development (Jaskowiak, 2018).

The neurobiological process of learning can be addressed in other fields of study such as language acquisition, which can promote an understanding of learning that is holistic in nature (Green-Mitchell, 2016; Hardiman, Rinne, Gregory, & Yarmolinskaya, 2011; Jaskowiak, 2018; Kartzir & Pare-Blagoev, 2006). In other words, learning can be represented from several perspectives (including, but not limited to: cognitive psychology, neuroscience, language acquisition), which provides a greater chance for student learning to occur. However, teacher preparation programs tend to focus largely on pedagogical practices such as teacher-directed,

lecture-based classroom environments which use adult reductionistic models that break information down into its smallest parts for student learning, for example, found in phonetic approaches (Arwood & Merideth, 2017) and less on an understanding of *how* students acquire information using their natural language to represent previously learned experiences to scaffold new information upon (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993). As a result, effective learning opportunities within the classroom may be restricted or limited to educators' understandings of how learning occurs. Educators with a limited understanding of learning is a problem; for how can one provide learning opportunities if teachers do not have an understanding of what learning *truly* is (Sylwester, 1995)?

Similarly, teacher preparation programs tend to lack information about learning as learning relates to language acquisition (Robb, 2016). Teacher preparation programs that lack information related to language acquisition will not make the connection that exists between language acquisition and language function which in the classroom limits the effectiveness of students' learning experiences (Missett & Foster, 2015; Owens, 2010; Robb, 2016; Tivnan & Hemphill, 2005). As mentioned earlier, functional language represents a student's previously acquired experiences (Arwood, 2011; Pulvermüller, 2013) and can be used within learning settings to help raise student cognition and increase students' overall learning (Arwood, 2011; Arwood & Merideth, 2017; Green-Mitchell, 2016; Jaskowiak, 2018).

Learning environments that lack an understanding of the connection between functional language and language acquisition tend to follow traditional or deficit-based models of teaching (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Dinishak, 2016; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Rappolt-Schlichtmann et al., 2018; Robb, 2016; Valencia, 2012). Traditional-based models of teaching are teacher-centered,



evidence-based, and requires a standardized test scores to show student learning (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Robb, 2016). Deficit-based models of teaching attempt to teach students based on their weaknesses instead of their strengths such as when a student who cannot make the sounds of letters is made to practice letter sounds (Dinishak, 2016; Rappolt-Schlichtmann et al., 2018; Valencia, 2012).

Teacher preparation programs have been shaped to fit the standards of numerous nationwide laws on education that were originally established to track and measure students' academic success including the Elementary and Secondary Education Act (1965), No Child Left Behind Act (2001), and Every Student Succeeds Act (2015). These legislative Acts have been determining factors towards school funding and impacts the types strategies used in the classroom for learning, such as test preparation programs (Dove, Pearson, Hooper, 2010). Educators who instruct in their classrooms based from a limited understanding of learning, such as not understanding the acquisition of and relationship between students' natural language and their neuronal circuitry, and the influence those things have on their actions or behaviors, will continue to produce the same low-achieving student learning results that have perpetuated within traditional- and deficit-based learning models in education (Dove et al., 2010; Robb, 2016).

**Education-related experiences.** Teaching practices grounded in self-familiarity whereby educators structure classroom instruction around their own strengths and past experiences instead of their students' strengths, influences educators' perceptions of effective learning (Ashkanasy, Wilderom, & Peterson, 2000; Brown, 2003). For example, Oleson and Hora (2014) interviewed and observed 53 science, technology, engineering, and mathematics undergraduate faculty at three different post-secondary institutions and found that faculty tended to teach how their

instructors taught them. Participants also drew from their previous experiences as instructors, as students, and as researchers to shape classroom experiences for their students. Similarly, Stitt-Gohdes (2001) conducted a study which analyzed 211 high school students' completed Canfield Learning Inventories and eight high school business teachers' completed inventories. Results showed that high school teachers tend to teach how they were taught, typically centering instruction within frameworks of pedagogically-based practices; for example, lecturing, using repetitive practices and memorization, and giving positive reinforcements to generate educator-desired, student behaviors such as giving a student a sticker for turning in their homework on time (Brown, 2003; Stitt-Gohdes, 2001). Research in neuroscience shows that non-inquiry-based activities (such as memorization) and repetitive instructional practices used in education turns off or disengages students' thinking making long-term learning difficult (Bookheimer, 2002; Cabeza, Locantore, & Anderson, 2003; Curran, 2000; Reas & Brewer, 2013; McGilvray, 2005).

Organizational beliefs too can be so entrenched in familiarity that the viability and efficacy of their instructional practices centered around learning are no longer questioned (Ashkanasy et al., 2000). For example, Ashkanasy and colleagues (2000) stated that organizational beliefs held within cultural frameworks tend to be so common that the efficacy of the practices are no longer questioned. As an example, an educator may not question whether or not they should give phonics-based reading instruction to help their struggling readers or may not question the process of sight word memorization towards learning to read because phonics and sight word memorization is a commonly practiced in their school. However, there are educators and researchers who view teaching as a social exchange through which individuals' experiences, driven by naturally acquired language, display and improve student learning in the classroom (Arwood, 2011; Damasio & Geschwind, 1984; Danielson, 2016; Dewey, 1938; Frith & Frith,

2007; Halliday, 1977; Mezirow, 1997; Skerry, Lambert, Powell, & McAuliffe, 2013; Wenger, 1998).

Proponents of teaching as a social exchange activity hold that teaching is a facilitation of social dialogue which utilizes students' individual experiences and natural language to showcase student learning (Bransford, Brown, & Cocking, 2000; Enríquez, 2017; Mezirow, 1997; Wenger, 1998). The approach of using students' natural language advocates that learning can be accomplished through use of students' natural, functional language which describes their experiences (Arwood, 2011; Damasio & Geschwinde, 1984; Halliday, 1977; Pulvermüller, 2013; Skerry et al., 2013). Exploring preconceived perceptions of learning or tenets of learning held within educational learning frameworks further encourages an understanding of the underlying influential factors contributing to educators' perceptions of student learning.

**Learning tenets within learning frameworks.** To better understand educators' perceptions of learning as they relate to student success, active reflection on preconceived perceptions of learning is essential (Bruner, 2001; Reed, 1996). For example, an educator that believes K-12 students need to be told what is important to learn, will tend to structure their classroom practices (e.g., lecturing, fill-in-the-blank worksheets, standardized testing) and beliefs of student learning around that perception (Brown, 2003). An educator who analyzes students' learning and bases students' overall knowledge from scores on standardized tests views students' learning through a behavioristic lens which requires a display of student products to show learning (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Robb, 2016). Further towards the understanding of educator perceptions of learning, one method from which learning has been examined is through the separation of learning tenets and expectations specific to adult learners

and to child (K-12) learners. Research has shown that adult and child learning tenets influence teachers' perceptions of student learning (Leibbrand & Watson, 2010),

Two common perspectives of learning used in education that separate adult and child learning tenets and expectations stem from two philosophical learning frameworks: andragogy and pedagogy (Holmes & Abington-Cooper, 2000; Knowles, 1980; Monts, 2000). *Andragogy* is defined as the science of teaching and leading adults, while *pedagogy* is defined as the science of instructing, teaching, and training children (Brown, 2010; Knowles, 1973; Knowles, 1980). Within andragogy, adult learners expect learning to be relevant, practical, and meaningful to their own lives (Knowles, Holton, & Swanson, 2005), while in pedagogy, child-learners learn what is expected of them by their teachers (Brown, 2010; Knowles, Elwood, Holton, Swanson, 1998). Distinguishing adult learning from child learning for the purposes of instructional practice used in the classroom and for the influence on educators' perceptions of learning, is difficult; for example, adult learners may not be motivated to learn, though they are expected to be motivated to learn because information will be meaningful, practical and relevant to their lives or a child learner's specific experience may be more useful for classroom instruction than an adult learner's experiences, etc.) (Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Knowles, 1980; Merriam, 2001; Rachal, 1994) and should be further analyzed.

### **The Debate of Andragogy and Pedagogy**

Though andragogy and pedagogy are defined differently and present specific expectations or standards of learning for each adult and child learner (e.g., adult learners need relevant, practical, meaningful information and child learners learn what is expected of them) (Brown, 2010; Knowles, 1973; Knowles, 1980), distinguishing adult learner from child learner for instructional purposes is difficult (Davenport & Davenport, 1985; Holmes & Abington-

Cooper, 2000; Knowles, 1980; Merriam, 2001; Rachal, 1994; Rachal, 2002). In fact, Knowles (1980) questioned the effectiveness of defining separate learning characteristics for adults and children and stated learning may be better represented, accounted for, or realistic when learning assumptions meet somewhere in the middle of the andragogical and pedagogical spectrum.

Knowles (1980) stated that on some occasions andragogical practice, such as classroom dialogue based on learners' experiences, may be more useful for children; while pedagogical practices, such as teacher-lecturing, may be more useful for adults, further complicating the established guidelines for andragogy and pedagogy practice.

Confusion between learning tenets held within andragogy and pedagogy philosophical frameworks was further highlighted in a meta-analysis conducted by Rachal (1994). The study measured common andragogical (e.g., small group discussion) and pedagogical approaches (e.g., lecture) in education from 18 different studies and concluded that approaches represented within andragogy and pedagogy were equally used by educators in classrooms with diverse ages of students. In other words, classrooms included within the meta-analysis were neither strictly andragogically-based or pedagogically-based in practice. Educators' use of multiple instructional approaches in a classroom, originating from different philosophical learning frameworks, may simply be random or may be due to educators' familiarity with particular instructional practices or personal perceptions of student learning (Brown, 2003).

Andragogy- and pedagogy-based instructional methods are not always implemented with fidelity. For example, Monts (2000) explored the efficacy of andragogy over pedagogy by examining five different studies which focused on the evaluation of teachers who utilized andragogically-based instruction and explored the perceptions of learning by both faculty and students. The andragogically-based instruction in the five studies centered around Knowles's

(1980) definition of andragogy -the art and science of teaching/leading adults. Andragogical instruction highlighted in the five studies included experimental techniques, discussion, problem solving cases, and field experiences. Results from the study were mixed. Inappropriate use of andragogically-based instructions were noted; for example, teachers used classroom discussion to combat student boredom, not engage student interest, and thereby created a mismatch between self-perceptions regarding how teachers felt they taught in the classroom and how their students viewed their teaching methods. In other words, teachers often viewed themselves as upholding andragogically-based practices; however, students reported that their teachers focused on content delivery which was provided through lecturing, which is a pedagogically-based, not andragogical practice (Monts, 2000).

Educators who reflect on their perceptions of student learning as it relates to age-appropriate methods of instruction can identify quality methods of instruction that work for all aged learners. Quality teaching often involves a combination of effective attributes, such as teachers' content knowledge or beliefs around learning, and is not limited to any single methodology (Coe, Aloisi, Higgins, & Major, 2014). At a summit held in Washington, D.C. in 2014, 80 school leaders and teachers from countries including Australia, Canada, Finland, Holland, Hong Kong, Singapore, the United Kingdom, and the United States were brought together to share instructional practices and strategies they had found to bring student success. One of the guiding questions addressed at the summit was: *What is good pedagogy?* School leaders and teachers at the summit compiled a list of components they found, through observations and formal teacher and student assessments, to positively affect student learning which included:

- The teacher's level of content knowledge. Teachers with a deeper content knowledge had more successful students;
- The quality of instruction provided including researched best practices of reviewing previous learning and scaffolding new learning from previous learning;
- The classroom climate where meaningful relationships between teachers and students exist and high learning expectations are placed on students;
- The teacher's classroom management approach uses time efficiently and sets clear classroom rules;
- The teacher's beliefs about student learning such as teachers having an understanding of why they are using particular instructional practices and the teacher's theories about learning and students' learning process;
- The teacher's professional behaviors, for example, the teacher's self-reflection on instructional practice, professional development, and building learning communities within and outside their schools (Coe et al., 2014).

Educators can easily misperceive (e.g., limitations of educators' perceptions caused by limited understandings held within teacher preparation programs) or misuse (e.g., Monts, 2000 study) the effective instructional components noted by Coe and colleagues (2014), therefore, this list of components needs careful interpretation before implementation (Coe et al., 2014).

Another framework of learning, different from the learning expectations held within andragogy and pedagogy frameworks, can be viewed from a neuroscience perspective and is valid for all aged learners (adults and K-12). In other words, learning is interpreted as a single human process which does not differ by age; meaning, human learning, no matter the age, can be represented with similar values and philosophies (Elias, 1979; London, 1973). Neuroscientists

state that all humans (of all ages) use their sensory receptors (e.g., eyes, ears, nose, mouth, skin) to take in sensory inputs (e.g., light, sound, pressure, smell, or taste) within their environment, the brain interprets the sensory inputs, and perception and learning then can occur (Fiser, Berkes, Orbán, & Lengyel, 2010; Gillett, 1989; Heeger, 2017; Pulvermüller & Fadiga, 2010; Schunk, 2012).

Another framework of learning which is different from the learning expectations held within andragogy and pedagogy frameworks and extends on the previously stated single human, neurobiological process of learning, incorporates cognitive psychology, neuroscience, and language perspectives of learning to inform learning. Arwood's (2011) Neuro-Semantic Language Learning Theory (NSLLT) is a four-leveled perspective of learning which states humans continuously rise and drop within the language levels: *sensory input, perceptual patterns, concepts, and language*. At the first and lowest level of thinking, *sensory input*, sensory receptors (i.e., eyes, ears, nose, mouth, and skin) take in specific sensory inputs from the environment (e.g., eyes take in particles of light, the ear takes in sound waves) (Arwood, 2011). Receptors only bring in sensory inputs that cellular structures can recognize. Receptors do not bring in whole products such as words or concepts. Distance receptors (eyes and ears), instead of nose, mouth, skin, are the most influential towards the development of language due to the ability to take in information that are at distances (Arwood, 2011).

At the second and next highest level of thinking, *perceptual patterns*, neuronal organization of the raw sensory inputs occurs (Arwood, 2011). Receptors (e.g., ears and eyes) convert raw sensory inputs (e.g., sound wave, particles of light) into chemical messages which are then uniquely bundled within structures of the brain and can later be tracked and relayed as past and present sensory input, eventually with enough layering of patterns, a concept is formed.



Each person's experiences are unique, therefore, cellular bundles are unique. At the perceptual patterns level of thinking, the brain is continuously seeking out new, meaningful patterns. Not all inputs of patterns contribute to the development of concepts or language, however. Because the brain utilizes patterns of sensory inputs from the environment as a part of its development and not all patterns contribute to the development of concepts or language, some patterns can be repeated without establishment of an underlying meaning of the pattern (Arwood, 2011). For example, a parent sees their two-year-old throw a grape across the room and hit her older brother; so the parent tells the two-year-old child to say "sorry" to her brother. The two-year-old says, "sorry." Just because the two-year-old could repeat back the pattern ("sorry") does not mean she understands the meaning of the word or when or why to say the word sorry.

The third level of the NSLLT is labelled *concepts* (Arwood, 2011). Concepts are formed when multiple layers of underlying, meaningful perceptual patterns have been formed within the brain. This level is where thinking first occurs. Language is used to express the concepts that have been formed by uniquely-acquired, underlying perceptual patterns. Brain-imaging shows activation in various areas of the cerebral cortex (the gray, wrinkly tissue covering the cerebrum) when language is used to describe its underlying concepts, or in other words, when thinking occurs. Overlapping visual sensory inputs can develop visual concepts for learning and overlapping acoustic sensory inputs can develop auditory concepts for learning, however, each individual is wired from an early age to either be a visual learner or an auditory learner, therefore, students with visual learning systems that have educators that instruct based from auditory-based practices (e.g., lecturing) will struggle to develop concepts to help them think (Arwood, 2011).

The fourth and highest level of the NSLLT is labeled *language* (Arwood, 2011). Language names our thinking, our thinking describes our concepts, and the concepts represent the underlying, neurobiologically-meaningful perceptual patterns that have been acquired from our social environments by our sensory receptors. Language is greater than the sum of its parts (i.e., concepts, perceptual patterns, sensory receptors). In other words, language occurs in the cerebral cortex and is able to disperse neuronal-based activity to various parts of the brain, making the brain synergistic. Learners can use their semantic language to retrieve new information or develop new concepts at later times and in different settings (Arwood, 2011). The NSLLT uses a transdisciplinary lens which better informs learning (Hook & Farah, 2013; Jeder, 2014; Tommerdahl, 2010).

As previously stated, teacher preparation programs typically do not investigate neurobiological learning (as highlighted by studies which used neuroeducation as a model to view learning) or the connection between language acquisition and language function (as highlighted by the NSLLT), which is problematic as a lack of neurobiological learning limits educators' understandings of how students learn (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993) and a lack of understanding around language acquisition and language function limits the effectiveness of students' learning experiences (Missett & Foster, 2015; Owens, 2010; Robb, 2016; Tivnan & Hemphill, 2005), which influences the types of instructional practices educators use in their classroom, and influences the degree of students' success (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998).

### **Statement of the Problem and Purpose of the Study**

As previously stated, a connection exists between educators' perceptions of student learning, the types of instructional practices educators use in the classroom, and the impacts of educators' perceptions of learning and instructional practices on students' success (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). Research has shown that educators' perceptions of learning are limited, due to a variety of factors which include:

- a lack of neurobiological learning content or information presented within teacher preparation programs, which contributes to educators' limited understandings of the learning process (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993),
- a lack of information related to language acquisition and the connection between language acquisition and language function within teacher preparation programs, which limits educators' ability to provide effective learning experiences for students (Missett & Foster, 2015; Owens, 2010; Robb, 2016; Tivnan & Hemphill, 2005),
- education-related experiences that are grounded in familiarity, are centered on educators' learning strengths instead of students' learning strengths, and lack reflective inquiry (Ashkanasy et al., 2000; Brown, 2003; Stitt-Gohdes, 2001),
- and confusions regarding the learning tenets and practices held within two common learning frameworks (e.g., andragogy and pedagogy) used in education (Brown, 2003; Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Knowles, 1980; Monts, 2000; Taylor & Kroth, 2009).

In an attempt to narrow the gap within the literature as well as better understand the connection between educators' limited perceptions of learning, classroom practices, and their impacts on

students' success, this study investigated the impact of a neuroeducation perspective of learning situated in cognitive psychology, neuroscience, and language acquisition, on the perceptions and practice of adult learners.

### **Significance of the Study**

Research displaying educators' perceptions of learning are limited; educators' limited perceptions of learning influences the types of instructional practices they use in the classroom, which restricts students' learning (Ashkanasy et al., 2000; Brown, 2003; Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Jeder, 2014; Jong, 2014; Knowles, 1980; Leibbrand & Watson, 2010; Missett & Foster, 2015; Owens, 2010; Monts, 2000; Pratt, 1993; Robb, 2016; Taylor & Kroth, 2009; Tivnan & Hemphill, 2005). In response to the literature regarding educators' limited perceptions of learning and its effects on instructional practice and student learning, this study investigated the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b) perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings. The semester long course will later be referred to as *target course*. Four research questions guided this study:

1. How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?
2. How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?

3. In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?
4. In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?

Neuroeducation-based perspectives of the terms *learning*, *perception*, *andragogy*, and *pedagogy* are highlighted within Chapter Two and served as a lens through which analysis of participant responses were made. Exploring transdisciplinary perspectives of learning, perception, andragogy, and pedagogy can provide insights into the terms which are practical, relevant, and meaningful for educational use (Hardiman et al., 2011; Hook & Farah, 2013; Kartzir & Pare-Blagoev, 2006; Tommerdahl, 2010). Using a neuroeducation-based model to analyze learning, perception, andragogy, and pedagogy can also provide deep insights into the terms as they relate to educational theory and practice. Investigating the terms this way addresses the limitations discussed within the literature regarding educators' limited understandings of the neurobiological process of learning and the impacts of language function on student learning (Arwood, 2011; Arwood & Merideth, 2017; Green-Mitchel, 2016; Jaskowiak, 2018; Murphy, 2016; Robb, 2016; Xiang Lam, 2016).

Using a neuroeducation model to investigate the term *learning*, brings perspectives of learning from cognitive psychology, neuroscience, and language acquisition to provide a neurobiological understanding that contributes to the gap in literature regarding limited educator understandings for neurobiological learning (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993). Triangulating literature from three distinct academic domains also emphasizes the importance of transdisciplinary research towards expanding teachers' perceptions of learning (Hardiman et al., 2011) related to the lack of information provided to pre-service

teachers around neurobiological learning, language acquisition, and language function within their preparation programs (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Missett & Foster, 2015; Owens, 2010; Pratt, 1993; Robb, 2016; Tivnan & Hemphill, 2005).

Investigating *how* learning neurobiologically occurs within a learner's brain highlights the synergistic nature of the brain itself and directly relates to why functional language use and development is important for continued learning for students of all ages (Arwood, 2011; Bruner, 1975; Halliday, 1977; Knowles et al., 2005; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Piaget, 1969; Searle, 1969; Vygotsky, 1962; Wilson, 2006). Translating adult (e.g., andragogy) and child (e.g., pedagogy) learning literatures across the domains of cognitive psychology, neuroscience, and language emphasizes a holistic, neuroeducation approach for learning and instructional practices used within education settings, and may further address the confusions held between andragogy and pedagogy philosophical frameworks (Hook & Farah, 2013; Kartzir & Pare-Blagoev, 2006; Tommerdahl, 2010; Edelenbosch, Kupper, Krabbendam, & Broerse, 2015). Using neuroeducation as a lens to view learning also encourages educators to reflect on their perceptions of learning acquired through their previous education-related experiences (Ashkanasy et al., 2000; Brown, 2003).

### **Chapter Summary**

Chapter One provided background information on the influence of educators' perceptions of learning on their instructional methods used in the classroom, and the impacts of educators' perceptions of learning and instructional practices on student achievement (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). Research showed that educators' perceptions of learning are limited due to a variety of factors such as a lack of content

surrounding neurobiological learning processes and language acquisition (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Missett & Foster, 2015; Owens, 2010; Pratt, 1993; Robb, 2016; Tivnan & Hemphill, 2005), education related experiences grounded in familiarity (Ashkanasy et al., 2000; Brown, 2003), and a confusion between appropriate learning processes and practices for adults and children (Brown, 2003; Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Knowles, 1980; Monts, 2000; Taylor & Kroth, 2009). Teachers' limited understanding of learning were used to form the statement of the problem within this chapter and directed the purpose of this study.

Andragogy and pedagogy philosophical frameworks were also explored. Research displayed difficulty in distinguishing adult learners from child learners in regards to instructional practices and educators' perceptions of learning (Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Knowles, 1980; Merriam, 2001; Rachal, 1994; Rachal, 2002), which was shown in research studies (Monts, 2000; Rachal, 1994). Furthermore, additional research pointed to a single human process for learning, meaning as humans we use our sensory receptors (e.g., eyes, ears, nose, mouth, skin) to take in sensory inputs (e.g., light, sound, pressure, smell, or taste) within their environment, our brains interpret the sensory inputs, and perception and learning then can occur (Fiser et al., 2010; Gillett, 1989; Heeger, 2017; Pulvermüller & Fadiga, 2010; Schunk, 2012).

The neuroeducation model used within this study overlaps research and literature from cognitive psychology, neuroscience, and language theories (Arwood, 2011; Arwood & Merideth, 2017). Using this neuroeducation model for learning helps fill the gap within literature regarding educators' understandings of neurobiological learning and the connection between language acquisition and language function as well as the impacts of language function on student learning

(Arwood, 2011; Bruner, 1975; Halliday, 1977; Knowles et al., 2005; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Piaget, 1969; Searle, 1969; Vygotsky, 1962).

Chapter Two continues with an application of a neuroeducation lens to the terms *learning, perception, andragogy, and pedagogy* in order to holistically represent each term. Using a neuroeducation model to investigate each term will help address the gap in educational learning literature previously mentioned (Hardiman et al., 2011; Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Missett & Foster, 2015; Owens, 2010; Pratt, 1993; Robb, 2016; Tivnan & Hemphill, 2005). Chapter Two will explore more thoroughly the connection between educators' perceptions of learning and classroom instruction, while providing research which highlights the effects of using a neuroeducation model for learning on instructional practice and student learning within a variety of scenarios.



## Chapter Two: Literature Review

Research on learning in education has highlighted that effective learning occurs when students (adults and children) are given information that is relevant, practical, meaningful, and connects with students' previously learned experiences (Bransford et al., 2000; Brooks & Brooks, 1993; Enríquez, 2017; Knowles, 1984a; Knowles, Elwood, Holton, & Swanson, 1998; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Scheurman, 1998). Research on language acquisition has displayed a relationship between effective student (adult and child) learning within pro-social learning environments that provide social learning contexts and encourages use of students' naturally-acquired, functional language as a source for new learning (Arwood, 2011; Bruner, 1975; Bruner, 1991; Enríquez, 2017; Gainotti, Ciaraffa, Silveri, & Marra, 2009; Greeno, Collins, & Resnick, 1996; Halliday, 1977; Knowles, 1984a; Knowles et al., 2005; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Piaget, 1969; Searle, 1969; Skerry et al., 2013; Taylor, 2006; Wenger, 1998; Vygotsky, 1962; Vygotsky, 1978). Research on learning in neuroscience has shown at the neurobiological level, a positive impact from social learning environments, the use of students' naturally-acquired language, and being given information that is relevant, practical, meaningful and represents individuals' previously learned experiences, on new learning and neuronal connectivity within the brain (Arwood, 2011; Bedny & Caramazza, 2011; Bookheimer, 2002; Carter, 2014; Egorova et al., 2016; Gallistell & Matzel, 2013; Mahon & Caramazza, 2008; Pulvermüller, 2005; Pulvermüller, Kherif, Hauk, Mohr, & Nimmo-Smith, 2009; Pulvermüller, 2013).

However, educators lack training that is informed by transdisciplinary learning theories and therefore a gap in educators' understandings of effective learning (which is supported within

multiple learning domains) and instructional practice persists (Hill, 1998; Leibbrand & Watson, 2010; Jeder, 2014; Jong, 2014; Pratt, 1993).

One transdisciplinary model that can be used for understanding and informing learning theory used in education is called neuroeducation. Using a neuroeducation model to triangulate research can help holistically inform educational theory and practice (Hook & Farah, 2013; Jeder, 2014; Tommerdahl, 2010). Throughout Chapter Two, a neuroeducation model will be used as a lens for exploring the terms *learning* and *perception*, for analyzing adult (andragogy) and child (pedagogy) philosophical learning theories and frameworks used in education, and for investigating educators' perceptions of learning and educators' implementations of that learning into the field of education. Chapter Two will follow the guiding questions:

- What is a neuroeducation perspective of learning?
- What is a neuroeducation perspective of perception?
- How do adult educators' perceptions of learning influence classroom instruction?
- What is a neuroeducation perspective of andragogy?
- What is a neuroeducation perspective of pedagogy?

Using a neuroeducation model to triangulate literature for learning, perception, andragogy, and pedagogy will provide a wholesome, transdisciplinary understanding of each term and their learning tenets. Using a neuroeducation model will also help showcase for educators a method to interpret literature and utilize research-informed instruction in learning settings (Hook & Farah, 2013; Jeder, 2014; Kartzir & Pare-Blagoev, 2006; Tommerdahl, 2010).

### **Using a Neuroeducation Model to Triangulate Literature**

Interdisciplinary collaboration can produce educationally relevant information about learning that could not be acquired through individual fields (Hardiman et al., 2011). Research

has highlighted the importance of transdisciplinary communication and discussion towards informed research, policy, and practice (Hook & Farah, 2013; Jeder, 2014; Tommerdahl, 2010). A multidisciplinary approach helps bridge research and practice (Edelenbosch et al., 2015). Multidisciplinary research related to learning provides “deeper insights into the possible connections between educationally relevant skills and the neuronal, genetic, and other biological factors that may underlie them” (Kartzir & Pare-Blagoev, 2006, p. 72).

One approach that can be used in education for administrator, teacher, and student gain is a transdisciplinary approach called neuroeducation (Murphy, 2016). Research shows that there are several definitions of neuroeducation (Fischer et al., 2010; Geake, 2004; Immordino-Yang, 2011), therefore, administrators and teachers should use caution when investigating neuroeducation learning frameworks. One definition of neuroeducation integrates theories, beliefs, and practices from the fields: neuroscience, psychology (or termed cognitive psychology), and education (Arwood & Merideth, 2017; Dana Foundation, 2009; Definitions, 2018; Johns Hopkins School of Education, 2018; Tokuhamma-Espinosa, 2008).

Educational practice informed by a neuroeducation perspective can provide school administrators and teachers with a deeper understanding of how the brain functions and how learning can be accomplished (Ansari & Coch, 2006; Limb, 2010; Sylwester, 1995; Wolfe, 2010). However, research has shown that within the education profession, the theories, tenets, and practices are often derived from the field of psychology; neuroscience learning principles are often not incorporated into educational theory and practice (Hill, 1998; Leibbrand & Watson, 2010; Pratt, 1993). Incorporating principles of learning into education that are derived from the field of psychology is significant to recognize and understand as theories, tenets, and practices found in psychology are often generated within controlled settings (i.e., laboratories), focus on

input/output-based products (e.g., worksheets, end of chapter questions, and standardized tests) to show learning (stimulus and response), and stem from a reductionist model (i.e., reducing into smaller parts to represent learning; e.g., phonics for learning to read) of learning that does not function within contextual, pragmatic, social learning literature (Arwood & Merideth, 2017; Green-Mitchell, 2016; Missett & Foster, 2015; Owens, 2010; Poulson, 2016; Reisberg, 2013; Robb, 2016; Tivan & Hemphill, 2005; Wellman, 2014). In order to triangulate learning literature and increase validity, at least three different learning domains must be incorporated (Holly, Arhar, & Kasten, 2009; Shenton, 2003).

One definition of neuroeducation (from a university in the pacific northwest) replaces the *education* domain with the *language acquisition* domain (Arwood & Merideth, 2017; Murphy, 2016). The language domain aids the interpretation and translation of data between the neuroscience and cognitive psychology fields (Arwood & Merideth, 2017). Triangulated research among the domains of neuroscience, cognitive psychology, and language can help filter out researcher bias (Arwood & Merideth, 2017; Shenton, 2003). This language-informed neuroeducation model was created by an educator, who incorporated 45 years' worth of practice as a speech-language pathologist and background in cognitive psychology and neuro-anatomy/physiology (Arwood & Merideth, 2017). Interpretations of learning derived from the domains neuroscience, cognitive psychology, and language are needed to inform educational theory, policy, and practice (Murphy, 2016).

### **A Neuroeducation Perspective of Learning**

To holistically understand the term *learning*, the guiding question: *What is a neuroeducation perspective of learning?* will be investigated. Exploring perspectives of learning that are transdisciplinary can provide insights into learning that are practical, relevant, and

meaningful for educational use (Hardiman et al., 2011; Hook & Farah, 2013; Kartzir & Pare-Blagoiev, 2006; Tommerdahl, 2010). The theories highlighted within each domain (cognitive psychology, neuroscience, language) are not representative of *all* learning theories found within them, rather the highlighted theories were selected due to either their foundational or continued influence in each domain.

**Learning in cognitive psychology.** Cognitive psychologists refer to learning as a response (in other words, behavior) to a stimulus or complex situation (Skinner, 1953; Thorndike, 1898). Behavior may be strengthened or manipulated through practice or controlled reinforcement (Skinner, 1953). Lasting changes of behaviors are the direct results of learning, which can be shown through cause and effect experiments (typically using conditioned-CS- and unconditioned stimuli-US) or through the formation of new synapses in the brain, due to habituation (Thompson, 1986). In other words, learning, according to many psychologists, is seen as an output behavior or *product* based from a response to stimuli.

Assumptions may lie within an input (stimulus)-output (behavior or product) view of behavior (i.e., learning), however (Skinner, 1953). Behavior is difficult to measure, as it is an extremely complex subject relying on many variables (Skinner, 1953). Often, study of behavior is explored within an artificial laboratory setting and is not directly relatable to real life, social settings (Knowles, 1973; Skinner, 1953). Also, results from early studies exploring behavior were based from animals' behavior, not humans', which provided a limited translation of knowledge from one species to the next (Knowles, 1973; Skinner, 1953; Thompson, 1986; Yeo, Hardiman, & Glickstein, 1985). A person's response, or behavior, to a stimulus, observed by an onlooker can be interpreted in a variety of ways. An onlooker's interpretations of another person's behavior can be described as Theory of Mind (ToM) (Frith & Frith, 2005; Goldman,

2012). ToM is widespread and can be seen in a variety of environments, including education (Chomsky, 1965; Paleeri, 2010).

***Components of theory of mind.*** An individual's behavior can be explained, predicted, and attributed by their mental states (for example, knowledge, beliefs, desires, etc.), which is what ToM accomplishes (Frith & Frith, 2005; Goldman, 2012). Theory of Mind (ToM) is sometimes called *commonsense psychology*, *mindreading*, or *mentalizing* and can be determined by a person's verbal and non-verbal communication (e.g., verbalized beliefs, perceptions, bodily feelings, desires, hopes, emotional states, and intentions) within a given setting (Frith & Frith, 2005; Goldman, 2012). From ToM, people's emotions, thoughts, and mental attributes are *assumed*, then labeled from an outside perspective. In order for the labeled behavior to be shared with others, the person who observed the behavior must generate specific terms to describe the observed behavior. Often in psychology, terms such as attention, awareness, engagement, and motivation are associated with the person who displayed the behavior (Brewer, 1974; Cowan, 1988; Griffiths & Mitchell, 2008; Shanks, 2010; Siegler, 2002; Skinner, 1953; Williams & Lombrozo, 2013). For example, if a student forgets to do homework the teacher may describe the student as lazy, unorganized, or that the student does not care about learning or doing well in class; the teacher is making an assumption about the mental states of the student based on the behavior that is displayed. The practice of observing and labeling behaviors (i.e., ToM) is prevalent in society and has contributed to an assumption-based model for learning in education (Chomsky, 1965; Paleeri, 2010).

***Assumption-based learning and behaviorism in education.*** In education, learning that is viewed through a Theory of Mind lens, results in an output of patterns or behaviors which does not represent social learning, especially in cultures with different sets of social patterns

(Chomsky, 1965; Chomsky, 1975; Worlfgang, 2006). In other words, a teacher's observation and analysis of a student's behavior, as well as the teacher's expectations of how the student is to respond to their analysis of the student's behavior, in a stimulus(S)- response(R) (S-R) learning environment (e.g., lecture-based classrooms, authoritarian-based classrooms, classrooms based on rewards and punishments), limits the student's transferability that learning into other settings (Worlfgang, 2006). Put another way, if a teacher gives a reward to a student after accomplishing every classroom-based expectation, the student will most likely not see that same reward system in society, therefore, that learning does not transfer into societal expectations. Ultimately, teachers who analyze their students' behavior through the lens of ToM are influenced by behaviorism-based tenets founded in psychology (Arwood, 2011; Moore, 1987; Thompson, 1986; Wijayanti, 2012).

Most learning in education today is rooted in behaviorism; behaviorism was established in the late 19th century and started to surface in the classroom in the early 20th century (Arwood, 2011; Arwood & Merideth, 2017; Moore, 1987; Thompson, 1986; Wijayanti, 2012).

Behaviorism can be described as a person's response to stimuli within an environment or by inner biological processes (Arwood & Merideth, 2017; Ertmer & Newby, 1993). In the late 19th century, researcher (and founder of behaviorism) John Watson explored animals' behavior within various clinical psychology environments (Horowitz, 1992; Wijayanti, 2012). Watson concluded from his experiments and research on animals' behavior (connecting animal behavior with human behavior, Watson called this connectionism), that one's surroundings (in other words, the stimuli within the environment) were more dominant of an influence than genetics in regard to determining behavior (in other words, responses or learning) (Wijayanti, 2012).

According to Watson, if a teacher could control a learning environment, the student could be

shaped into any type of person or learner. Watson's S-R related views of learning later influenced psychologist and behaviorist, B.F. Skinner and impacted his interests, investigations, and applications of learning into various settings (Horowitz, 1992; Wijayanti, 2012).

In the early to mid-20th century, American psychologist and behaviorist, B.F. Skinner continued to investigate behavior and learning and applied concepts of a learning system he developed called operant conditioning, which stemmed from, psychologist, Ivan Pavlov's classical conditioning (Chomsky, 1959; Skinner, 1953; Skinner & Belmont, 1993; Wijayanti, 2012). Similar to Watson, Skinner used animals to analyze behavior (i.e., learning) and make associations of learning with humans. Operant conditioning is based on the idea that past consequences influence our current behaviors (Skinner, 1953). By giving a positive reinforcement, the hope is that the likelihood of the intended behavior will increase and by giving a negative reinforcement the likelihood of the intended behavior will decrease.

A product of operant conditioning in Skinner's work is the *Skinner box*; in the experiment, a rat or pigeon would have to press a lever in order to receive food, the more the animal received the food the greater the likelihood it would continue to press the lever (Skinner, 1953; Skinner & Belmont, 1993). Skinner and colleagues (1953; 1993) concluded that responses (in other words, behaviors) could be controlled or changed by providing reinforcements after the behavior was displayed. In education, teachers who directly reward or punish students based on their behaviors, are using principles of learning founded in operant conditioning (Arwood, 2011). Student behavior observed within operant conditioning (positive and negative reinforcements) or behaviorism-based environments would eventually be quantitatively measured and analyzed, which would make it easier for teachers to compare students' learning with one another as well as conclude whether or not the student was learning at an age-appropriate pace; quantitative



analysis of student behavior as well as school subjects (e.g., math, science, reading) was introduced by U.S. psychologist, Edward Thorndike (Moore, 1987; Rizo, 1991).

***Quantitative-based learning in education.*** Psychologist, Thorndike, in the early 20th century, incorporated the use of quantitative data (e.g. statistics) into various social sciences (e.g., psychology and education) in order to make findings more scientific and efficient (e.g., Thorndike, 1932b, *A Teacher's Word Book*) and also applied tenets of educational psychology within the field of education (Moore, 1987; Wijayanti, 2012). Educational psychology focuses on the learning processes and psychological problems found in education; studying and analyzing aptitude and learning measurements on products as well as motivational dynamics between students and their teachers (Rizo, 1991).

Like Watson and Skinner, Thorndike (1898) too studied animals' behaviors from which to draw characteristics and processes of learning for humans. Thorndike posited that behaviors could be controlled by positive and negative reinforcements (in other words, Thorndike's Law of Effect theory) and was the first to apply these principles of learning in education (Moore, 1987). Thorndike did not feel there was sufficient evidence to support use of negative reinforcements for decreasing student behaviors and found the connection and predictability of outcomes of S-R environments on student behavior (i.e., Thorndike's law of exercise) to be invalid or random in most cases (1932a), however, principles of behaviorism drawn from Watson's and Skinner's theories for behavior (i.e. learning) and Thorndike's use of quantitative analyses continue to influence education today which has resulted in a deficit-based model towards learning (Arwood, 2011; Moore, 1987; Poulson, 2016; Valencia, 2012; Wijayanti, 2012).

***Deficit-based learning.*** Deficit-based thinking is based on the assumption that a student who fails in a subject, class, or in school does so because of an internal deficit or deficiency;

within deficit-based thinking, students' intellectual deficiencies are associated with their intellectual, linguistic, motivational, or behavioral capacities (Dinishak, 2016; Rappolt-Schlichtmann et al., 2018; Valencia, 2012). Deficit-based learning stems from deficit-based thinking; for example, standardized testing allows teachers to measure, compare, tract, and label students' knowledge of a subject (or lack of) and pace of learning. Teachers who instruct based on the answers that students do not know on standardized tests or provide classroom instruction based on students' weaknesses (versus their strengths), practice a deficit-based model for learning and may be limiting or hindering students' academic and social growth (Dinishak, 2016; Rappolt-Schlichtmann et al., 2018; Valencia, 2012).

Deficit-based thinking can be seen in other learning domains, such as neuroscience, as well. A number of studies have been conducted based on various neuronal alternations induced on animals; the animals' behaviors were then recorded, measured, and studied (Thompson, 1986). For example, the removal of cerebellums in dogs helped researchers learn about conditioned leg flexions and salivary responses (Karamian, Fanardijian, & Kosareva, 1969) and by creating lesions in the cerebellar vermis, long-term habituation for startle responses would be abolished (Leaton & Supple, N.D.). Similarly, exploring human behavior (i.e., learning) based from studies of patients with traumatic brain injuries (TBI) has helped neuroscientists discover specific brain areas and label their functions based from what functions and areas of the brain had been lost and has continued to influence how many people understand the brain functions (Carter, 2014; Milner & Petrides, 1984).

The deficit framework of thinking has influenced education in terms of teaching (e.g., teaching phonics if a student does not understand how to make letter sounds; giving a student lots of the same mathematical problems to practice and get better at) the acceptability of

students' specific behaviors (e.g., giving students rewards for school-appropriate behaviors and warnings or punishments for atypical behavior), and has produced non-inquiry-based and repetitive tasks for learning (e.g., numerous math problems, repetition of sight words for learning to read, verbally repeating school or classroom behavioral expectations) (Chomsky, 1965; McGilvray, 2005). However, research in the neuroscience domain, for example, shows that repetitiveness turns off thinking through disengaging the brain (Bookheimer, 2002; Cabeza et al., 2003; Curran, 2000; Reas & Brewer, 2013). Therefore, investigating learning in the neuroscience domain is reasonable towards understanding conflicting statements for learning between psychology and neuroscience and for the reflection and potential better understanding of effective classroom practice and student learning in education.

**Learning in neuroscience.** Learning, as described within neuroscience, is the strengthening of connections between neurons which results in permanent cellular change (Pulvermüller, 2005). Connections between neurons are strengthened when a received sensory stimulus is meaningful (i.e., semantic) at the cellular level; during this process of neuronal connectivity, neurotransmitters are released between the neurons and the connections are then strengthened (Gallistel & Matzel, 2013). Reactivation or firing of the connected neurons (or circuits) occurs when semantic information is recognized, creating meaningful or neuro-semantic learning circuits (Pulvermüller, 2013). Neuro-semantic circuits are widely distributed within the brain, multimodal, and reach into all areas of the cortex, which helps bridge modality-specific systems (e.g., frontal, parietal, occipital, temporal lobes) and their typically-associated functions across hemispheres or neuro-semantic circuits (e.g., sight recognition for the occipital lobe or spatial awareness for the parietal lobe) (creating long-term learning) (Barsalou, Simmons,

Barbey, & Wilson, 2003; Bookheimer, 2002; Pulvermüller, 1999; 2012; 2013). These circuits and networks are precursors for the acquisition of language.

*Semantic circuits and language.* The main function for human language is to be able to communicate in social interactions (Egorova, Shtyrov, & Pulvermüller, 2016). Using semantically acquired language in social interactions that is contextual (involving agents, objects, and actions) causes the circuits which represent previous learning, with similar context-dependent information to fire (Arwood, 2011; Austin, 1962; Egorova et al., 2016; Pulvermüller, 2013). Functional imaging (e.g., fMRI) used on human brains show (Bookheimer, 2002) that unified firing of neuronal circuits (in other words, networks) occurs across cortical hemispheres represents complex learning and memory necessary for language representation (Bedny & Caramazza, 2011; Egorova et al., 2016). In other words, the contextual information that defines the communicative function within the social interaction is semantically processed within the brain, is distributed across hemispheres, and represents a distinct and complex learning experience that is long-term and greater than the sum of its parts (in other words, pragmatism) (Bookheimer, 2002; Mahon & Caramazza, 2008; Peirce, 1905; Pulvermüller et al., 2009).

Semantically acquired language (representing complex learning) is represented within the brain by an overlap or layering of neuronal circuits (i.e., networks) that are distributed over varying areas of the cerebral cortex (Pulvermüller, 2013). The cerebral cortex is the outer, gray, wrinkly layer that covers the left and right hemispheres of the brain (Carter, 2014). Due to the nature of complex learning (for example, the neuronal circuits are dispersed and connected over multiple cortical regions due to meaningful and contextual sensory information integration) neuronal connections that are wired together, activate or fire together and represent higher-order semantic networks of learning (Moseley & Pulvermüller, 2014). In other words, contributing or

layering contextual information with previously learned experiences (i.e., established neuronal circuits or networks) aids the long-term memory process (Pulvermüller, 2014).

Functional imaging has shown that the concept of *layering* is also seen in the neurobiological makeup in the brain itself (Pulvermüller, 2013). For example, semantic learning (represented by semantic circuits or networks), memory, and language comes from the top layers of the cerebral cortex, progresses down, and is spread to the rest of the cerebrum (for example, frontal, parietal, temporal, occipital lobes), making neuronal connections more complex, less easily disrupted (due to a TBI, for example), and makes the learned experience more long-term (Mahon & Caramazza, 2008). Top-down functions (e.g., language) may affect what we perceive (Carter, 2014). For example, when we look into a room we may physically see everything in the room, but our uniquely-acquired language will define what stands out to us, is perceived, or essentially what is remembered (Carter, 2014). The term, *perception*, will be explored later in this chapter. Functional brain imaging has shown that semantic processing and acquisition occurs in multiple areas of the cerebral cortex (for example, frontal, temporal, parietal) (Pulvermüller, 2013). Having numerous areas of the brain available for semantic processing and acquisition means semantic, contextual information creates neuronal networks in the cerebral cortex in various areas, language becomes more functional, and learning is more long-term (Pulvermüller, 2013). Understanding learning from a neuroscience perspective highlights the contribution of meaningful and contextual information for long-term learning (Moseley & Pulvermüller, 2014; Pulvermüller, 2014), displays the connection between meaningful and contextual information (Pulvermüller, 2013), and showcases the connection between language acquisition and conceptual learning (Mahon & Caramazza, 2008).

**Learning in language acquisition.** Learning, according to language theorists, is the ability to *mean* or express an understanding that fits socially within the current context (Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977). Language represents its culture (Chomsky, 1975); within the culture, language is used for social interactions (Egorova et al., 2016). In other words, language is inherently social in nature (Frith & Frith, 2007). In order to learn using language, one must be able to understand as well as express a concept or idea in a way that fits socially within the culture (Halliday, 1977). Since humans can only acquire and use concepts (i.e., learn) in social interactions with other people, learning is also inherently social in nature (Frith & Frith, 2007). Cognitive functions (thinking, language, learning), therefore, have transformed to meet the needs and complexities of social living (Humphrey, 1976).

Language represents the concepts that have been acquired through various social interactions (Arwood, 2011; Bruner, 1975). The concepts are subsequently widely disbursed throughout the cerebrum from the cerebral cortex, making learning more holistic and long-term (Gainotti et al., 2009). Since concepts and language are acquired through social interactions and social interactions involve contexts (people, actions, objects), using language to learn should also involve contextual components (Searle, 1969). The context of a social interaction is important for the overall understanding of the interaction, for the meaning given to concepts within the interaction, and is valuable for learning and continued language acquisition to occur (Searle, 1969).

***Acquisition of language.*** For language to be acquired, one must reflect on and understand the meanings attached to the concepts used within the interactions (according to cultural and social norms) and be able to flexibly use those meanings in a variety of social interactions (Bruner, 1975; Cromer, 1974; Halliday, 1977; Pulvermüller, 2012; Searle, 1969;

Vygotsky, 1962). Further, the innateness of language acquisition comes more from social interaction than linguistic attainment (Bruner, 1975; Gainotti et al., 2009). For example, a person will be able to develop functional language (which can be used in future social interactions and learning) more easily from mutual interactions with people in a contextual setting, rather than from studying the properties (linguistics) of the language itself (for example, nouns, punctuation, sentence structure, syntax, phonetics). Using a word to represent an idea within various settings is essential towards the acquisition of functional language and an investment towards future in-depth conceptual learning (Bruner, 1975). Furthermore, the phrase, “There is a snake under you.” to a *reader*, implies that there is a snake underneath someone, however, in a real time, the illocutionary function or connotation of the phrase may display a sense of urgency to move (assuming one is fearful of snakes); the illocutionary or connotation function may be something that is missed solely through linguistic study (Bruner, 1975). In addition to social interaction, language acquisition is directly related to neuronal connectivity and functioning in the brain. As previously mentioned, acquiring language that is natural and functional (e.g., makes sense in the situation, is flexible, can be displaced into other settings with various connections) occurs in social, contextual settings (Bruner, 1975; Cromer, 1974; Halliday, 1977; Pulvermüller, 2012; Searle, 1969; Vygotsky, 1962); in the brain neuronal networks that represent and produce a learners’ natural, functional language fire together and strengthen when social, contextual components are present, aiding our development of language (Pulvermüller, 2013).

***Development of language.*** As humans grow, we move through developmental stages; for example, developmental cognitive stages include: sensory motor, preoperational, concrete, and formal levels of thinking (Arwood, 2011; Piaget, 1936; Piaget, 1959). However, our development as social human beings is learned when including the acquisition of language

(Vygotsky, 1962). Language is developed through a compilation of experiences that have occurred in various social contexts (Vygotsky, 1962). Language learned within social experiences results in a neurobiological acquisition of concepts which are specific to individuals (Pulvermüller, 2013). Initially, a child learns to replicate specific language based from interactions between agents in an immediate social context (Bruner, 1975). The child's language which represents their underlying concepts become more abstract or formal. Eventually, language is acquired and observers are able to see the child's language develop (e.g., thinking about themselves- preoperational; thinking about others-concrete; thinking about others' perspectives in multiple, displaced scenarios- formal) (Bruner, 1975; Piaget, 1959; Vygotsky, 1962).

***Conceptualization and language.*** Culture represents and is shaped by language and is social in nature (Chomsky, 1975; Frith & Frith, 2007). Social interactions involve context, includes relational connections, and semantic concepts such as agents, objects, and actions (Searle, 1969; Vygotsky, 1962). Contextual features (i.e., agents, objects, and actions) are also recognized as semantic features in the brain, acquired through the sensory neurobiological systems, and represented by natural, functional language (Pulvermüller, 2013). However, not all people develop the same functional language (Arwood, 1991). Several variables may influence differences in functional language acquisition, such as a mismatch between the input and the ability of the learner to acquire the neural networks needed for a specific conceptualization (Pulvermüller, 2012) or through differing perceptions formed through individualized conceptualizations representing unique cultural learning experiences (Carter, 2014; Chao & Martin, 2000; Goodale, Milner, Jakobson, & Carey, 1991). For example, a person who is color blind may not have the same perception of the color orange as someone who is *not* color blind.



Similarly, students' perceptions of their teacher's instructional practices may be viewed differently compared to how the teacher perceives their instructional practices occur (Monts, 2000). Therefore, to understand educators' and learners' (K-12 and adult) perceptions of learning a deeper understanding of *perception* as it applies to learning, is needed; a neuroeducation model will be used to investigate the term, *perception*.

### **A Neuroeducation Perspective of Perception**

Educators' perceptions of learning as well as educators' perceptions of students' capabilities to learn, has a direct impact on students' immediate and future academic achievements (Alvidrez & Weinstein, 1999; Calderhead, 1996; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). However, educators' perceptions of their instructional methods used in the classroom (and what is actually implemented) may be mismatched or inaccurate, causing a disconnect between learning theory and practice as well as missed learning opportunities for students (Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Leibbrand & Watson, 2010; Monts, 2000; Rachal, 1994); therefore, an investigation of perception proves useful towards connecting learning theory and effective instructional practice.

In order to holistically understand the term *perception*, the guiding question: *What is a neuroeducation perspective of perception?* will be investigated. Exploring perspectives of perception that are transdisciplinary will provide a baseline for interpreting adult learners' (who took an adult learning class with a neuroeducational perspective on learning) perceptions of learning as it relates to student (adult and child) learning (García Carrasco, Hernández Serrano, & Martín Garcia, 2015). The theories highlighted within each domain (cognitive psychology, neuroscience, language) are not representative of *all* perception-related theories found within

them, rather the highlighted theories were selected due to either their foundational or continued influence in each domain.

**Perception in cognitive psychology.** Cognitive psychologists define perception as the internal process of recognizing or interpreting sensory information, or stimuli, within an environment (Chowdhury & DeAngelis, 2008; Goldstone, 1998; Law & Gold, 2009; Wohlwill, 1958). Perceptual learning, defined by cognitive psychologists, then is the transfer or lasting change in behavior, in response to a new set of stimuli within an environment (Skrandies, Jedynek, & Fahle, 2001; Wohlwill, 1958). Therefore, some type of stimulus (for example, light, sound, pressure, smell, or taste) must be present within an environment for either perception or perceptual learning to occur (Goldstone, 1998; Gu et al., 2011; Law & Gold, 2009).

Neuro-cognitive psychologists identify the occurrence of perceptual learning based from alterations of neuronal representations of environmental stimuli (in other words, the neuronal activity, change, or plasticity in the brain based from environmental stimuli) and the effects the neuronal representations have on behavior (Chowdhury & DeAngelis, 2008). Researchers often test and measure changes in neuronal representations within the brains of animals either through brain imaging techniques or by performing autopsies and examining changes in the neuronal structures of the animals' brains (Chowdhury & DeAngelis, 2008; Gu et al., 2011). For example, Chowdhury and DeAngelis (2008) conducted a study which involved four adult macaque monkeys performing several sensory tasks (for example, monkeys were made to view a flat-screen, 22-inch, color television from a specific distance) over a period of time. Results from postmortem examinations showed that when monkeys were made to perform new sensory tasks (in other words, allowed new perceptual learning to occur) changes to the existing neuronal circuitries (which represented the monkeys' previously learned experiences) within specific areas

of the monkeys' brains occurred. Therefore, perceptual learning, influenced by environmental stimuli, scaffolds from previously established neuronal circuitries in the brain (Bedford, 1993; Goldstone, 1998), can improve sensory perception (for example, recognizing new stimuli in the environment), and influence performance (Chowdhury & DeAngelis, 2008; Goldstone, 1998; Gu et al., 2011). In cognitive psychology, performance that is cognitively attended to or controlled by an individual often occurs through top-down perception (Cohen, 2000).

***Top-down perception.*** In cognitive psychology, top-down perception may also be referred to as top-down attention (Baars & Gage, 2010; Carter, 2014; Cohen, 2000). Attention, in cognitive psychology is dependent on perception and perception is often dependent on a stimulus within an environment (Goldstone, 1998; Gu et al., 2011; Law & Gold, 2009). In other words, when an individual gives attention to a stimulus represented in the environment, a hierarchy of structures within the brain (e.g., cerebral cortex- top; cerebrum-bottom or down) influences the individual's perceptions related to the environmental stimulus (Mechelli, Price, Friston, & Ishai, 2004). For example, a participant who is instructed to give attention to specific letters, name the specific letters when they are present on a screen, while ignoring other letters present, can do so (Frith, Dolan, 1997). However, the top-down perceptions, which stem from the higher regions of the brain, such as the cerebral cortex, represents thinking, determines the output or behavior, and ultimately does not need a stimulus to be present within an environment (Mechelli et al., 2004).

The cerebral cortex does not require a stimulus to be present within the environment to function. Mechelli and colleagues (2004) conducted a study, using a fMRI machine, which sought to explore top-down (e.g., cerebral cortex to cerebrum) and bottom-up (e.g., ventral stream) neuronal interactions in the occipital, parietal, and frontal regions of the brain during visually-based activities. Results from the study showed that while in the absence of a visual

stimulus, participants were able to generate a mental image of an object which occurred in a top-down cognitive process either from the parietal or frontal cortex. The prefrontal cortex was determined to be the mediator between content-related activity and visual perception (Mechelli et al., 2004). The primary roles of the prefrontal cortex are largely attributed with higher executive functioning skills such as thinking, planning, and anticipating abstract events in the future (Baars & Gage, 2010; Cabeza et al., 2003). Examining perception through a neuroscience perspective (e.g., brain functions) will generate further conceptualization of term perception.

**Perception in neuroscience.** Neuroscientists define perception as an *unconscious* process by which sensory stimuli from an environment are recognized or interpreted by the brain (Fiser et al., 2010; Gillett, 1989; Heeger, 2017; Pulvermüller & Fadiga, 2010; Schunk, 2012). Perceptual processes, such as recognition and interpretation, begins when a piece or several pieces of sensory stimuli within an environment (for example, light, sound, pressure, smell, or taste) are taken in through the sensory receptors (for example, eyes, ears, skin, nose, or mouth) (Arwood, 2011; Gillett, 1989; Schunk, 2012). For example, a person standing in a room turns on the lights; the light waves bounce off the objects in the room (revealing the objects' edges); then, the light waves enter into the person's eyes, hitting the retina and are transported to the visual cortex in the back of the brain, via the optic nerve (Arwood, 2011; Baars & Gage, 2010). The visual stimuli are either recognized (i.e., integrated) by the neurons within the visual cortex and sent along the ventral and dorsal pathways in the brain to be further interpreted in other areas of the brain or the stimuli are not recognized (i.e., inhibited) by the brain and are dumped or not perceived (Arwood, 2011; Baars & Gage, 2010). Therefore, the presence of stimuli in an environment does not guarantee that recognition or interpretive processes in the brain will occur (Carter, 2014; Fiser et al., 2010).

**Perception in language acquisition.** Language theorists define perception as an active process of making sense or searching for meanings and values within the social interactions we have with others and our surrounding environment (Arwood, 2011; Arwood & Kaulitz, 2007; Bruner, 2001; Piaget, 1969; Reed, 1996). From a language perspective, perception provides information that is never static and always looking for additional information as well as additional meaningful interpretations of social and cultural values (Bruner, 2001). More specifically, from a language perspective, perception is linked with thought (Piaget, 1969), thought stems from and is directed by our uniquely acquired language, and our uniquely acquired language is dependent on the integration of sensory inputs (i.e., stimuli) received within an environment (Arwood, 2011; Arwood & Kaulitz, 2007). Therefore, in order for perception (that is linked with thought, in other words, language) to occur, our sensory receptors (e.g., eyes, ears, skin, nose, or mouth) must bring in new sensory inputs from our surrounding environment (Arwood, 2011; Arwood & Kaulitz, 2007; Baars & Gage, 2010; Gillett, 1989; Schunk, 2012). Sensory inputs must be processed by the sensory specific pathways.

Different stimuli within an environment as well as different, previously acquired language can influence the integration of different perceptions in different people (Arwood, 2011; Kuhl, 2000). For example, a student who has established an understanding for the word “appropriate” will perceive the term differently than a student who has never heard or experienced the meaning of the term before. Thus, people can generate different perceptions of the same stimuli received in an environment, making perceptions individual or unique (Arwood, 2011). Perceptual uniqueness is brain-specific which means that all perceptions of stimuli within an environment are valid (Arwood, 2011). For example, two different-leveled, track-and-field high-jumpers see the coach set the high-jump bar height to seven feet, but one high-jumper has

cleared the seven-foot bar multiple times and feels comfortable with the bar being at that height and the other high-jumper has failed every attempt at seven feet and begins to feel tense or nervous when they see the bar set at seven feet; therefore, each athlete perceives the same height (i.e., seven feet) differently. Similarly, a first-grade student whose parents talk about the benefits of school every day will perceive the word *school* differently when compared to another first grade student whose parents never talk about school or speak poorly of school. Likewise, perception is dependent on the neuronal circuitry that is acquired as perceptual patterns overlap in the brain pathways (Arwood, 2011; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Pulvermüller et al., 2009; Pulvermüller & Fadiga, 2010).

***Perceptual patterns.*** Perceptual patterns, in the brain, are meaningful arrangements of cellular assemblies from sensory inputs received from the surrounding environment (Arwood, 2011; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Pulvermüller, 1999; Pulvermüller et al., 2009; Pulvermüller & Fadiga, 2010). More specifically, perception occurs when perceptual patterns, from various stimuli within numerous environments and experiences over time, overlap, to form meaningful connections and connects to concepts (Arwood, 2011; Pulvermüller, 2009). A concept represents the perceptions displayed within societal and cultural values (Arwood, 2011). For example, a child recognizes a set of perceptual patterns (e.g., positive talk about school) within an environment, in the same way as the societally- or culturally-based assignment of meaning to the concept (e.g., school is positive or beneficial). When numerous meaningful and relatable perceptual patterns overlap, a concept representing the overlapping perceptual patterns is formed; when numerous concepts representing their underlying perceptual patterns overlap, language is formed; language then represents the underlying concepts (Arwood, 2011;

Arwood & Kaulitz, 2007; Pulvermüller et al., 2009; Pulvermüller & Fadiga, 2010). Language acquisition, then, can alter perception (Kuhl, 2000).

Understanding our uniquely acquired perceptions of the world and how they influence and guide our interactions with others is important (Bruner, 2001). In education, educators must reflect on their perceptions of learning and the impacts of their instructional practice in order to provide effective learning environments for students (Bruner, 2001). In order to holistically understand the potential impacts of educators' perceptions on their students, the guiding question: *How do educators' perceptions of learning influence classroom instruction?* will be investigated. Examining perceptions of learning held in education can provide insight into effective classroom instruction and highlight influential adult and child learning philosophical theories and frameworks used in education.

### **Educator Perceptions of Learning and Classroom Instruction**

Educators' perceptions of learning influence both the types of instruction that are used in the classroom as well as the degree of academic success accomplished by students (Goddard et al., 2000; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). Educators who reflect on their perceptions or learning beliefs are more likely to provide students with various and diverse opportunities for success (Bruner, 2001; Goddard et al., 2000; Sylwester, 1995). However, the focus in education (and educational research) often is on the connections between classroom practice (i.e., the *what*; the procedure; the curriculum; the practice) and student success instead of focusing on the connection between *why* specific classroom practices have been chosen and are conducted (e.g., what studies or learning theories support the practices; should the practices be used in the first place) and the outcomes of student success (Burns, 1992; Ross, 1994). The interactions that occur within classrooms and schools are

reflective of the collective social and cultural norms which inform them (Ellemers, Spears, & Doosje, 2002; Wagner, 2016). Educators who reflect on their beliefs can start to understand the impact that social and cultural norms have on their identities and actions in the classroom (Wagner, 2016). Our language connects our ability to reflect on social and cultural norms as well as allows us to examine our identity (Arwood, 2011; Bruner, 1975; Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977; Humphrey, 1976).

**Identity.** As previously mentioned, language theorists state that learning is the ability to *mean* or express an understanding that fits socially within the current context (Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977). The language that we learn through our social interactions shapes our individual beliefs, identities, as well as our approaches within any given environment (Arwood, 2011; Bruner, 1975; Humphrey, 1976; Wanger, 2016). Furthermore, individuals' abilities to recognize how they can positively contribute within those social interactions shapes their self-worth, which also constitutes their *self* (Arwood & Young, 2000). As we interact with our environment our beliefs are shaped and our identities (or self) are formed based from those interactions. Educators bring their own identities to the classroom every day, which impacts students socially and academically (Wagner, 2016). Educators' beliefs, which shapes their identities, should be challenged in order to positively impact individuals within a diverse class of students.

Educators can start to understand their belief systems by reflecting on the relationships that are formed between themselves and their students (Wagner, 2016). Educators who realize their belief systems affect the culture of their classroom, the educational content they provide to their students, and the likelihood of their students' success can start to expand their thinking to societal norms and misbeliefs that they may be placing on their students (McKay & Dennett,



2009). Beliefs and misbeliefs are limited to self-perceptions which center around one's ability to organize the environment around them and make sense of their experiences (Dweck, 2000).

Dweck's (2000) *self-theory* described how people's beliefs can create various psychological worlds or environments, which influences them to think and behave in a number of ways within similar contexts. Educators who seek meaningful relationships with their students should reflect on their belief systems in order to examine whether or not they are placing their values or misbeliefs onto their students (Dweck, 2000; McKay & Dennett, 2009; Wagner, 2016).

Educator *beliefs* (i.e., perceptions) inform classroom instruction (Burns, 1992; Levin & Nevo, 2009; Turner, Nicholson, & Sander, 2011). In education, educators are provided with curriculums to help guide their classroom instruction, but curriculums often do not provide discrete sequential stages for progressive classroom instruction (e.g., adapting to varying student proficiency levels within any given subject), therefore educators are left to inform their classroom instruction based from their own theories or sets of beliefs surrounding teaching and learning (Burns, 1992). For example, Burns (1992) interviewed six English as a Second Language (ESL) teachers to better understand how their perceptions towards learning a second language affected their classroom instruction. Results from Burns' (1992) study displayed a connection between the six teachers' learning beliefs and the classroom instruction that was implemented. The teachers' instructional practices were largely based on their observations and generated perceptions of students' behaviors in response to the classroom instruction and not on *why* teachers had initially chosen or been given the instructional practices to implement (e.g., repetitive practices for learning a second language) (Burns, 1992).

Because people's perceptions are diverse and unique (Arwood, 2011; Cumming, 1989; Knowles & Holt-Reynolds, 1991), investigating educators' beliefs regarding learning is needed

to support the implementation of effective classroom practices (Kuhl, 2000). Instructional practices are informed by educators' perceptions of learning which are often very personalized and context-specific as well as tend to be informed by their past experiences as a student, from influential teachers in their past, from teaching experiences in their own classroom, and from their self-efficacy (Cumming, 1989; Knowles & Holt-Reynolds, 1991; Levin & Nevo, 2009).

**Self-efficacy.** Self-efficacy can be defined as a person's perceived ability to generate a desired effect in any given setting (Bandura, 1977; Bandura & Wessels, 1997). Teacher self-efficacy can be viewed as a teachers' perceived ability to implement strategies which may have a desired outcome on students (Tschannen-Moran, Woolfolk Hoy, & Hoy, 1998). Teacher self-efficacy can impact teachers' instructional planning, competency, and motivation which ultimately influences how they behave (Tschannen-Moran et al., 1998). Further, self-efficacy and a teacher's perception are connected (Tschannen-Moran et al., 1998). If a teacher does not believe in the likelihood of students' success from a new method of instruction or intervention there may be a lag in the teacher's efficacy beliefs (Stein & Wang, 1988; Tschannen-Moran et al., 1998). Therefore, it does not completely matter whether or not the new method of instruction or intervention is actually effective, what matters is whether or not the teacher perceives or believes they will be able to implement it successfully. Self-efficacy, then, has merit as an influential factor towards an educator's likelihood or degree of implementation surrounding instructional practices and interventions (Tschannen-Moran et al., 1998; Turner et al., 2011).

Changing teachers' instructional practices and perceptions of self-efficacy takes time and needs continued support (Hall & Hord, 2001; Tunks & Weller, 2009). Challenges for changing a teacher's perceptions also lies within the teacher's ability to self-reflect, becoming more aware of their beliefs and the impacts their beliefs have on their students (Gregory, Bell, & Bollock 2014;

Griner & Stewart, 2012). Educators who self-reflect can benefit neurobiologically through increased neural functionality and socially by gaining enhanced world-view perspectives (Wagner, 2016). Teachers' perceptions (e.g., of learning, self-efficacy, academic instruction, identity) need to be challenged; otherwise, inequities and biases will continue to persist within teachers' thinking as well as their practice (Cooper, 2007; Garcia, Aria, Harris Murri, & Serna, 2010). Educators' thinking may be challenged by reflecting on self-identity (Wagner, 2016). With regular support, however, teachers' self-efficacy can continue to increase (Tunks & Weller (2009). One way to challenge teachers' perceptions of their self-efficacy is by using a transdisciplinary lens to investigate different domains of research outside of education (Breen, 1991).

### **Educator Perceptions, Transdisciplinary Learning, and Student Success**

It is important that educators are given opportunities to reflect on their personally held beliefs about learning and the potential impacts that their beliefs of learning have on their students (Burns, 1992). However, teachers often discard theories of learning if they do not match up with their own belief systems surrounding learning conducted in the classroom (Richardson, 1996; Stern, Stern, Tarone, Stern, & Yule, 1983). Also, teachers may not be provided with training outside the educational domain (Pratt, 1993) or teachers may encounter mismatches in conceptualizations and meanings of vocabulary across learning domains (e.g., neuroscience) making it difficult for teachers to learn and expand their understandings of learning outside the educational domain (Cheng, 2016; Jong, 2014). However, from transdisciplinary research, teachers are presented with multiple and diverse paradigmatic beliefs (i.e., beliefs that may be different than their own but overlap with each other in research) and the paradigmatic beliefs do

not contradict either other, but rather, teachers are able to pull elements of truth from each perspective to utilize in their practice (Levin & Nevo, 2009; Visser, 1999).

Educators' beliefs and practices can be informed or transformed through transdisciplinary researcher (Levin & Nevo, 2009). One three-year, longitudinal study conducted by Levin and Nevo (2009) examined the educational beliefs and practices of 10 elementary educators located in central Israel. The action-research study used open-ended questions, reflective questions, and metaphors as methods to uncover educators' beliefs and practices. A university team tutored educators on rationale, goals, and procedures derived from a transdisciplinary curriculum in a constructivist-based environment. At the beginning of the study, eight out of the ten educators considered themselves behaviorists and believed that teaching was mostly passive, compliant, quantitative-based, and the learning environment was teacher-controlled. One educator did not identify themselves as any particular type of instructor and the other educator identified themselves as cognitively-focused, meaning they emphasized contextual relationships to build new student learning. Results at the end of the three years displayed a shift in educators' perceptions of learning and practice from mostly behavioristic (eight out of ten) to cognitive and constructivist (ten out of ten). Though two educators still viewed themselves as behaviorists, they also viewed themselves as constructivists wherein their classroom practice centered around coaching students based from social dialogues and critical reflections (Levin & Nevo, 2009).

In order to support learning outside of the field of education, effectively transforming educators' perceptions of learning and practice, educators need additional support (Hardiman et al., 2011; Levin & Nevo, 2009). In order to provide deeper learning opportunities for students, classroom instruction and teacher beliefs of learning needs to explore different avenues of student learning held outside education (Breen, 1991). Considering multiple perspectives of

learning, such as transdisciplinary approaches or neuroeducation perspectives, helps inform educational practice (Edelenbosch et al., 2015; Hook & Farah, 2013; Levin & Nevo, 2009; Tommerdahl, 2010;) and can provide deeper insights into learning and teacher-efficacy (Kartzir & Pare-Blagoev, 2006; Levin & Nevo, 2009). Further, educators who understand principles of learning from various domains other than education can impact students' academic achievements through enhanced planning and implementation of instruction as well as by providing more effective remediation to students' learning and social needs (Kartzir & Pare-Blagoev, 2006; Leibbrand & Watson, 2010; Levin & Nevo, 2009).

Educators who incorporate transdisciplinary views of learning in the classroom may be able to design and implement learning experiences that attribute to the characteristics supportive of learning, such as social competence (Comer, Haynes, Joyner, & Ben-Avie, 1996; Hamre & Pianta, 2001; Wentzel, 2003); students' social competency is linked with academic achievement (Leibbrand & Watson, 2010). For example, Durlak, Weissberg, Dymnicki, Taylor, and Schellinger (2011) conducted a meta-analysis with 213 school programs, which involved over 300,000 K-12 students, who had implemented developmentally- and cognitively-focused approaches and found there was an 11 percentile point gain in student academic achievement. Similarly, Borman, Hewes, Overman, and Brown (2003) found, through conducting a meta-analysis focusing on schools who had implemented programs incorporating knowledge from social and developmental sciences into the classroom, that students' tests scores had improved. Also, students can benefit socially and academically when educators reflect on their perceptions of learning through a specific transdisciplinary model called neuroeducation.

**Interpreting educator perceptions of learning with a neuroeducation lens and the impacts on students.** One approach, that is transdisciplinary in nature and beneficial towards the

translation of learning theories, is called neuroeducation (refer to section called, Using a Neuroeducation Model to Triangulate Literature). Educators who expand their understanding of learning outside of the traditional education domain by using a neuroeducation perspective as a lens to investigate learning, can positively impact students socially and academically (Arwood & Merideth, 2017). For example, one K-2, Structured Learning Class with a focus on Behavior (SLC-B) educator implemented classroom instruction based from neuroeducation perspectives of learning, called Viconic Language Methods® (VLMs) (Arwood, 2011). VLMs® help visual thinkers translate visual cognition into auditory English by using what is known about visual languages executed in auditory English (Arwood, 2011). VLMs® include visual-based strategies such as: cartooning, event-based pictures, word bubbling (outlining words' shapes), hand-over-hand, and picture dictionaries. During a five-year timeframe, 37 students went through the SLC-B program. The students were determined by the district, through functional behavior assessments, as not being able to function in a general education classroom. During the five years, VLMs® were incorporated into the SLC-B program; during the fifth year 82% of the students were either fully integrated or partially integrated into the mainstream classroom (Arwood & Merideth, 2017). Because the educator's perception of learning included a holistic understanding of the learners and how students' learning systems functioned, students found academic and social successes.

Educators who use neuroeducation perspectives for learning can help increase students' language and decrease students' anxiety (Arwood & Merideth, 2017). One special education educator positively impacted a high-stress student by incorporating effective teaching methods based from theories of learning held within the fields cognitive psychology, neuroscience, and language (i.e., neuroeducation). The educator helped the student utilize real-time drawings to

produce natural language in order to raise her cognition and lower her anxiety. Over a one-year period of time using visual language interventions derived from neuroeducation (e.g., cartooning, flowcharting, event-based pictures), the student was able to better understand herself through development of agency, had displayed more pro-social behaviors towards adults and peers, and lowered the stress to her neurobiological system (Arwood & Merideth, 2017).

Educator perceptions of learning translated through a neuroeducation lens can positively impact diverse groups of students socially and academically (Arwood & Merideth, 2017).

Speech and language pathologist, Gillaspy, implemented instructional methods based from a neuroeducation perspective of learning, centered around visual-motor learning for one student who was deaf and for one student labeled as being autistic. Gillaspy focused on building conceptual and neurobiological layers of understanding for both students by providing movement-based strategies that connected with visual-based learning. Students were allowed to use their learning system's (i.e., visual learning) strengths by layering visual-motor-based strategies such as watching the educator's pencil movements, watching signs from sign language, watching the speaker's mouth move when speaking and layering those strategies with writing, signing, and drawing; all of which increases conceptual development and overall cognition (Arwood, 2011; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). Both students had originally failed sound-based instruction (e.g., phonetics) used in traditional education settings, then after seven months of utilizing visual-motor-based instructional methods (which highlighted the students' learning system's strengths) derived from a neuroeducation perspective towards learning, students jumped ahead six years in social cognition and language development (Arwood & Merideth, 2017). Educators who utilize neuroeducation views of learning can help

students in multiple ways (e.g., socially and academically) (Arwood, 2011; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017).

Educators can use a neuroeducation perspective to learning to help meet students' various learning needs. One qualitative narrative inquiry study conducted by Murphy (2016) investigated the pros and cons of neuroeducation towards educators' instructional practices. Murphy used pre-interviews, classroom observations, and post-interviews to capture the narratives of five educators who were at various levels of completion in a graduate neuroeducation program. Participants taught in various K-12 classrooms which included public and private, elementary and secondary, and general education and special education. Themes within participants' narratives revealed that the educators felt their students' academic and social abilities were met, students developed and learned in meaningful ways, and students' functional language levels had resulted in academic changes, behavioral changes, as well as produced problem-solving abilities. Murphy's (2016) study also revealed a theme within participants' narratives which showed a mindset mismatch between educators who utilized a neuroeducation perspective to learning and the mindset for learning associated within the schools themselves. The educators in the study said that they felt they were constantly fighting against the common perspectives and instructional methods commonly used in their schools and therefore felt either isolated or felt that they always had to prove that the neuroeducation perspective was the correct perspective to use in education. The feeling of not having the support from their schools caused some of the participants to feel stressed and created self-doubt. However, despite participants' concerns most had implemented the neuroeducation-based approaches (e.g., VLMs®, flowcharting, picture dictionaries, drawing) anyway (Murphy, 2016).



**Visual-based learning strategies and auditory language.** The stories shared in the section above were based on educators' incorporations of neuroeducation-based perspectives of learning and educators' implementations of visual-based instructional strategies into their classroom settings. Though the educators each had different stories, which included students who had various social and academic needs, the stories had similar outcomes. Two common themes occurred within the stories shared above: 1) visual-based strategies were used to help struggling students and 2) students either socially or academically improved. The neuroeducation model (i.e., cognitive psychology, neuroscience, and language) the educators used to view learning and implement instructional practices from, does not assume or require the use of visual strategies within educational instruction; rather, the educators utilized the model to better understand the visual learning system and how visual-based strategies can positively affect struggling students' thinking and behaviors. To better understand the significance of *why* the visual-based strategies worked within the educators' stories shared above, an understanding of English as a language, the structures and functions of the visual learning system, and how visual learning strategies impacts students' thinking is needed (Arwood, 2011; Arwood & Merideth, 2017).

English as a written and spoken language is considered to be a low context, auditory language (Arwood, 2011; Arwood, Brown, Kaulitz, 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). In other words, a person can speak to a listener a very meaning-filled word (e.g., the spoken word, "there, they're, their") or phrase (e.g., "Get that over there.") by using very few words; the listener, then, is left to figure out the intentions of the speaker's word or phrase. Considering 85 percent of learners develop concepts, which are used to name their thinking and aid new learning, from visual-based ways of thinking, *not* auditory (Arwood, 2011; Arwood & Kaulitz, 2007; Lucas, 1980, 1991), English, as a low context, auditory language

causes difficulty for visual learners' conceptualization of information. Therefore, visual learners need visual-based methods or strategies to help them interpret auditory-based meanings within an environment (Arwood, 2011; Arwood, Brown, Kaulitz, 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). Visual-based learning strategies such as VLMs®, flowcharting, picture dictionaries, and real-time drawings, which were used by the educators previously mentioned, can help neurobiologically layer meaningful information (i.e., sensory inputs) within visual learners' learning systems (Arwood, 2011; Arwood, Brown, Kaulitz, 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Pulvermüller, 2009) which might otherwise be missed within an auditory-dominant setting.

Considering the structures and functions of the visual learning system, first, learners' eyes either process motion or the reflected light particles within the environment (Baars & Gage, 2010; Bear, Connors, & Paradiso, 2001). The human eye contains several important structures which bring in sensory inputs, such as motion or light particles, from the environment. Optical structures starting from outside of the body, the cornea, the iris, and then the lens mechanically adjusts sensory inputs from the periphery (Baars & Gage, 2010; Carter, 2014). The sensory inputs travel through the structures of the eyes and are passed on to other structures by ganglion cells, bipolar cells, rods and cones, and transformed into electro-chemical information for the brain to use (Baars & Gage, 2010; Carter, 2014). The electro-chemical information travels through the optic nerve, meeting at the optic chiasm, travels through each thalamus, and into the primary visual cortex (V1) (Baars & Gage, 2010). From the visual cortex, neurobiologically-meaningful information is sent to the dorsal pathway (towards the parietal lobe and the parietal cortex) and the ventral pathway (towards the temporal lobe and the temporal cortex), eventually reaching the frontal lobe and the prefrontal cortex (Baars & Gage, 2010). The primary roles of

the prefrontal cortex are largely attributed with higher executive functioning skills such as thinking, planning, and anticipating abstract events in the future (Baars & Gage, 2010; Cabeza et al., 2003); whereas, each executive functioning skill requires language to occur (Arwood, 2011; Pulvermüller, 2013). Because the visual cortex includes parts of the parietal, temporal, and frontal lobes as well as the whole occipital lobe, visual information is combined with other cortical functions such as motor and memory (Wandell, Dumouin, & Brewer, 2007) and highlights the synergistic nature of the brain (Arwood, 2011).

Earlier, this model of neuroeducation was used to explore learning and consequently highlighted the relationship between language acquisition, cognition, and behavior (Arwood, 2011; Bruner, 1975; Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977). Since research highlighted in neuroeducation shows a relationship between language acquisition, cognition, and behavior, students who struggle academically or display forms of atypical social behaviors due to auditory-dominant, low-context practices can benefit academically and socially by receiving and participating in visual-based practices (Arwood, 2011; Arwood, Brown, Kaulitz, 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). In other words, visual-based strategies such as the ones used by the educators in the examples above, can be used to help visual learners conceptualize information within a low context, auditory language in order to develop functional language which represents their thinking or cognitive abilities and can be used within multiple social settings (Bruner, 1975; Cromer, 1974; Halliday, 1977; Pulvermüller, 2012; Searle, 1969; Vygotsky, 1962).

To further understand the various philosophical foundations that may influence educators' perceptions of learning and the impacts those instructional strategies have on students' success, andragogy and pedagogy philosophical theories and frameworks will be

investigated based from guiding questions: *What is a neuroeducation perspective of andragogy?* and *What is a neuroeducation perspective of pedagogy?* In order to provide a neuroeducation perspective of learning, andragogy and pedagogy perspectives of learning include multiple foundational and influential adult and child philosophical theories and frameworks found in educational theory and practice.

### **Andragogy and Pedagogy**

The source or sources of educators' knowledge influences their instructional practices and students' learning outcomes (Buehl & Fives, 2009; Sommer, 2017). Educator sources of acquired knowledge often include: the educators' understanding of the historical context of their role as an educator, national or state standards that inform their school's direction for instruction and perspectives of learning, and educators' professional and personal experiences (Sommer, 2017). In education, two contrasting frameworks of learning inform educators' beliefs, one represents learning for adults (i.e., andragogy) and one represents learning for children (K-12) (i.e., pedagogy). To better understand learning, philosophical frameworks and theories of learning held within andragogy and pedagogy will be explored. First, non-transdisciplinary sources of andragogy and pedagogy philosophical frameworks will be explored; then a neuroeducational (i.e., transdisciplinary) perspective for learning will be used as a lens to investigate the learning tenets held within andragogy and pedagogy philosophical frameworks to provide a deeper understanding of learning tenets within each framework and their effects on teachers' perceptions of learning and student success.

An investigation of andragogy and pedagogy philosophical learning frameworks and their learning tenets from a neuroeducation perspective will highlight effective learning instruction applicable for K-12 learners and for adult learners. Guiding questions: *What is a neuroeducation*

*perspective of andragogy?* and *What is a neuroeducation perspective of pedagogy?* will be investigated after non-transdisciplinary perspectives of andragogy and pedagogy have been highlighted. The andragogy- and pedagogy-based philosophical frameworks described are not representative of *all* adult learning literature or pedagogy-based literature, nor are the learning theories which are used within the neuroeducation domains (cognitive psychology, neuroscience, language) representative of all learning theories within those domains, but rather were selected due to their foundational or continued influence in education or within each domain.

### **Andragogy**

**Historical origins.** The term *andragogy*, when broken down to its Greek roots, means “adult-leading;” put another way, the art and science of teaching or leading adults (Knowles, 1980). Andragogy was invented by a German educator named Knapp in the early-nineteenth century and was practiced in Europe for years. Later, andragogy became a focus of study in the mid-twentieth century under a different name, *adult learning* (Thorndike, Bregman, Tilton, & Woodyward, 1928). Psychologists Thorndike and colleagues (1928) used behavioral approaches for understanding adult learning; learning was often studied and observed in clinical psychology settings and with animals (Merriam, 2001). In other words, clinical studies about learning viewed learning as an adult behavior in response to environmental stimuli (Knowles, 1984b). Adult learning in the mid-twentieth century was also influenced by social psychologist Lindeman (1926), whose social perspective emphasized the importance of adults’ experiences as resources for adult learning, could more directly be applied to the formal setting of adult education, versus a clinical S-R setting which involved animals (Lindeman, 1926; Taylor & Kroth, 2009). Lindeman believed that adults rely greatly on their past experiences to help them learn (Knowles, 1984b; Lindeman, 1926). In the early- to mid-nineteenth century, adult educators relied heavily

on research for learning derived from psychologists,' cognitive psychologists,' and educational psychologists' studies to help them better understand how to teach their adult learners (Hagen & Park, 2016; Knowles, 1973; Merriam, 2001).

Later, in 1967, the term andragogy brought itself to Malcolm Knowles' attention while presenting in a session at Boston University (Knowles, 1989). Knowles was the professor of adult education at Boston University and was approached by a Yugoslavian adult educator named Dusan Savicevic, who told him he was teaching tenets of andragogy (Knowles, 1989). Knowles grew accustomed to the term andragogy and later re-popularized it after using it within educational communities (Saunders, 1991). Knowles presented his tenets of adult learning within his four basic assumptions about adult learners and described the differences between adult learners and child learners in his book *The Modern Practice of Adult Education: Andragogy Versus Pedagogy* (Knowles, 1970; Lee, 1998). Knowles has continued to add to his list of learning assumptions regarding adult learners and is now considered by many educational professionals to be the father of andragogy (Lee, 1998).

**Andragogy assumptions and principles.** Knowles and colleagues' (2005) theory of andragogy attempts to identify how adults learn and how to involve adults in the process of learning (Henschke, 1998; Merriam, 2001). In attempt to involve adults in the process of learning, Knowles and colleagues (2005) developed a set of assumptions that describes the characteristics of adults as learners: 1) Learners' Need to Know, 2) Self-Concept of the Learners, 3) Prior Experience of the Learner, 4) Learners' Readiness to Learn, 5) Learners' Orientation to (Knowles, et al., 2005).

Adult educators who understand and implement instructional practices based on the six core andragogy principles will help their adult learners learn (Knowles et al., 2005). The first

principle, *Learners' Need to Know*, addresses the question of why adults are learning the content at hand. Adults will invest a large amount of time and effort when they find something valuable (Knowles, 1984b; Knowles et al., 1998; Knowles et al., 2005). The second principle, *Self-concept of the Learners*, explains that as people mature, their self-concept move from being that of a dependent to an independent learner. When adults feel as though they are being forced to learn something, they will naturally resist (Knowles et al., 1998; Knowles et al., 2005; Taylor & Kroth, 2009). The third principle, *Prior Experience of the Learner*, assumes that when a person matures, there is an accumulation of knowledge gained that can be utilized for new learning situations. Adults' prior experiences can be used as a valuable resource for learning (Knowles et al., 1998; Knowles et al., 2005; Taylor & Kroth, 2009). The fourth principle, *Learners' Readiness to Learn*, assumes that when adults choose to learn new material it is because the material is directly related to his or her social roles in life; adults' readiness to learn greatly depends on the relevance of the topic, however (Knowles et al., 1998; Knowles et al., 2005; Taylor & Kroth, 2009). The fifth principle, *Learners' Orientation to Learning*, assumes that learning is problem-centered and new learning can immediately be applied to social role. Adults are motivated to learn as long as the content learned can help them answer a problem that is related to their social roles (Knowles et al., 1998; Knowles et al., 2005; Taylor & Kroth, 2009). The sixth and final principle about adult learners, *Learners' Motivation to Learn*, assumes that when adults choose to learn, there is internal motivation pushing them towards accomplishment (Knowles et al., 2005). Motivation "to learn" is accomplished when the adults' learning experiences are directly related to the problems they face every day and has the potential to help them grow as an individual or professional (Knowles et al., 1998; Knowles et al., 2005; Taylor & Kroth, 2009). Adult educators may reflect on Knowles and colleagues' (2005) six principles of

learning for adults and may also consider Knowles' (1984a) list of principles for effective application of adult learning principles.

**Application of andragogy in education.** Andragogy is more than a set of learning theory principles, andragogy also emphasizes educational practice that fosters adult educators to promote success for their adult learners (Lee, 1998). Knowles' (1984a) list of methods that adult educators should follow are:

1. Create a climate (physical and psychological) that is conducive to learning (i.e., Learners' Need to Know; Self-Concept of Learners);
2. Involve the adult learners in the planning and evaluations processes of their instruction (i.e., Learners' Motivation to Learn);
3. Adult learners' experiences (including mistakes) should set the stage for learning activities (i.e., Prior Experience of Learner);
4. Design learning plans that are directly related to problem-solving circumstances which they face in day-to-day scenarios (i.e., Learners' Orientation to Learning, Learners' Readiness to Learn) (Kearsely, 2010; Knowles, 1984a; Knowles et al., 2005).

Many educators and trainers use Knowles' principles and follow his recommended methods to promote adult learners' success inside and outside the classroom (Lee, 1998; Maddalena, 2015).

However, researchers have criticized several aspects of Knowles' concept of andragogy which include: a lack of scientific evidence (Pratt, 1993), difficulty towards measuring (with fidelity) implementation of andragogical principles (Heller, 2004), and inability to confidently define differences between adult learners and child learners (Merriam, 2001).

**Criticisms.** Knowles' list of principles has proven to be a great source to adult educators and leaders, however, the concept of andragogy and its principles for adult learning have



undergone great scrutiny (Pratt, 1993). One of the main arguments made against andragogy is that it lacks scientifically-measured evidence to support its claims and also, in fact, cannot be measured (Merriam, Caffarella, & Baumgartner, 2007; Lee, 1998; Pratt 1993; Taylor & Kroth, 2009). According to Heller (2004) the effects (e.g., quantitative analysis, grades, etc.) of andragogy cannot be measured because that would flaw one of the very things that makes andragogical practice effective, adult-learner-driven assessments (*not* teacher or curriculum-driven assessment) for more applicable, immediate learning and application to their life circumstances. Also, distinguishing between an *adult* learner versus a *child* learner is not always as easily defined (Merriam, 2001). In other words, if educators or researchers cannot distinguish between the characteristics of an adult learner or a child learner, how should the teacher then teach to the learner? Also, Knowles and colleagues' (2005) list of principles are based on introspection of adults about adult behaviors and are compiled from educators' observations of the adult learners (Hanson, 1996; McGrath, 2009; Merriam, 2001). In other words, adult educators cannot assume that these six principles will necessarily be true for all adults (e.g., some adult learners may lack motivation due to being forced to attend by their job); and, in some cases, children may certainly have richer life or learning experiences than some adults and therefore the child learners' experiences should be utilized according to andragogy principles for learning (Hanson, 1996; McGrath, 2009; Merriam, 2001).

Other factors (e.g., neurobiological learning systems, socio-cultural influences) may affect the efficacy of Knowles' (1970) and colleagues' (2005) definition and application of andragogy. One factor influencing the efficacy of andragogically-based learning principles comes from a lack of expansion to the understanding of the process of *how* (i.e., neurobiologically) humans learn (Pratt, 1993). Neuroscientists have attempted to connect adult

learning with brain science, but more research is needed to better understand this relationship (Hill, 1998). Also, an important question to ask is whether or not Knowles’ definition of andragogy represents all ethnicities of adult learners (Roberson, 2002). Often, people who are marginalized must develop ways of knowing that are different than that of the dominant culture (Goldberger, Tarule, Clinchy, & Belenky., 1995; Roberson, 2002). Therefore, adult educators need to focus on social, economic, and political systems to expand adult learners’ thinking (Goldberger et al., 1995). Table 2.1 displays andragogical-based tenets, applications of andragogy into education, and criticisms of andragogy principles of learning.

Table 2.1

*Andragogy Educational Tenets, Application into Education, and Criticisms*

Andragogy	
Educational tenet	The art and science of teaching or leading adults (Knowles, 1980).
Application into education	Climate is conducive to learning; learners participate in planning and evaluations; learners’ experiences set stage for learning; classroom learning plans relate to learners’ everyday problems (Kearsely, 2010; Knowles, 1984a; Knowles et al., 2005).
Criticisms	Lack of scientific evidence (Pratt, 1993); lack of explaining how learning neurobiologically occurs (Pratt, 1993); difficulty measuring implementation (Heller, 2004); difficulty defining adult versus child learner (Merriam, 2001); Knowles’ (2005) six principles difficult to validly measure within all populations of learners (Hanson, 1996; McGrath, 2009; Merriam, 2001); may not represent understandings of learning representative of all ethnicities (Roberson, 2002).

In order to address some of the criticisms of andragogy and to help fill in the gap between missing educational research surrounding principles of learning held with andragogy, additional

adult learning theories (e.g., Transformative Learning Theory, Experiential Learning Theory, Communities of Practice, neuroandragogy) will be incorporated alongside andragogy.

Incorporating additional adult learning theories will help represent the learning domains held within a neuroeducation model (e.g., cognitive psychology, neuroscience, language). Examining adult learning theories and philosophical frameworks for learning through a transdisciplinary model (i.e., neuroeducation) can help expand and explain the learning beliefs held within andragogy and satisfy issues of credibility towards educational application and effective student learning (Shenton, 2003). The philosophical frameworks and principles of learning held within andragogy will be investigated through the guiding question: *What is a neuroeducation perspective of andragogy?*

### **A Neuroeducation Perspective of Andragogy**

In an attempt to gain deeper insight into adult learning as well as the essential learning components and practices for adult learners, a neuroeducation approach will be used in this study. The neuroeducation perspective used in this study is transdisciplinary (i.e., cognitive psychology, neuroscience, language). Using a transdisciplinary approach helps inform research, policy, and practice (Hook & Farah, 2013; Tommerdahl, 2010), helps bridge research and practice (Edelenbosch et al., 2015), and can provide deeper insights for learning related to the connections between instruction used in education and underlying neurobiological factors in the learner (Kartzir & Pare-Blagoev, 2006). Tenets of learning held within adult philosophical frameworks and theories: andragogy, Transformative Learning Theory (TLT), Experiential Learning Theory (ELT), Communities of Practice (CoP), and neuroandragogy will be compiled and explored within the three neuroeducation lenses: cognitive psychology, neuroscience, and language in order to holistically understand *andragogy*. The philosophical frameworks and

theories (andragogy, TLT, ELT, CoP, neuroandragogy) highlighted within each domain (cognitive psychology, neuroscience, language) are not representative of *all* adult learning literature found within each domain, rather the highlighted philosophical frameworks and theories were selected due to either their foundational or continued influence within each domain.

**Andragogy in cognitive psychology.** In psychology, learning is viewed as a response (observable behavior) to a stimulus (Skinner, 1953) and in education, learners' products (in other words, observable behaviors) are learners' responses (i.e., behaviors) to classroom expectations (stimuli) set by the classroom teacher; educational products in a classroom environment, are therefore, evidence of student learning (Owens, 2010; Robb, 2016; Tivnan & Hemphill, 2005).

Behavioral changes are also observed as products. For example, there are a number of adult learning theories that place value in student-driven products as a means towards learning. Knowles and colleagues' (2005) perspective on andragogy as well as other adult learning theories: Transformative Learning Theory (TLT) (Mezirow, 1997); Experiential Learning Theory (ELT) (Kolb & Kolb, 2009), Communities of Practice (CoP) (Lave & Wenger, 1991), and neuroandragogy (Wilson, 2006) adhere to the importance of having some form of product to show learning. For example, one principle for learning within andragogy that adult educators are encouraged to follow involves utilization of adult learners' experiences (including mistakes) to set the stage for learning activities (Knowles, 1984a). The adult learners' experiences are used as learning evidence to allow more products (learning activities) to occur and thus demonstrate learning. In a similar fashion, Transformative Learning Theory uses adult learners' experiences as a foundation to create change in individual perceptions and feelings (in other words, products) (Mezirow, 1997). Changes in adult learners' perceptions, feelings, and knowledge allows the

adult learner the chance to collectively and critically assess new knowledge (Mezirow, 1997). Experiential Learning Theory uses adult learners' experiences as a platform for solution from conflict between opposed perspectives to the world, which is required for learning to occur (Altamini, 2015; Kolb, 1984). One of the identified key characteristics of a Communities of Practice is the ability to assess a group's actions and products to show learning (Wenger, 1998). Similarly, within the neuroandragogy philosophical framework, adult learners are encouraged to utilize, connect, then display their various experiences, with content shared in the learning environment, through various products (e.g., mind maps, collages, slideshows) (Wilson, 2006).

As previously noted, adult learning theories and philosophical frameworks for learning (andragogy, Transformative Learning Theory, Experiential Learning Theory, Communities of Practice, and neuroandragogy) use adult learners' experiences as a platform to create and enhance learning in the classroom. Experiences within the learning setting stem from information that is made meaningful, practical, and relevant to the adult learner through a collaborative process for development of the course's content by the educator and the adult learners (Knowles et al., 2005; Mezirow, 1997). Besides Wilson's (2006) neuroandragogy, each adult learning theory previously mentioned (andragogy, TLT, ELT, CoP), is criticized due to a lack of explanation for neurobiological learning or *how* learning occurs in the brain, nor is the neurobiological factor of learning addressed within the adult learning theories (i.e., andragogy, TLT, ELT, CoP) (Hill, 1998; Lesser & Storck, 2001; Pratt, 1993; Schenck & Cruickshank, 2015; Taylor, 2000). As previously noted in Chapter One, teachers do not typically receive training in neurobiological learning (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993). Therefore, the following section will incorporate principles from the adult learning theories

(andragogy, TLT, ELT, CoP, neuroandragogy) that are supported within various neuroscience literature.

**Andragogy in neuroscience.** One of the main arguments made against Knowles' perspective of andragogy as well as other adult learning theories (TLT- Mezirow, ELT- Kolb & Kolb, CoP- Wenger & Lave) is the lack of scientifically-measured evidence (for example, observations within the brain) to support adult learning claims (Merriam et al., 2007; Lee, 1998; Pratt 1993). However, continued research in neuroscience has shown that components of adult learning theories (andragogy, TLT, ELT, CoP) are supported by neuroscience (neuroandragogy already connects brain research with adult learning). For example, research has shown that the human brain is social and tends to learn best in a contextual setting (Cozolino & Sprokay, 2006). Adult learning theories andragogy, TLT, ELT, CoP, and neuroandragogy all place importance in group discussion as well as setting environments that are conducive to learning in a social manner (Knowles, 1984a; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Wilson, 2006). Further, adults can use previously learned experiences to connect new knowledge with old, creating new learning experiences that can be used in the present or future (Knowles et al., 2005; Taylor, 2006; Wilson, 2006). The human brain can be viewed as a set of networks, gained through experiences, which become richer and more complex when utilized and connected with new information or stimuli (Kolb & Kolb, 2005; Kolb & Kolb, 2009; Moseley & Pulvermüller, 2014; Pulvermüller, 2013; Pulvermüller, 2014).

Adult learning theories and philosophical frameworks for learning (andragogy, TLT, ELT, CoP, neuroandragogy) emphasize the importance of using learners' past learning experiences to create new learning within the environment (Knowles, 1984a; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Wilson, 2006). Within the brain, neuronal networks represent

previously learned experiences (Pulvermüller, 2013). The neuronal networks cover the cerebral cortex and are spread over various regions of the cerebrum (Zull, 2002). Because adults have previous learned experiences gained over time, the brain is never a blank slate for learning (Taylor, 2006). Therefore, adult educators should set up learning experiences that are social as well as utilizes each learner's previously learned experiences (Cozolino & Sprokay, 2006) and uniquely acquired, functional language to represent the previously learned experiences in order to create new learning; it is an adult learner's language that makes sharing previously learned experiences possible (Amsterlaw & Wellman, 2006; Wellman & Liu, 2007; Williams & Lombrozo, 2013).

Understanding the impact on learning from using functional language within an education setting is important as learning becomes more efficient and effective, as well as long-term (Pulvermüller, 2013). Research suggests that functional language comes from the cerebral cortex (in other words, from the top-down within the cerebrum) (Damasio & Geschwind, 1984; Mechelli et al., 2004) and is then disbursed to lower levels of the brain (Cohen, 2000; Conway, 1992; Craik, 2002). Top-down variables typically include meaningful, contextual, and abstract experiences (in other words, functional language) (Cohen, 2000; Conway, 1992; Craik, 2002). Though neuroscientists have struggled to connect adult learning in non-artificial environments with traditional brain science (Hill, 1998), learning theories within the language domain can allow for further interpretation, as language is the main mediator of understanding past learned experiences as well as communicating experiences and their meaning to others in the present (Arwood & Merideth, 2017; Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977).

**Andragogy in language acquisition.** As previously mentioned, language, culture, and learning are naturally intertwined within social interactions (Chomsky, 1975; Egorova et al.,

2016; Frith & Frith, 2007; Vygotsky, 1978). Therefore, learning is social in nature (Frith & Frith, 2007). When adults use language to express an idea or meaning, the underlying concepts that have been acquired through numerous social interactions represent learners' thoughts and previously learned experiences (Arwood, 2011, Bruner, 1975; Frith & Frith, 2007). Learned experiences (in other words, concepts and functional language) are socially structured to fit the interactions within a context; moreover, the study of how language functions in a social situation is called *pragmatics* (Arwood, 2011, Robb, 2016).

Within the six assumptions of andragogy, as well as within the adult learning theories and frameworks TLT, ELT, CoP, and neuroandragogy, the underlying concepts meaningful, practical, and relevant contribute to an understanding of how adults learn and what is assumed they need to learn (Knowles et al., 2005; Kolb & Kolb, 2009; Lave & Wenger, 1991; Mezirow, 1997; Taylor & Kroth, 2009; Wilson, 2006). Language literature provides additional understandings towards the concepts meaningful, practical, and relevant with the concepts semantic (i.e., meaningful), pragmatic (i.e., practical), and semiotic (i.e., relevant) (Arwood, 2011; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Bruner, 1975; Peirce, 1902; Searle, 1969; Wenger, 1998; Vygotsky, 1962; Xiang Lam, 2016). To gain deeper insights into the concepts meaningful, practical, and relevant as they occur within adult learning literatures, connections will be made with the concepts semantic, pragmatic, and semiotic within language literatures.

Natural language, used to aid new learning, is meaningful and semantic to the learner (Arwood, 2011; Piaget, 1936; Pulvermüller, 2013; Vygotsky, 1978). Adults use language (for example, concepts or previously learned experiences) to learn from the social contexts from which the culture the language is derived (Halliday, 1977). Highlighted within Knowles and



colleagues' (2005) six assumptions regarding adult learning, such as *Learners' Need to Know* and *Prior Experience of the Learner*, as well as noted within adult learning theories TLT, ELT, CoP, and neuroandragogy, using adults' experiences to create new learning is an important component for learning to occur. Ultimately, adults' experiences are shared through the use of their language, the language that represents the adults' experiences and is meaningful (i.e., semantic) and aids new learning. The language used in social contexts, such as classrooms for adult learning, is functional and can be used in displaced, future social interactions to produce new learning as well (Arwood, 2011; Bruner, 1975; Gainotti et al., 2009). Furthermore, functional language is contextual (includes information about who, what, where, when, why) and therefore is greater than the sum of its parts (in other words, linguistics- nouns, punctuation, sentence structure, syntax, phonetics) (Peirce, 1902). Language that is greater than the sum of its parts is semantic or meaningful (Bruner, 1975, Searle, 1969, Wenger, 1998; Vygotsky, 1962), is situational, and helps the learner adapt to new learning environments by creating new learning experiences (Bruner, 1975; Bruner, 2001).

Meaningful learning experiences are semantic in nature and are also relevant and practical (Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). Highlighted within Knowles and colleagues' (2005) six assumptions regarding adult learning, such as *Learners' Readiness to Learn* and *Learners' Orientation to Learning*, as well as noted within adult learning theories TLT, ELT, CoP, and neuroandragogy, adult learning content should be relevant and practical within adults' lives (Knowles et al., 2005; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997; Wilson, 2006). A key component previously highlighted for learning to occur for adults was through the application of the adult learners' previously learned experiences in a social context (Knowles, 1984a; Knowles et al., 2005; Kolb, 1984; Lave & Wenger, 1991; Mezirow, 1997;

Wilson, 2006). Social contexts (e.g., learning environments) as well as the information within the contexts, according to adult learning literatures, are to be constructed by the adult learners and the adult educator, allowing for information within the context to be relevant and practical to the adult learners (Knowles et al., 2005; Mezirow). Social settings, within language literatures, investigates the signs and symbols which represent the meanings of patterns and multiple concepts used in the settings (Arwood & Kaulitz, 2007; Peirce, 1902). In order for a person within a social setting to understand the meanings being used, the person has to have acquired specific language to represent their thinking within that setting (Arwood & Kaulitz, 2007). Considering learning for adults, adult educators may consider providing their adult learners with a compiled list of relevant texts for the course and allow their learners to select the texts they prefer or the adult learners may also be encouraged to select from a set of texts outside of the educators' compiled texts in order to increase relevancy (i.e., semiotic) and practicality (i.e., pragmatic) to classroom content, as well as increase the likelihood of connecting adult learners' experiences and language to the new content presented in the class.

As described, learners' previously learned experiences represent the underlying concepts and thinking of the learner and are social in nature (Chomsky, 1975; Egorova et al., 2016; Frith & Frith, 2007). Adult educators, therefore, can help their adult learners increase the likelihood of meaningful learning by utilizing the learner's experiences in classroom discussions, narratives, and self-dialogue (Dewey, 1938; James, 1997; Mezirow, 1997; Scott, 1991; Wilson, 2006). Since the adult learner's experiences are naturally semantic (i.e., meaningful) the underlying concepts have already been neurobiologically established within the learner's brain as meaningful (Pulvermüller, 2013); also, because the content constructed within the learning setting is based from adult learners' interests, information is relevant (i.e., semiotic), practical (i.e., pragmatic),

and contributes to further learning (Knowles et al., 1998). Adult educators, therefore, can use adult learners' experiences to help raise their cognition (i.e., thinking) so that the adults can perform better at work, in their personal lives, and within society (Freire, 1970). Additionally, research in neuroscience highlights and supports the process of scaffolding new information with adult learners' previously established, neurobiologically meaningful, neuronal circuits, as well as the impact those neuronal networks within the cerebral cortex have on language function and raised cognition (Arwood, 2011; Damasio & Geschwind, 1984; Mechelli et al., 2004; Pulvermüller, 2013).

Educators who teach children (i.e., pedagogy or K-12 learners) can also use their students' previously learned experiences (which represent K-12 learners' naturally acquired language) to help create and enhance student learning (Bransford et al., 2000; Brooks & Brooks, 1993; Danielson, 2016; Scheurman, 1998; Enríquez, 2017). A neuroeducation perspective will be used as a lens to investigate learning theories held within pedagogical frameworks and theories for learning. Examining pedagogical learning theories and learning frameworks through a transdisciplinary model (i.e., neuroeducation) can help expand learning beliefs held within pedagogy, satisfy issues of credibility regarding educational applications and student learning (Shenton, 2003), and follows the guiding question: *What is a neuroeducation perspective of pedagogy?*

## **Pedagogy**

**Historical origins.** Pedagogy is largely known as the art and science of instruction, teaching, training, or helping children learn (Brown, 2010; Knowles, 1973; Knowles, 1980). A traditional, more commonly practiced philosophy of pedagogy is a teacher-centered, evidence-based model for learning, that requires student products or standardized test scores to represent

students' knowledge and learning (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Robb, 2016).

The traditional pedagogical model for student learning originated during the mid-nineteenth century when the understanding of learning stemmed from behavioristic, S-R clinical psychology settings (Horowitz, 1992) and emphasized repetition for strengthening learning (Chomsky, 1959; Hill, 2012; Skinner, 1953).

**Application of traditional education.** Because the traditional education perspective of learning was dominant during the mid-nineteenth century, student answer-replication (e.g., input-output or S-R) and content memorization were common practices used in classrooms to show student learning (Garrison, 2009; Hill, 2012). In a traditional education setting, students were expected to memorize and produce replications of the answers given to them by their teachers for their thinking to be correct; students who could replicate answers may also perform well on standardized tests (Arwood, 2011; Garrison, 2009). The traditional pedagogical model for student learning used standardized tests to measure student intelligence and academic mastery (Garrison, 2009). Using quantitative, data-based measurements for standardized tests originated from psychologist, Edward Thorndike; after he incorporated quantitative data analysis in education and psychology in an attempt to make the social sciences more efficient and effective (Levin, 1991).

**Criticisms.** Standardized tests reflect social values, are government-controlled, and may not represent culturally-diverse students' values, which may be a barrier to ethnically diverse students (Garrison, 2009). Standardized testing is still prevalent as a practice and as a means of measuring student learning in education today. President Nixon in 1969, created the National Institute of Education to study the link between federal aid and student performance and since

then, various government-created laws (Elementary and Secondary Education Act, No Child Left Behind, Every Student Succeeds Act) have been created as additional means of measuring the relationships between the federal aid given to schools and student performance on standardized tests (Dove et al., 2010). Students' standardized testing scores are used as accountability measures to incentivize low performing schools to show higher performance (Dove et al., 2010). In order to motivate student learning within the traditional pedagogical model, a system of punishments and rewards are used to produce a desired student behavior, which again is based on a S-R methodology (Chomsky, 1959; Ertmer & Newby, 1993). Schools that use a system of punishments and rewards to help produce desired behaviors from their students are enforcing practices derived from behaviorism (Arwood, 2011; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Poulson, 2016; Robb, 2016). Research shows that using methods of behaviorism in education may produce a deficit-based system of learning which hinders student inquiry and long-term learning (Dinishak, 2016; Rappolt-Schlichtmann et al., 2018; Valencia, 2012). A S-R perspective of learning used in education represents a two-tier western psychological model for learning (e.g., call and response, fill-in-the-blank, answers are either correct or incorrect), does not allow concept or language development, and therefore restricts student learning (Arwood, 2011). Table 2.2 displays a traditional-based model of education, its tenets, applications into education, and criticisms of traditional education principles of learning.

Table 2.2

*Pedagogy Educational Tenets, Application into Education, and Criticisms*

	Pedagogy
Educational tenet	Teacher-centered, evidence-based model for learning referred to as traditional education (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Robb, 2016).
Application into education	Input/ output, content memorization, standardized tests (Arwood, 2011; Chomsky, 1959; Garrison, 2009).
Criticisms	Standardized tests reflect social values of those who create the tests (Garrison, 2009); school funding corresponds to high test scores (Dove et al., 2010); schools use a system of positive and negative reinforcements which operates within a deficit-based model for learning and hinders student learning (Dinishak, 2016; Rappolt-Schlichtmann et al., 2018; Valencia, 2012).

**Student-centered learning.** An alternative to the traditional pedagogical model based on behaviorist perspectives of teaching performance is the notion that emphasis be placed on learning from a student-centered model (versus a teacher-centered model). A student-centered model of learning emphasizes students’ natural artifacts including language to assess conceptual learning. This model is social and contextual, and can be supported by learning research in cognitive psychology, neuroscience, and language domains (Arwood, 2011; Dewey, 1938; Enríquez, 2017; Piaget, 1959; Popkewitz, 1998; McCabe & O’Connor, 2014; Vygotsky, 1962; Vygotsky, 1978). Several student-centered theories and conceptualizations of learning which influenced education were inspired from American psychologist John Dewey, American philosopher Charles Peirce, Russian psychologist Lev Vygotsky, and Swiss psychologist Jean

Piaget in the early and mid-twentieth century (Dewey, 1938; Peirce, 1905; Piaget, 1936; Vygotsky, 1978). Peirce's (1905) concept of pragmatism, Vygotsky's (1978) theory of socio-constructivism, Dewey's (1938) theory of experiential learning, and Piaget's (1936) Theory of Cognitive Development have helped shape a perspective of pedagogy that focused on the whole student and included cognitive, language, social, and academic growth (Popkewitz, 1998).

**Application of student-centered learning in education.** Student-centered learning incorporates components of student learning that centers around the whole child, including the child's experiences both social (external) and neurobiological (internal) as well as the child's functional language. For example, Peirce's (1905) concept of pragmatism considers the students' *whole* story to be greater than the underlying *parts* of their story (Arwood, 2011; Peirce, 1905). For example, when instructing novice readers, educators can use Peirce's concept of pragmatism as a lens to view learning instruction. Educators can give novice readers more context, use whole sentences, overarching themes or morals, and student-drawn pictures related to the story to help students learn to think with reading as a form of language. Reductionistic methods (e.g., phonics, letter sounds) are opposite to Peirce's concept of a pragmatism perspective of learning, wherein educators' instruction of reading is based on teaching the students the pieces that represent the whole (Arwood, 2011; Robb, 2016).

Vygotsky's (1978) theory of socio-constructivism, a compilation of Vygotsky's works published by his colleagues after his death in 1933, considered the child's learning as a part of student collaboration, social learning contexts, relational thinking, applied language, and conceptual learning (Hickey, 1997, Vygotsky, 1978). Vygotsky believed that collaborative actions (e.g., behaviors, actions, and language representing thinking, learning, and experiences) were shaped from oral speech and natural activities within a community or culture that

interconnect to form social language which can be used to think and learn (Kanselaar, 2002; Vygotsky, 1978). In other words, thought develops within contextual features (e.g., language and interactions with others) of society. Also, within Vygotsky's socio-constructivism theory, the concept of assisted learning or Zones of Proximal Development (ZPD) is highlighted (Hickey, 1997; Vygotsky, 1978). Within Vygotsky's ZPD, the child's thinking is actively scaffolded to facilitate higher cognitive levels. Adults provide support with relevant problem-solving and critical thinking activities and information that are practical and relate to the K-12 students' previously learned experiences (Kanselaar, 2002; Vygotsky, 1978).

Further to relevancy and practicality, Dewey's (1938) theory of experiential learning incorporates learning experiences that are social in nature and applicable to students' real life scenarios (Roberts, 2003). An educators' primary role in an experiential learning setting is as facilitator of student experiences. Educators are also responsible for subject matter knowledge and having an understanding of what individual learners know. Educators using principles of learning derived from Dewey's experiential learning will facilitate students' learning experiences. Educators should encourage and help establish student-led activities in order for student learning to be more meaningful (Dewey, 1938; Roberts, 2003).

Piaget's (1936) Theory of Cognitive Development has given education an understanding of the developmental and cognitive capacities of students' acquisition and use of knowledge. Within Piaget's theory, cognitive development is a product of knowledge and learning. Piaget listed four stages of cognitive development: 1) *sensorimotor*, children ages birth to two explore and interact with their environments, but have no verbal language; 2) *preoperational*, children ages three to seven are able to speak about self and others, but are limited to their own perspectives (i.e., egocentric); 3) *concrete*, children ages seven to eleven, are able to use



language to understand another person's views; children will be able to use inductive and deductive reasoning and understand social norms and rule-following; and 4) *formal* thinking children ages eleven and greater will be able to formally displace their thinking; be able to think critically about a variety of abstract concepts including homelessness, trust, and love; and be able to problem solve at a formal level (Arwood, 2011; Piaget, 1936). Because language and cognition are interdependent (Bruner, 1975; Frith & Frith, 2007; Humphrey, 1976; Searle, 1969; Vygotsky, 1978), educators can consider students' use of natural language to represent their cognitive capacities.

Student-centered instruction incorporated into a classroom setting is also known as student-centered teaching (Popkewitz, 1998). Student-centered teaching highlights pedagogically-based practices that focuses on learning that is constructed by students through social interactions as the teacher acts more as a facilitator of knowledge, scaffolding students' previously learned experiences with new information given (Dewey, 1938; Enríquez, 2017; McCabe & O'Connor, 2014; Peirce, 1905; Piaget, 1936; Vygotsky, 1978). Student-centered concepts and theories of learning: pragmatism, experiential learning, socio-constructivism, and Theory of Cognitive Development will be used to explore pedagogical learning within a neuroeducation model.

### **A Neuroeducation Perspective of Pedagogy**

In an attempt to gain deeper insight into pedagogy-based (child) learning as well as the essential learning components and practices for child learners, a neuroeducation approach will be used. Pedagogy-based concepts, learning theories and philosophical frameworks for pedagogy-based learning will be explored within the three neuroeducation lens: cognitive psychology, neuroscience, and language in order to holistically understand the term *pedagogy* and investigate

the guiding question: *What is a neuroeducation perspective of perception?* The theories highlighted within each domain (cognitive psychology, neuroscience, language) are not representative of *all* pedagogy-related literature found within them, rather they were selected due to either foundational or continued influential purposes in each domain.

**Pedagogy in cognitive psychology.** As previously mentioned, in psychology, learning is represented by some type of permanent, observable (external or internal) change (neuronal, functional language) in behaviors (Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977; Pulvermüller, 2005; Skinner, 1953). In student-centered pedagogy, teachers often observe and measure learning through a students' creation of a product that represents their knowledge in any given subject (MacGill, 2016; Skerry et al., 2013). Similar to the ideas of learning in andragogy, a child's knowledge (in other words experiences) can be utilized as a product to display learning in the moment as well as display learning over time (Danielson, 2016; Dewey, 1938; Piaget, 1936). Students' previously learned experiences can be used to generate new learning in a classroom or informal learning setting and should be student-led too (Dewey, 1938; Vygotsky, 1978). Utilizing a student's experience enhances the relevancy and meaning of the new information for the student and causes the student to process the new information at a higher cognitive level (Bransford et al., 2000; Brooks & Brooks, 1993; Piaget, 1936; Scheurman, 1998; Enríquez, 2017; Vygotsky, 1978).

**Pedagogy in neuroscience.** As previously mentioned, neuroscientists describe learning as the strengthening of connections between neurons which results in permanent cellular change (Pulvermüller, 2005). Learning in education (i.e., pedagogy), from a neuroscience perspective, can be described as the forming of neuronal connections generated from a form of external, sensory input within an environment (Koizumi, 2003). For example, when a teacher gives

instruction to the class, or the students lead an experienced-based event, the sensory input (the instruction, oral or visual) within the classroom can cause new neuronal connections within the students' brains. The neuronal connections formed within the students' brains act as information-processing circuits and consequently store new information (Koizumi, 2003). Similarly, student-led activities which are based from students' previously learned experiences, activate neuronal circuitry in the brain that allows scaffolding of new information to previously acquired circuits and neuronal networks. Both Dewey's (1938) experiential learning and Vygotsky's (1978) socio-constructivism theory emphasized student-experience-based activities that contributed to information being relevant and meaningful to students.

Neural pathways in the brain that are formed by new learning experiences occurs within the central nervous system (CNS). Sensory input is accessed by the peripheral nervous system (PNS) for learning to occur within the Central Nervous System (Carter, 2014; Morgan, 2003). Sensory input (acoustic, visual, taste, touch, smell) enter learners' PNS as an important first step in the overall learning process (Arasteh, 1953; Deligianni, Senju, Gergely, & Csibra, 2011). Once the sensory input entered the PNS the physical input generates changes in cells in pathways on the way to the learner's brain. The first learning pathways create a perception of the experience which continues to increase connections among cells into cerebral circuits (Meltzoff, Kuhl, Movellan, & Sejnowski, 2009), these circuits create images or concepts which can be shared with others through reading, writing, talking, calculating, etc. (Enríquez, 2017; Greeno et al., 1996; Piaget, 1969). The cognitive stages represented within Piaget's (1936) Theory of Cognitive Development takes into consideration the assimilation of sensory input to form more complex levels of thinking. When students share information that is meaningful to them, the learned experiences they have acquired are represented with their natural language (Piaget, 1936;

Piaget, 1969), which was neurobiologically established in their learning systems (Meltzkoff et al., 2009).

**Pedagogy in language acquisition.** As previously mentioned, language theorists describe learning as the ability to *mean* or express an understanding that fits socially within a context (Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977). Therefore, learning is directly connected to contexts, which are connected within a society following a set of social rules, and are housed within a culture, making neurobiological learning social and cultural (Kuhl, 2007). When a student uses natural language to represent their knowledge or experiences, the student's knowledge is socially constructed to fit within the environment (Dewey, 1938; McLaren & Giarelli, 1995; Popkewitz & Brennan, 1998; Skerry et al., 2013). Children's social development deepens the concept of agency (i.e., identity) and thinking (Piaget, 1936; Popkewitz, 1998; Vygotsky, 1978).

In education, children are able to learn efficiently from teaching that occurs within social contexts (Enríquez, 2017; Skerry et al., 2013; Vygotsky, 1978) and utilizes students' natural language to express their concepts formed from their experiences (Vygotsky, 1978). Therefore, educators can use narratives or rich-language stories to help shape the social realities or perceptions for increasing students' thinking and further influence students' language development (Bruner, 1991; Erickson, 2008; Peirce, 1905; Piaget, 1936). Similarly, educators provide information that is relevant, practical, and meaningful for K-12 learners when the information reflects the K-12 learners' experiences and natural language (Dewey, 1938; MacGill, 2016; Skerry et al., 2013; Vygotsky, 1978). Through representation of an experience with language, shared meaning can be organized as knowledge and used as a tool for deepening concepts and thinking (Halliday, 1993; Piaget, 1936; Vygotsky, 1981). A large study conducted

by researcher Hattie (2012) compared over 800 meta-analyses and 50,000 research articles and concluded that successful teaching methods utilized students' self-verbalization or self-questioning (in other words, natural, functional language to raise their thinking (Piaget, 1936)). Functional language, therefore, helps students increase as well as deepen conceptual learning (Hattie, 2012; Peirce, 1905; Piaget, 1936; Vygotsky, 1978).

### **Chapter Summary**

Research within this literature review highlighted a gap in educators' training surrounding transdisciplinary learning (e.g., neurobiological learning and language acquisition) and effective instructional practice (Hill, 1998; Leibbrand & Watson, 2010; Jeder, 2014; Jong, 2014; Pratt, 1993). Therefore, a neuroeducation model, which included the learning domains: cognitive psychology, neuroeducation, and language, was used as a lens to investigate the terms *learning* and *perception* as they apply to learning in education and educators' perceptions of learning. The impact of educators' perceptions of learning on classroom instruction and learning for K-12 learners and adult learners was also explored. Educators' perceptions of learning influence both the types of instruction that are used in the classroom as well as the degree of academic success accomplished by students (Goddard et al., 2000; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). Additionally, educators' perspectives of learning, who had a background in neuroeducation (i.e., neuroeducators), were highlighted to display an additional perspective of learning that is holistically informed (e.g., cognitive psychology, neuroscience, language) by theory and practice and the effects of those perceptions on their students. Neuroeducators were able to raise students' cognition, increase students' pro-social behaviors and language development, and in one case, lower a student's level of stress (Arwood & Merideth, 2017).

The neuroeducational model was also used to investigate adult and child (i.e., pedagogy) philosophical learning theories and frameworks in order to more holistically understand tenets of learning held within each theory and the impacts of those learning tenets on adult learners and K-12 learners. Adult philosophical learning theories and frameworks included: Knowles and colleagues' (2005) andragogy, Mezirow's (1997) Transformative Learning Theory, Kolb and Kolb's (2009) Experiential Learning Theory, Lave and Wenger's (1991) Communities of Practice, and Wilson's (2006) neuroandragogy. Pedagogical learning theories and frameworks included: Peirce's (1905) concept of pragmatism, Dewey's (1938) theory of experiential learning, Vygotsky's (1978) socio-constructivism theory, and Piaget's (1936) Theory of Cognitive Development. Adult learning theories and pedagogical learning theories and/or frameworks highlighted the importance of using learners' experiences within a social context and emphasized students' (adult and K-12) natural, functional language to increase conceptual learning within a classroom which allows the setting and the information within it to be meaningful, practical, and relevant (Dewey, 1938; Knowles et al., 2005; Kolb & Kolb, 2009; Lave & Wenger, 1991; Mezirow, 1997; Piaget, 1969; Peirce, 1905; Pulvermüller, 2013; Vygotsky, 1978; Wilson, 2006).

Research on learning in neuroscience has shown at the neurobiological level, the positive impacts of social learning environments that use information that is relevant, practical, meaningful, and representing individuals' previously learned experiences, and emphasizes the use of students' naturally-acquired language, on new learning and neuronal connectivity within the brain (Arwood, 2011; Bedny & Caramazza, 2011; Bookheimer, 2002; Carter, 2014; Egorova et al., 2016; Gallistell & Matzel, 2013; Mahon & Caramazza, 2008; Pulvermüller, 2005; Pulvermüller et al., 2009; Pulvermüller, 2013).

In an attempt to contribute research towards the gap in literature regarding the effects of transdisciplinary research, practice, and learning on educators' perceptions and professional and personal lives, this researcher conducted a study which measured the impact of an adult learning class with a neuroeducational perspective of learning on adult learners' identity, their perceptions of learning in various settings, their implementations based from their perceptions of learning into their professional and personal lives, and the impacts those implementations had on individuals within their professional and personal lives.

### **Chapter Three: Methodology**

This chapter discusses the methodology used to conduct this study. The chapter includes the purpose of the study, the guiding research questions, the rationale for the chosen methodology, the participants and their situational and professional context, instrumentation, design and procedures, role of the researcher, trustworthiness of the findings and ethical considerations, and data analysis procedures.

#### **Research Purpose and Research Questions**

The purpose of this study was to investigate the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b) perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings. Analysis of educators' perceptions of learning is important as educators' perceptions of student learning influences the instructional practices used in the classroom and impacts the degree of student success (Alvidrez & Weinstein, 1999; Calderhead, 1996; Coe et al., 2014; Gottfried, 1985; Leibbrand & Watson, 2010; Monts, 2000; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998). Four research questions guided this study:

1. How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?
2. How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?
3. In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?



4. In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?

These questions were explored through semi-structured interviews with two different groups of participants, Experts in the Field and Focal Participants; Experts' and Focal Participants' criteria and background information will be discussed more in-depth in later sections within this chapter.

### **Methodology and Rationale for Methodology**

This study captured the perspectives and narratives from two different groups of participants (i.e., Experts and Focal Participants) that related to the neuroeducation perspective of learning held within the adult learning class. Experts' and Focal Participants' implementations of neuroeducation-related perspectives of learning into their professional and personal lives and the participants' perceived impacts of those implementations were examined. The questions that guided the literature review related to a neuroeducation perspective of learning and a neuroeducation perspective of andragogy served as a foundation for this study's research questions and informed the semi-structured interview question protocol. A narrative inquiry design was used for this study with three Experts in the Field and the seven Focal Participants.

**Narrative inquiry design.** Narrative inquiry allows the researcher to listen to participants' narratives, study, then retell those stories in a narrative form (Clandinin & Connelly, 2000). Using a *semi-structured* interview approach within a narrative inquiry design can help the researcher explain possible patterns found within participants' responses and assumes participants' perspectives are unique and diverse (Clandinin & Connelly, 2000; Holly et al., 2009; Merriam, 2009). Because people are unique, demographic and contextual information regarding participants' work history, Ed.D. track selection, and number of neuroeducation courses with the Ed.D. program attended was gathered.

This study attempted to capture the unique and diverse experiences of individuals within an Ed.D. graduate program. Conducting a study that involves human social relationships, interactions, and experiences is tricky as each of these things are unique, diverse, and complex (Denzin & Lincoln, 2005; Merriam, 2009). In order to interpret the meanings within the narratives shared from the Experts and Focal Participants within this study, qualitative research principles, such as narrative inquiry design, are appropriate (Clandinin & Connelly, 2000; Denzin & Lincoln, 2005; Merriam, 2009). Using a qualitative research approach allows the researcher to connect theory with specific exploratory questions to further investigate observed phenomena (Brun, 2016). This study used a narrative inquiry design to capture participant experiences around learning theories used within the adult learning class with a neuroeducation perspective of learning by listening to their personal stories within unique professional contexts.

### **Learning Environment and Participants**

**Learning Environment.** The university is an independently governed Catholic university in the Pacific Northwest serving a community of more than 4,000 students. The adult learning class was conducted within the doctoral program once-a-week for 2 hours and 45 minutes over a 14-week semester. The class was instructed by a tenured faculty member with expertise in the field and drew on the neurobiological principles of adult learning in addition to concepts related to individual, group, and organizational dynamics. The intent of the course was to utilize and strengthen educators' ability to design and evaluate structural dimensions held within organizations and enhance individual and interpersonal efficacy and cooperation. Within the course, Focal Participants explored the science behind andragogy and analyzed the application of andragogical-based, scientific principles into organizational dynamics. The course was specifically designed to assist students' development of deep knowledge and learning

around course concepts and students' ability to connect learning theory to practice. The instructor incorporated neuroscience, cognitive psychology, and language theories, as a part of the neuroeducation model used to translate adult learning theories.

**Participants.** Two different groups of participants are examined in this study. The first group of participants are the *Experts in the Field* (also referred to as *Experts*) and the second group are the *Focal Participants*. Each group of participants have been purposefully selected based on specific criteria. Information about the university and the participants have been anonymized in order to protect both Experts' and Focal Participants' identities. Pseudonyms will be used to protect Experts' and Focal Participants' identities when referencing their narratives later in Chapter Four; in addition, Focal Participants Ed.D. concentrations will either be referred to neuroeducation or non-neuroeducation within Chapter Four to further protect their identities.

**Experts in the field.** Three Experts were selected to be in this study based on the specific criteria: 1) the Expert had graduated from the pacific northwest university's Ed.D. program with a concentration in neuroeducation; 2) the Expert was not from the same cohort as the Focal Participants in this study; 3) the Expert worked during the time of this study with adult learners or had previously worked with adult learners; and 4) the Expert's instructional practice utilized components of learning grounded in neuroeducation The researcher initially contacted three participants who met the previous Expert criteria; all three participants chose to participate in this study. Experts were asked to reflect on the impacts of their background in neuroeducation in their professional and personal lives. Experts' identities throughout the dissertation were protected with pseudonyms. Expert, Mary, worked as a language instructor for K-12 learners and post-secondary learners and instructed in-service/ pre-service educators. Mitch, worked as an administrator within a K-12 school, had experience doing professional development for K-12

educators, and had experience as an invited presenter within post-secondary education settings. Barb, worked as a K-12 educator and had experience as a post-secondary adjunct professor.

***Focal participants.*** Seven Focal Participants were selected to be in the study based from specific criteria: 1) to have been an Ed.D. graduate from the pacific northwest university; 2) to have graduated from a different cohort than the Experts; and 3) to have taken the adult learning class with the updated and refined learning content. The researcher initially contacted 13 potential participants who fit the Focal Participant criteria; of the 13 potential participants contacted, three did not respond to the several invitations to participate in the study and three potential participants responded and stated they were unable to participate. The seven Focal Participants in this study were the first to participate in the adult learning class when neuroeducation was fully incorporated. For example, Ed.D. students within the initial cohorts of the program did not have the benefit of critiques, refinement, and improvement to the adult learning class based from previous students' or instructors' course evaluations. Further, the adult learning class initially changed from having too much focus on neuroscience literature and then too little focus on neuroscience literature. An appropriate amount of neuroscience literature was determined by the instructor based from previous cohorts' background and understandings of neuroscience prior to attending the course. Content in the adult learning class received by the Experts' cohorts were different compared to Focal Participants' cohort. Focal Participants received content that was administratively changed to include organizational dynamic literature, which Experts had not received. Content from the Focal Participants' cohort also had the opportunity to be refined through instructors' revisions and students' evaluations. Focal Participants were asked to reflect on their experiences from an adult learning class which incorporated neuroeducation learning theories on their professional and personal lives. In order

to protect each of the Focal Participants' identities throughout the dissertation, pseudonyms were used.

All seven Focal Participants worked in an area of education (e.g., K-12 educator or K-12 administrator or post-secondary education educator) and three out seven Focal Participants had an Ed.D. neuroeducation concentration. Focal Participant, Mike, worked as a K-12 administrator and had a non-neuroeducation concentration. Xeng, worked as a K-12 educator and had a concentration in neuroeducation. Leonna was a post-secondary educator and had a non-neuroeducation concentration. Cora worked as a K-12 educator support specialist and had a concentration in neuroeducation. Leighla worked as a K-12 administrator and had a concentration in neuroeducation. Elly was a K-12 educator and had a non-neuroeducation concentration. George worked as a K-12 educator and had a non-neuroeducation concentration.

Experts and Focal Participants attended the course on adult learning theory at different times, however, each time the course was instructed by the same tenured faculty member. Each time the course was instructed, the faculty member was able to apply her unique neuroeducation perspective of learning with her diverse background to help inform course instruction. The neuroeducation course used in this study uses the transdisciplinary lens of cognitive psychology, neuroscience, and language domain-specific perspectives. This neuroeducation lens is unique because it includes language. Language theory aids the translation of cognitive psychology and neuroscience literature within educational settings (Arwood & Merideth, 2017).

Experts' and Focal Participants' background information, such as profession and neuroeducation or non-neuroeducation concentration, will be noted during analysis of the interview narratives. For example, if a neuroeducation-specific term is mentioned within the narratives of only neuroeducation concentration participants, the researcher may be better able to

determine the degree of influence of the term within the adult learning class (the adult learning class included the entire cohort, neuroeducation and non-neuroeducation concentrations). By acknowledging each of the Focal Participants' area of concentration, the researcher will be able to better interpret the degree of influence of the adult learning class's content as reported in each individual narrative.

### **Instrumentation and Design**

Two separate groups of participants were involved in this study 1) a group of three participants labeled, *Experts in the Field* and 2) a group of seven participants labeled, *Focal Participants*. Semi-structured interviews were used for both groups of participants. A semi-structured interview is a qualitative method that can be used to capture participants' unique perspectives towards any given situation (Denzin & Lincoln, 2005; Merriam, 2009; Patton, 2002).

The interview protocol for the Experts within this study went through several development procedures which included alignment with literature, critiques from graduate course instructors (including the researcher's dissertation chair) and critiques from graduate students within the researcher's Ed.D. cohort as well as other Ed.D. cohorts excluding the Focal Participants' cohort. The interview protocol for the Focal Participants of this study went through even more rigorous developmental procedures which similarly included critiques from graduate course instructors and graduate students as well as had the opportunity to be refined from critiques provided by the Experts in the Field. Semi-structured interview questions for both the Experts in the Field and the Focal Participants had the same underlying themes which included 1) impacts of neuroeducation on their identities, 2) the influence of neuroeducation on their perceptions of learning, 3) how they implemented their neuroeducation perceptions in their

professional and personal lives, and 4) how the implementations of their neuroeducation-based perspectives impacts those around them.

**Experts' interview question development.** The Experts' semi-structured interview protocol (Appendix C) contained two demographic questions about their current and recent work positions as well as their interests surrounding neuroeducation; these questions were utilized to provide a context for interpretation of each Expert's individual narrative. The remainder of the Experts' interview questions pertained to their identity, their perceptions of learning, their implementation of those perceptions, the impacts those perceptions had on others, and their thoughts towards one Ed.D. adult learning class with a neuroeducation perspective of learning on adult learners. The researcher emailed the interview protocol to the Experts one day before their scheduled interview. Experts were instructed to simply review the questions for reflective purposes and were not expected or directed to prepare their thoughts in writing. The Focal Participants' semi-structured interview question protocol (Appendix G) were critiqued by the Experts and refined by the researcher as needed prior to administration. Demographic questions for the Experts were phrased in a way that would elicit a conversation instead of structured question-and-response- so that Experts' responses would be more natural and conversation-based (Appendix D).

Each semi-structured interview question is connected with or supported by literature provided in Chapter Two. Questions one through four, for both Experts and Focal Participants, are guided by the same themes (i.e., identity, perceptions of learning, implementation, impacts) and therefore are supported by the same literature, however, question number five was specific to the Experts and served as a support towards any Focal Participant response surrounding no influence based from the adult learning course with the neuroeducation perspective of learning

on Focal Participants' identity, perceptions of learning, implementation changes, or impacts of implementation strategies.

Question number one focused on how Experts viewed themselves or their belief systems in relation to the neuroeducation perspective of learning they had acquired from the Ed.D. program. Gregory and colleagues (2014) as well as Grine and Stewart (2012) stated that it is important for educators to reflect on their self-efficacy and their belief systems as an educator's self-efficacy and belief systems impact the things they do in the classroom. Similarly, Bruner (2001) and Burns (1992) said educators must understand their own perceptions as their perceptions influences their interactions with their students.

Question number two focused on Experts' perceptions of learning as applied to themselves, K-12 learners and adult learners. An educator's perceptions of learning influence the types of instruction they use in the classroom and influences the likelihood of student success (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998).

Question number three focused on how Experts implemented their perceptions of learning, as influenced by a neuroeducation perspective of learning, into various settings such as their professional and personal lives. Similarly related to question two, question three highlighted the connection between educators' perceptions of learning, the instructional practices used in the classroom, and the impacts on students (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998).

Question four considered Experts' perceived impacts of the neuroeducation-related implementations into their professional and personal lives. Similarly related to questions two and



three, question four re-highlighted the connection between educators' perceptions of learning, the instructional practices used in the classroom, and the impacts on students (Alvidrez & Weinstein, 1999; Calderhead, 1996; Goddard et al., 2000; Gottfried, 1985; Leibbrand & Watson, 2010; Ross, 1994; Skinner & Belmont, 1993; Sweet et al., 1998).

Question five, specific to the Experts, explored the possible reasons of the adult learning class with the neuroeducation perspective of learning not having an impact on Focal Participants' perceptions of learning or causing them to implement a change into their various professional and personal settings. For example, one adult learning class may not have provided enough time or provided enough information to influence specific adult learners (e.g., adult learners who were non-neuroeducation concentration) to change their thinking or practices, especially if the adult learning class was the adult learners' first experience to neuroeducation-related terms and concepts.

**Experts' role in refinement of Focal Participants' semi-structured interview questions.** Experts received the Focal Participants' semi-structured interview questions one day before their scheduled interview. The researcher utilized Experts as an additional source of critique to help refine the Focal Participants' semi-structured interview questions. The adult learning class with the neuroeducation perspective of learning was one of the core classes required within the Pacific Northwest University's Ed.D. program, therefore, for some of the Focal Participants (Mike, Leonna, Elly, and George) this adult learning class was their first experience with neuroeducation. The purpose of the Experts' refinement process was two-fold: 1) to help the researcher identify terms within questions that may have been too content-specific for Focal Participants who were non-neuroeducation concentration (e.g., transdisciplinary, neuroeducation, perceptions of learning) and 2) to help give the researcher an estimated time of

completion for the Focal Participants' interviews for consistency amongst Focal Participants' responses and chance of in-depth responses for both neuroeducation and non-neuroeducation Focal Participants. For example, if a Focal Participant without a background in neuroeducation does not fully answer or wants to skip over one of the questions, the researcher will move forward with the interview and return to that question later on, as time permits, reword the question so that the Focal Participant can contribute a response to that question. By rewording questions that may be initially difficult for non-neuroeducation concentration Focal Participant, the researcher ensures that responses are not one-sided or biased towards Focal Participants who were in the neuroeducation concentration.

**Focal participants' interview question development.** The semi-structured interview questions for the Focal Participants contained both demographic questions about their previous work position while taking the adult learning class with the neuroeducation perspective to learning, their work position during this study, their interests surrounding neuroeducation, and whether or not they were neuroeducation or non-neuroeducation concentration. Similar to the Experts' questions, interview questions pertained to their identity, their perceptions of learning as they related to the adult learning class with the neuroeducation perspective to learning, their implementation of those perceptions, and the impacts those perceptions had on others. The researcher sent the Focal Participants their semi-structured interview questions one day before their scheduled interview so they could read, review, and reflect on the adult learning class and how it had impacted them during that time. Focal Participants were instructed to simply review the questions for reflective purposes and not for concluding their thoughts in writing. Similar to the format of Experts' questions, the demographic questions for the Focal Participants were phrased in a way that would elicit a conversation to learn more about their work settings and to

help the researcher gain an understanding of their background as it related to neuroeducation (Appendix G). Demographic phrases asked them to reflect back to the adult learning class with the neuroeducation perspective to learning.

As stated earlier, Focal Participants' questions one through four purposefully aligned with literature in Chapter Two. Focal Participants did not receive question number five, as question five was specific to Experts who were all neuroeducation concentration. Focal Participants were both neuroeducation and non-neuroeducation concentrations; question five addressed whether or not an adult learning class would impact neuroeducation and non-neuroeducation concentrations.

### **Data Collection**

The researcher used semi-structured interviews with both Experts and Focal Participants and conducted member checks with only the Focal Participants in the study. All semi-structured interviews were conducted individually by the researcher for each of the three Experts and each of the seven Focal Participants. Interviews were recorded using an audio recorder, and handwritten notes were taken by the researcher during each interview. The interviews with Focal Participants were member checked for accuracy over the phone or in-person. The interviews with Experts and Focal Participants occurred between September 2018 and November 2018. Semi-structured interviews were conducted with two different, criteria-based groups of participants, Experts in the Field and Focal Participants, in order to align data between their narratives; themes found within the literature were then aligned with those from both group's responses to the semi-structured interview questions related to the purposes of this study: to investigate the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b)

perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings

**Procedures with Experts.** The Experts in the Field were first to receive the email confirming their participation in the study. The email included information about the purpose of the study, the Experts' role in this study, how findings would be disseminated, how anonymity would be accomplished, and also included a consent form (see Appendix B). The researcher provided the same information within the phone call as was in the initial email (e.g., purpose of the study, etc.) and directed the expert to electronically sign their consent in the email and send it back to the researcher signifying their willingness to participate in this study.

The researcher individually called ( $n = 2$ ) and met in-person ( $n = 1$ ) with Experts, audio recorded, and took hand-written notes for Experts' responses to the semi-structured interview questions as well as their comments for refinement of Focal Participants' semi-structured interview questions. To ensure the questions were understood by the Focal Participants (gaining Focal Participants' highest quality responses) the wording within the questions of the semi-structured interview, such as "Neuroeducation," and key phrases such as, "perceptions of learning" were examined by the researcher and Experts in the Field. The questions followed Patton's (2002) six recommendations for *good questions* to ask during an interview: questions should be experience, opinion-, feeling-, knowledge-, sensory-, and background-based. Examining the quality of the interview questions before the interview took place increased the likelihood of quality responses from the Focal Participants and increased the overall credibility of the study and its findings (Merriam, 2009; Patton, 2002).

Experts' audio recordings were saved within a recording app on the researcher's mobile device and laptop which were password-protected and in the sole possession of the researcher. Transcriptions from Experts' responses were coded using an open coding method. Qualitative researchers use open coding as a method to label the concepts or ideas made within the gathered data, which then can be more easily analyzed and compared (Miles, Huberman, & Saldaña, 2014).

**Procedures with Focal Participants.** The Focal Participants received an email which confirmed their participation in the study and also included information regarding the purpose of the study, how findings would be disseminated, how anonymity would be accomplished, and was accompanied with a consent form. The researcher provided the same information, over the phone, about the study in the email and directed the focal participant to electronically sign their consent form attached in the email and then send it back to the researcher signifying their willingness to participate.

The researcher individually called ( $n = 4$ ) or met in-person ( $n = 3$ ) with Focal Participants and audio recorded the responses to the semi-structured interview questions with an audio recording app on the researcher's mobile device. Interview responses were secured using password protection on the researcher's mobile device and laptop which was solely in the possession of the researcher. The researcher's hand-written notes and transcriptions of the audio recordings from the interviews with Focal Participants were coded using an open coding method (Miles et al., 2014). Member checks with Focal Participants were conducted after the researcher transcribed and coded, their responses. Member checks were also audio recorded for validity purposes and acted as an opportunity for Focal Participants to extend or clarify themes that were generated from the semi-structured interviews.

Member checks were conducted with the Focal Participants after the semi-structured interviews had taken place and themes were coded by the researcher. Member checks ensure participants' responses are accurate and free of any researcher bias (Creswell, 2014; Merriam, 2009; Miles et al., 2014; Saldaña, 2016). The member checks were conducted individually with Focal Participants after the researcher had transcribed and coded themes within each response. The researcher presented the themes to the Focal Participants and captured their extended thoughts on the themes. The member checks were also audio recorded and accompanied by hand-written notes as well. Any changes, due to additional information provided within the member checks, to the Focal Participants' responses were incorporated in the results section of Chapter Four.

### **Data Analysis**

Semi-structured interviews were used with both Experts and Focal Participants in order to capture participants' narratives within their contexts. The common context of this study centered around the adult learning class with the neuroeducation perspective of learning (see Learning Environment and Participants section), which each group attended in a different semester. The audio recordings were transcribed with an online transcription tool called Rev and were stored in the researcher's password-protected computer. The online transcription service, Rev, follows the General Data Protection Regulation (GDPR) best practices for handling personal or confidential information and does not share or sell any information (Rev, 2019).

Narrative inquiry requires the researcher to tell each participant's story or narrative (Clandinin & Connelly, 2000). To help ensure accurate and complete documentation of participants' stories, the researcher re-listened to audio recordings while cross-checking each typed transcription and referencing hand-written notes made during that interview. For the

transcripts of each individual participant, an *Open coding* method was used for the first cycle of data coding and a *focused coding* method was used for the second cycle of data coding (Saldaña, 2016). Open coding separates qualitative data into distinct parts, allows for close examination of the parts, and compares the parts for similarities and differences; focused coding occurs after the initial round of coding and searches for frequently occurring or significant themes within and across narratives (Saldaña, 2013; 2016). The researcher also used *audit trails* to help categorize themes within participants' responses and was used for continued reflection on decisions made surrounding themes and categorization. Audit trails are records or journals which show researchers' decisions made for categorization during the coding process (Patton, 2002). Miles and colleagues (2014) place value in labels derived from coded qualitative data, as labels help assign descriptive, symbolic meaning.

Coded transcriptions of Experts' and Focal Participants' responses helped the researcher label and generate themes which were then cross-referenced to the purpose of the study. Themes within and across Focal Participants' narratives were aligned to the themes within and across Experts' narratives. The themes within Experts' and Focal Participants' narratives as well as the themes within the Chapter Two literature centered around the effects of a neuroeducation perspective of learning on adult learners' identity, perceptions of learning, implementation of those learning theories, and the impacts of those implementations into their professional and personal lives. The results of these data analysis procedures including Experts' and Focal Participants' themes will be discussed in Chapter Four of this study.

### **Role of the Researcher**

The researcher believes that both positive and negative experiences within education largely contributes to students' self-identities, self-worth, and self-efficacy. In other words,

students who receive negative messages, from their educators, year after year regarding their poor academic performance or unacceptable social behaviors displayed in school, start to develop negative self-identities, failure or quitting is normal, and learning is not fun. On the other hand, students who are successful in school (academically and socially) may have the exact opposite experiences, wherein students are likely to develop positive self-identities, every goal set by the student or their educator seems attainable, and learning is viewed as fun.

For the researcher as a K-12 and early post-secondary student, receiving negative messages was the norm. Although, growing up, the researcher never displayed atypical or antisocial behaviors within school, he simply felt as though he was not a smart student. A variety of reasons made him feel this way such as his yearly report cards which labeled him as either average or below average, his teachers generally only focused on his areas of improvement, always focusing and practicing on his areas of weakness, instead of identifying and utilizing his strengths to build up his weaknesses. Interestingly, the researcher grew up and found himself studying to become an educator. His passion to understand *learning* and its application into the classroom became one of his primary priorities. Further, the researcher believes no student should be made to feel inadequate or incapable of accomplishing their dreams and every student should be allowed to utilize their unique strengths to learn and grow as individuals. Progressing through his educational career, the researcher invested himself in the neuroeducation program at the university located in the pacific northwest. In the researcher's opinion, he feels as though the neuroeducation program's incorporation and translation of learning literatures across multiple domains of study (cognitive psychology, neuroscience, language acquisition) wholesomely represents student learning and effectively acts as an advocate for utilizing student strengths in education versus students' weaknesses.



The researcher's interest in effective and positive student learning led him to pursue the neuroeducation program within the Pacific Northwest University and could be considered a bias of this study. Throughout the study, the researcher reflected on his beliefs surrounding the effectiveness of neuroeducation perspectives of learning and instructional practice on students' academic, social, and emotional well-being as well as the positive impacts of the neuroeducation perspective of learning on educators' perceptions of learning and instructional practices. The researcher also reflected on his beliefs surrounding the effectiveness of the neuroeducation perspective of learning towards his interpretations of the study's results. It is important for educators to reflect on their beliefs surrounding learning in order to increase students' likelihood of success (Bruner, 2001; Burns, 1992; Goddard et al., 2000; Sylwester, 1995). The researcher understood that his bias towards the effectiveness of the neuroeducation perspective of learning allowed for bias in the study's findings, which raised issues of trustworthiness.

The primary roles of the researcher within this study were to access participants' thoughts and feelings through narrative inquiry as well as to protect participants' identities within the study (Creswell, 2014). The researcher previously stated his bias towards neuroeducation within this section and throughout the study continuously reflected on the themes revealed in participants' narratives through audit trails (Creswell, 2014).

### **Issues of Trustworthiness**

In order for qualitative researchers to conduct trustworthy studies with respectable findings, specific criteria centered around validity and reliability must be addressed (Guba, 1981; Miles et al., 2014). Guba proposed four criteria that each qualitative study should include in order to make it trustworthy: credibility, transferability, dependability, and confirmability.

**Credibility.** One criteria that should be used within a qualitative study to help increase trustworthiness to its findings is credibility (Merriam, 2009; Shenton, 2003). Credibility seeks to ensure that the study is measuring what it is actually intended to measure. One way to measure credibility is by triangulating research (Shenton, 2003). Triangulation increases the trustworthiness of a study's findings by showing that at least three independent components support the study's findings (Miles et al., 2014). Triangulation can use different research methods (e.g., observation, focus groups, interviews, research) or use different research and literature within different domains of study (e.g., cognitive psychology, neuroscience, language). Within this study, the researcher triangulated the findings by aligning Focal Participants' responses to semi-structured interview questions with Experts' responses, and research in Chapter Two.

Further to the credibility of this study, throughout the process of conducting this study, the research was provided with opportunities for scrutiny and feedback by various colleagues and peers within the doctoral program. Feedback was based on the researcher's findings, research methods, and background knowledge of literature after several presentations and reviews of the study had been conducted. Peer scrutiny was used as a form of constructive advice to help the researcher refine and expand his reasoning regarding the study which consequently helped increase the credibility of the study as well (Merriam, 2009; Shenton, 2003).

**Transferability.** Qualitative research tends to be very specific which may complicate the transferability of the findings from one study to the next (Merriam, 2009). For example, this study looked at two specific groups of graduate students and asked them questions in regards to a specific class within a doctoral program at a university located in the pacific northwest. Conducting a qualitative research study that is specific or unique to a given moment should be

done with caution so other researchers and professionals can utilize the findings in different situations (Merriam, 2009; Shenton, 2003). To increase the likelihood of the transferability of the study's findings, researchers Cole and Gardner (1979) and Marchionini and Teague (1987) compiled a list of information regarding a study's boundaries:

1. The number of organizations participating in the study and their locations;
2. The restrictions associated with the participants within the study;
3. The number of participants involved in the fieldwork;
4. The methods used to collect data;
5. The length and number of data collection sessions within the study;
6. The amount of time it took to collect data (Cole & Gardner, 1979; Marchionini & Teague, 1987).

The boundaries within this study were: (1) one organization participated (a university located in the pacific northwest); (2) each Expert and Focal Participant was asked to reflect on previous experiences held within an adult learning course; three out of the seven Focal Participants had received previous neuroeducation courses prior to taking the adult learning course with the neuroeducation perspective of learning, which made distinguishing between the three Focal Participants' previous neuroeducation courses and the influence of the adult learning course on their responses more difficult; (3) there were two groups of participants within this study: three Experts and seven Focal Participants; (4) the researcher used an audio recorder app on his mobile phone to record, then transcribed Experts' and Focal Participants' responses with an online transcription service called Rev; the researcher also had hand-written notes from the semi-structured interviews; (5) Experts participated in one semi-structured interview and a refinement process of the Focal Participants' semi-structured interview questions which averaged

about 35 minutes; Focal Participants participated in one semi-structured interview session which averaged about 30 minutes and one member check which averaged about 20 minutes; and (6) the researcher collected data first with the Experts which started in late September and ended in early October and started collecting data for the Focal Participants mid-October and ended in early November.

**Dependability.** Another criterion which helps increase a study's trustworthiness is its dependability. Dependability means being able to conduct a study, using specific techniques, with specific participants, and generating specific results, then being able to use those same techniques, with the same participants, and still getting the same results (Merriam, 2009; Shenton, 2003). However, since qualitative research is conducted on phenomena that often changes, in this case participants' perspectives towards learning, dependability is difficult to ascertain. How does a researcher truly know if the results he or she found were not simply based on chance or researcher bias? To address issues of dependability, the processes utilized in the study should be documented in detail, allowing researchers conducting duplication studies to investigate and compare the similarities or differences in their findings with the study being duplicated (Merriam, 2009; Shenton, 2003). Within this study, the researcher identified the specific method (i.e., semi-structured interviews) used to conduct the study and shared the forms of communication and protocols the researcher used for initial and continued contact with both groups of participants (see Appendices A-H).

**Confirmability.** Qualitative researchers often bring unique perspectives to their studies (Merriam, 2009). Therefore, confirmability ensures the results of a qualitative study could be confirmed by other researchers holding different perspectives, increasing the trustworthiness of the study (Merriam, 2009). To place confirmability into a study, steps must be taken by the

researcher to ensure that the study's findings are the results of participants' experiences, not the researcher's experiences (Merriam, 2009; Shenton, 2003). In Appendix I, the researcher provided Focal Participants' and Experts' narratives related to each research question for reference and to aid in confirmability. Also, as a means to increase the confirmability within a study, researchers Miles and colleagues (2014) suggest that the researcher displays his or her own predispositions or biases towards the topic of the study. Displaying researcher bias helps other researchers make more informed decisions regarding their interpretations of the methods and the study's findings. The researcher addresses his bias towards the topic of the study within the Role of the Researcher section, mentioning his background and motivation for wanting to have a deeper understanding of learning and what learning can look like for all students.

### **Ethical Considerations**

The Institutional Review Board (IRB) granted permission to conduct this research study on September 14, 2018. An initial consent form to participate was given to each person participating in the study (see Appendix B and F), signifying their acceptance to participate in the researcher's study, to their best ability, truthfully respond to interview questions, and to be informed of the study's results when finished. A written information sheet was provided to each participant via email to re-signify their participation in the study (see Appendix A and E) as well as provide them with information about the study and voluntary participation. The researcher also placed value in the protection of individuals' identities who participated in the study. One way the researcher protected experts' and Focal Participants' identities was through anonymization of experts' and Focal Participants' cohort numbers and university name. Pseudonyms were also used to protect the identities of experts and Focal Participants in the

study. Finally, all data collected from the experts and Focal Participants was secured within the researcher's work laptop and mobile device, which are password protected.

### **Chapter Summary**

This chapter shared the methodology used to conduct this study as well as the rationale for the chosen methodology. The study's design and data analysis procedures were also included. Guba's (1981) criteria that qualitative studies should follow: credibility, transferability, dependability, and confirmability were explored; assurances were made to address researcher bias and allow for individual participant voices to be heard.

### Chapter Four: Results

This chapter reports the results of this narrative inquiry conducted over a ten-month time period with recursive reflective interactions with the data and literature to triangulate the responses of expert neuroeducation practitioners, participants in a neuroeducation-based doctoral course, and established scholars in the field. The results that follow are guided by the four research questions:

1. How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?
2. How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?
3. In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?
4. In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?

Both groups, *Focal Participants* and *Experts in the Field*, were interviewed using similarly-focused, semi-structured interview questions (see Appendix C and G). Narratives were transcribed based from participants' responses to the semi-structured interview questions (see Appendix I), then analyzed using first-round open coding and second-round focused coding methods to highlight themes based from participants' responses to semi-structured interview questions. The following results include the themes from Focal Participants' and Experts' narratives that reflect most directly each research question and the impacts on participants for each question. Within the Focal Participant group, neuroeducation and non-neuroeducation concentration groups' responses were compared to better understand the impact that various

levels and understandings of neuroeducation had on participant's thinking and behaviors. Several of the tables included the question's intended focus. Some data and results from sub-questions were not included due to a lack of participant response or non-applicability to participants' professional or personal lives. To begin, Focal Participants' and Experts' background information, transcribed at the beginning of each semi-structured interview, is provided to orient the reader to the unique context of each participant.

### **The Focal Participants: Background Information**

At the beginning of the semi-structured interview, the researcher collected Focal Participants' contextual background information to inform the analysis of their responses to the semi-structured interview questions. The researcher asked Focal Participants to reflect back to the adult learning class with the neuroeducation perspective to learning and stated: *Tell me about your job while taking the adult learning class...*, *Are you currently employed? (If so, tell me about your current job) ...*, *Tell me about your interest in neuroeducation...*, and *How many Ed.D. neuroeducation courses did you take?* Focal Participants' narratives in response to these contextual background phrases are listed below.

#### **Mike**

While enrolled in the Ed.D. program at the university in the Pacific Northwest, Mike was working as an assistant principal in a K-12 public education setting in a school district located in the Pacific Northwest. He oversaw both the curriculum and counseling domains within his school. Mike's responsibilities included reviewing all curriculum, implementing new curriculum, and making sure that what was being taught in the classrooms aligned with the learners' experiences. In overseeing counseling, his responsibilities included making sure the students' emotional, psychological, and intellectual needs were met. Mike's track selection within the



Ed.D. program was non-neuroeducation, therefore, Mike only received one neuroeducation course, the target adult learning class with the neuroeducation perspective to learning. Mike noted that within his Ed.D. cohort, over half of his cohort members had selected the neuroeducation track, so he had heard, informally, about neuroeducation before the adult learning class with the neuroeducation perspective to learning.

### **Xeng**

While enrolled in the Ed.D. program at the university in the Pacific Northwest, Xeng worked as a teacher-support specialist in a K-12 school district. She served students who had specific language disabilities. She provided evaluation services for those students within the school setting and communicated with the students' parents, providing them with information regarding various language-related services they may need outside of the school setting. Xeng heard about neuroeducation from a workshop her school district provided where she gained neuroeducational learning, applicable to her profession. Before the workshop, Xeng noted, she did not have the words to be able to express the type of learning which was presented. Xeng said, "Yes! Yes! Finally, this is how it [learning] happens." When she reflected on her profession, Xeng recognized that she had seen only a small group of people who were thinking about pragmatics and social learning.

...nobody was looking into the function of language, and what language allows us to do... when she [the presenter at the workshop] started talking about that, and about some of how we learn to draw up to like visual learners, I was just like, 'Holy moly. Where has this been all my life? This is it... everything came together.'

Later that spring, Xeng had enrolled for the post-masters, neuroeducation courses and therefore chose the neuroeducation area of concentration when she began her Ed.D. program.

**Leonna**

Leonna worked as director of teachers at a post-secondary level while she attended her Ed.D. program. She worked with undergraduate and graduate students who were studying to become teachers or continue their education as a teacher. She taught a number of teacher education courses and supervised student teachers in the classroom. As an Ed.D. student, Leonna's track selection was non-neuroeducation, therefore, the adult learning class with the neuroeducation perspective of learning was the only neuroeducation course that she had received.

**Cora**

Cora worked as a teacher support specialist while she attended the Ed.D. program located in the pacific northwest and served K-12 students. Cora's track selection within the Ed.D. program was neuroeducation. Cora had a general interest in the brain and best ways to implement brain-related knowledge prior to taking the Ed.D. program. Her professional role after she graduated from the doctoral program was as a district administrator supporting K-12 support specialists where she helped coordinate the types of activities the support specialists did. She also served as an adjunct professor in a post-secondary setting.

**Leighla**

While enrolled in the Ed.D. program at the university in the pacific northwest, Leighla worked as a district administrator within a K-12 school district. As a district administrator Leighla worked mostly with various educational professionals and administrators. Her track selection within the Ed.D. program was neuroeducation and she heard about the neuroeducation program from her numerous searches online related to language acquisition. Leighla noticed that a lot of her training as an educator, prior to taking neuroeducation classes in the Ed.D. program,

did not include the neuroeducation lens and that she had never considered the impact of having a neurobiological understanding of learning towards language acquisition. The neuroeducation perspective of learning was new to Leighla and helped “open up a new world” for her as an educator.

### **Elly**

While enrolled in the Ed.D. program, Elly worked as a K-12 educator. One role Elly fulfilled was as a member of the intervention committee at her school which helped at-risk learners through the facilitation of instructional interventions when “the norm” for classroom instruction and intervention strategies did not work. In addition, Elly assisted with equity-related work in her school which included the inclusion of social and emotional learning into the school’s curriculum. Elly’s track selection with the Ed.D. program was non-neuroeducation and therefore she only received the target neuroeducation class with the neuroeducation perspective of learning while in the program.

### **George**

George worked as a K-12 educator while he attended the Ed.D. program located in the pacific northwest. His track selection within the Ed.D. program was non-neuroeducation, therefore, he had only taken the target neuroeducation course, the adult learning class with the neuroeducation perspective.

### **The Experts in the Field: Background Information**

At the beginning of the semi-structured interview, the researcher collected Experts’ contextual background information to inform the analysis of their responses to the semi-structured interview questions. Experts’ responses to semi-structured interview questions were used as a point of alignment for Focal Participants’ responses to semi-structured interview

questions. Experts were chosen to be in this study based on their concentration in neuroeducation, implementation of neuroeducation-related practices into their profession, experiences working with adult learners, and from being in a different cohort than Focal Participants. The researcher asked Experts to reflect on their current job as well as their background in neuroeducation. Demographic phrases included: *Tell me about your current job...* and *Tell me about your interest in neuroeducation...* Experts' narratives in response to these contextual background phrases are listed below.

### **Mary**

Mary has over eight years' worth experience teaching as an English as a Second Language (ESL) educator in a K-12 education setting and one year of experience instructing in a post-secondary setting working with in-service and pre-service educators. Mary noted that before applying to the Ed.D. program at the pacific northwest university, she never heard of the term neuroeducation, but that her previously-established interest in language acquisition, continued studies in psychology, and her observed student-displayed need for effective instructional practices, drove her to explore the neuroeducation program. Mary stated:

I'm very interested in language acquisition; however, I realized that to be a teacher and know about those terms, those terminologies, the skills of teaching is not good enough. I need to really help students learn. I saw the need in my students.

Mary mentioned that when participating in the neuroeducation program, the program helped open her eyes to the value of combining psychology theory and practice with that of language acquisition's theory and practice. The neuroeducation program allowed her to build from her previous experiences and interests with language acquisition. Mary mentioned that the

neuroeducation program taught her more about, "...how learners from different backgrounds interpret meanings;" and helped her transfer understandings of learning a language from her previous education and training. Moving from training focused on surface structures for helping ESL students learn a language to a focus on deep language structures through a neuroeducation lens was a new perspective for Mary. Mary's Ed.D. concentration was neuroeducation, so she had taken the required amount ( $n = 6$ ) of neuroeducation courses from the pacific northwest university serving as the context for this work.

### **Mitch**

Mitch is an assistant principal serving within a K-12 public school setting with experience as a K-12 educator. He has additional experience in educational counseling with adult learners and experience with co-teaching at a post-secondary level. He currently is part of a year-long effort within a pacific northwest school district to utilize neuroeducation principles in an attempt to help adult learners who serve as educators. Mitch noted that he heard about neuroeducation from other friends and colleagues who attended neuroeducation workshop conferences to improve their instruction. He appreciated the combination of psychology, neuroscience, and linguistics (i.e., language acquisition) in helping him become a better teacher.

I think linguistics and psychology and neuroscience are all interesting things, so throw those together and help me be a better teacher and help better the experience of students and the adult, who try and serve them. That's totally something that I want to do. I was very excited to find out about that and as I continued to find out more, I really felt like I had made the right choice for me.

Mitch's Ed.D. concentration was neuroeducation, therefore he took the required amount ( $n = 6$ ) of neuroeducation courses from the Pacific Northwest University serving as the context for this work.

### **Barb**

Barb has over 19 years of experience serving as an educator for multiple grade levels within a K-12 public education setting and one year of experience teaching in a post-secondary setting. Before neuroeducation at the Pacific Northwest University was available, the current neuroeducation instructor taught classes featuring the inclusion of her background in language. Barb noted that after she attended those classes she later implemented the language-based practices into her K-12 instruction; she noted, the social and cognitive impact on her students was positive. So, when the neuroeducation program was established at the Pacific Northwest University, Barb enrolled. Barb's Ed.D. concentration was neuroeducation, so she took the Pacific Northwest University's required amount ( $n = 6$ ) of neuroeducation courses offered, serving as the context for this work.

### **Research Question #1: How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?**

The first semi-structured interview question asked to Focal Participants investigated the impact of a course on adult learning theory with a neuroeducation perspective of learning on their identities: *Did taking an adult learning class with a neuroeducation perspective of learning cause you to reflect on who you are (in other words, your belief systems)? (In what ways? or Why not?).* Similarly, the first semi-structured interview question asked to Experts investigated the impact of their background in neuroeducation on their identities: *Has a background in neuroeducation impacted who you are (in other words, your belief systems)?*

**Focal Participant Theme Related to Research Question #1**

Focal Participants' narratives regarding their perceptions of their own identities, as influenced by an adult learning class with a neuroeducation perspective of learning, revealed several themes related to neuroeducation and approaches to learning; however, one theme in particular, a *reflection of self and actions*, most directly relates to the first research question addressing identity.

**Reflection of self and actions.** Considered together, self-reflection, on themselves as learners, as individuals, and on their actions within professional settings was an important theme that appeared across all the Focal Participant narratives. Table 4.1 highlights prominent quotes from Focal Participants regarding the theme *reflection of self and actions* as a perceived impact of an adult learning class with a neuroeducation perspective of learning on their identities. These quotes illustrate the changes in Focal Participants' thinking both about their experiences as learners, as indicated by comments by Mike, Xeng Leonna, Leighla, Elly, and as individuals, as indicated by comments from Cora and George. These are all elements of identity that signify possible changes that may have occurred for these Focal Participants based from the target course. Similarly, a common theme in Experts' narratives centered around self-reflection as well.

Table 4.1

*Did taking an adult learning class with a neuroeducation perspective of learning cause you to reflect on who you are (in other words, your belief systems)? (In what ways? or Why not?)*

Focal	Participants	Prominent Quote
Mike		“I think it challenged me at my core... and the reason I say that is because I pride myself in being a lifelong learner and this particular class helped me to look at my mind and my brain.”
Xeng		“Covering different communication styles, I think that was something that I really thought, ‘Oh my gosh. I’ve got to remember why I can teach this people this way.’ And “...how can I go and bring this knowledge that I have acquired recently into a larger audience?”
Leonna		“I do remember sitting in the class and wishing that I had been taught differently when I was a child, because I kept referring back to the way I learned in my K through 8 and K through 12 education, all the misconceptions that I had as a student. I felt a bit of regret, if only I would have had a teacher who did x, y, z.”
Cora		“I was the brainy kid. So grades were really important, doing well on the test was really important. Knowing things was really important and that I saw myself as the smart kid. Right? And then taking this class you start thinking about okay, but you know if I don’t have those <i>what’s</i> , then <i>who</i> am I really and what does that mean? And so, it was interesting.”
Leighla		“...this definitely caused me to reflect on kind of my belief systems around how I view language acquisition. Also, to reflect on my journey in learning different languages.”
Elly		“it definitely opened up a new way to think about learning and how the process does have the brain component.”
George		“Separating your self-worth...the <i>who</i> , from your self-esteem and the <i>what</i> was a good point of reflection.”



**Expert Theme Related to Research Question #1**

Experts' narratives regarding their perceptions of their own identities, as influenced by an adult learning class with a neuroeducation perspective of learning, similar to the Focal Participants, included several themes that addressed topics of providing support and value-added instruction. However, the theme of a *reflection of self*, most directly relates to the first research question on identity and is therefore reported in this work.

**Reflection of self.** Cumulatively, the responses within Experts' narratives displayed thinking more deeply about themselves as individuals, their abilities as learners, how they viewed the process of learning, and how they viewed others. These concepts all speak to identity. Table 4.2 highlights prominent quotes from Experts regarding the theme *reflection of self* as a perceived impact of a background in neuroeducation on their personal and professional identities. These quotes illustrate the changes in Experts' thinking both in regards to themselves as learners, as indicated by comments by Barb, and as individuals, as indicated by comments from Experts Mitch and Mary. These are all elements of identity that signify possible changes that may have occurred for these Experts based from the background in neuroeducation.

Table 4.2

*Has a background in neuroeducation impacted who you are (in other words, your belief systems)?*

Expert	Prominent Quote
Mary	“...the neuroeducation background helped me to have me think more about myself.”
Mitch	“It tremendously shifted my understanding of how humans acquire knowledge, concepts, abilities, my own background, my own strengths, my own capabilities.”
Barb	“...the neuroeducation information has helped me really understanding, if I understand how people learn, and understanding that everybody can learn, it shifts how you think of people.

**Impact of a Neuroeducation Perspective of Learning on Adult Learners’ Identities**

Results from the first research question showed that all seven Focal Participants felt a course on adult learning theory with a neuroeducation perspective of learning caused them to reflect on areas related to their identities, such as how they viewed themselves as individuals or how they viewed themselves as learners. Focal Participants’ responses positively aligned with Experts’ responses. For example, five Focal Participants (Mike, Xeng, Leonna, Leighla, and Elly) and one Expert (Barb) spoke specifically to the impact of the neuroeducation perspective of learning on themselves as learners; two Focal Participants (Cora and George) and two Experts (Mary and Mitch) spoke specifically to the impact of neuroeducation perspectives of learning on themselves as individuals.

**Focal Participants: Neuroeducation versus non-neuroeducation.** After noting Focal Participants’ themes related to their identities, the researcher compared neuroeducation and non-neuroeducation groups of Focal Participants’ responses to expose any relationships that may exist. There did not seem to be any relationship between Ed.D. concentration area and Focal

Participants' responses in relation to how the class on adult learning theory with the neuroeducation perspective of learning impacted their identities. For example, of the five Focal Participants who felt the target course caused them to reflect on themselves as a learner to some degree, they were mixed in their areas of concentration and two of the seven who believed the course caused them to reflect on themselves as individuals came from different areas of concentration as well.

Cora (neuroeducation) and George (non-neuroeducation) stated that the neuroeducation perspective of learning presented in the class helped them identify and separate their self-worth from their accomplishments which helped them view themselves in a more positive perspective (e.g., as an individual). Though Mike (non-neuroeducation) and Elly (non-neuroeducation) had the same concentration, the influence (importance of neurobiological understanding of learning) the class had on their identities was different than the influence for Xeng (neuroeducation) and Leighla (neuroeducation) who too had similar concentrations but different influences (communication and language acquisition) (e.g., as a learner). Lastly, the impact of the course on Leonna's (non-neuroeducation) identity was different from all other Focal Participants (though was still related to younger self as a learner) and was related to a sense of regret from not knowing neuroeducation-related information earlier in her K-12 education career.

Nonetheless, a neuroeducation perspective of learning, embedded within a course on adult learning theory appeared to allow Focal Participants to reflect on components related to their identities. All Focal Participants' displayed positive impacts related to the reflection of themselves as a learner, which they attributed to the course(s) on adult learning theory.

**Research Question #2: How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?**

The second semi-structured interview question asked to Focal Participants investigated the impact of the target course and a neuroeducation perspective on how adult learners perceive learning occurs for K-12 and adult learners. The question asked: *Did a class on adult learning theory (in other words, andragogy) with a neuroeducation perspective of learning, influence how you understand the learning process occurs: a) for K-12 learners? b) for adult learners? c) within your profession? and d) within your personal life?* Similarly, the second semi-structured interview question for the Experts investigated the impact of their background in neuroeducation towards their perceptions of learning asking: *How has a background in neuroeducation influenced how you perceive learning occurs: a) for K-12 learners? b) for adult learners? c) within the field of education? and d) within your personal life?*

**Focal Participant Theme Related to Research Question #2**

Focal Participants' narratives regarding their perspectives of learning, as influenced by an adult learning class with a neuroeducation perspective of learning, revealed several themes related to perceptions of learning, however, the theme: *learning for K-12 and adult learners is the same*, will be explored as it most directly relates to the second research question.

**Learning for K-12 and adult learners is the same.** Combined together, the responses within Focal Participants' narratives displayed a common theme related to similarities for learning between K-12 learners and adult learners. In essence, Focal Participants viewing learning needs, instructional practices, the quality of instructional content, and incorporation of learners' previously learned experiences into instruction to aid new learning, for K-12 learners and adult learners as being similar, were common themes within their narratives. Table 4.3

displays Focal Participants' prominent quotes in response to the theme: *learning for K-12 and adult learners is the same*, as the theme related to the influence of a course on adult learning theory with a neuroeducation perspective of learning on their perceptions of learning. These quotes illustrate the influence of the target course on Focal Participants' perceptions of learning for both K-12 learners and for adult learners, as indicated by comments by Elly, surrounding the use of learners' experiences for new learning, George, Mike, Xeng, and Leighla regarding the use of visual-based strategies for all ages of learners, and from Focal Participant Cora surrounding the importance of information being meaningful, practical, and relevant for learners. The theme of learning being the same for K-12 learners and for adult learners was not noted within Focal Participant Leonna's narratives. These are all elements of Focal Participants' perceptions of learning for K-12 learners and adult learners that signify possible influences that may have occurred based from the target course. Similarly, a common theme in Experts' narratives centered around learning being the same for all ages of learners as well.

Table 4.3

*Did a class on adult learning theory (in other words, andragogy) with a neuroeducation perspective of learning, influence how you understand the learning process occurs: a) for K-12 learners? b) for adult learners? c) within your profession? and d) within your personal life?*

Focal	Participants	Prominent Quote
Mike		“...we have to start over; introduce to them [adult learners] as though they are second or third grade learners; drawing to reach the visual learners...drawing is so vital for how we understand...”
Xeng		When Xeng referenced learning for adult learners and compared it with learning for K-12 learners she stated, “... it was the same idea... I still can’t just spout out information, and assume that they’re going to get it without context or anything, which is sometimes the platform we use a lot in professional developments or whatever.”
Leonna		Did not mention a similarity for learning for K-12 learners and adult learners.
Cora		When Cora referred to information that was meaningful, practical, and relevant, she said, “oh my gosh, well you know that this is what adults need and want or they will check out. Why do we somehow think that that’s not what kids need and want or they’ll check out?”
Leighla		“When we do professional development for teachers, we actually utilize a lot of the visual Viconic learning methods... because for myself I was able to reflect on, okay, how am I as a learner and if I also need visuals; If I’m a visual learners, if I need things broken down then all students need that...”
Elly		“I don’t care if it’s an adult learner or if it’s a child learner. What you bring to the table is your experiences.”
George		“The learning process itself, the activities and the environment can be similar.”

**Expert Theme Related to Research Question #2**

Experts' narratives regarding their perspectives of learning, as influenced by the adult learning class with a neuroeducation perspective of learning, included several themes related to the influence of their background in neuroeducation on their perceptions of learning for K-12 learners and adult learners, however, the theme: *learning is the same for all ages* of learners, will be explored as it most directly relates to the second research question.

**Learning is the same for all ages.** Considered together, the responses within Experts' narratives revealed a common theme which centered on learning being the same for all ages of learners. Basically, the process of learning, learning being purposeful, and the quality of instructional content for K-12 learners and adult learners being the same for all ages of learners were highlighted as common themes within their narratives. Table 4.4 highlights Experts' prominent quotes related to the theme *learning is the same for all ages* which stemmed from Experts' perceptions of learning. These quotes illustrate the influence of Experts' background in neuroeducation on their perceptions of learning for both K-12 learners and for adult learners, as indicated by comments from Mitch regarding the use of visual-based strategies for all ages of learners, and from Barb surrounding the importance of information being meaningful, practical, and relevant for learners. The theme of learning being the same for all ages of learners was not presented within Expert Mary's narratives. These are all elements of Experts' perceptions of learning for all ages of learners and signify possible influences that may have occurred based from Experts' background in neuroeducation.

Table 4.4

*How has a background in neuroeducation influenced how you perceive learning occurs: a) for K-12 learners? b) for adult learners? c) within the field of education? and d) within your personal life?*

Expert	Prominent Quote
Mary	Mary did not note similarities between K-12 learners and adult learners and said, "I'm still testing neuroeducation on my adult students."
Mitch	"... what adult learners benefit from is similar to what kids benefit from and what motivates adult learners often, the opportunity for autonomy and mastery and there's some purpose in the learning really motivates younger learners too."
Barb	"I took a lot of the same principles, because the principles of andragogy are the same as for children really, which is that learning should be meaningful and relevant, honestly."

**Impact of a Neuroeducation Perspective of Learning on Adult Learners' Perceptions of Learning for K-12 Learners and Adult Learners**

Results from the second research question showed that the majority of Focal Participants showed some positive change in their thinking. For example, six out of seven Focal Participants felt a course on adult learning theory with a neuroeducation perspective of learning influenced them to believe that learning for K-12 learners and adult learners was the same. Focal Participants' representations of the similarities in learning between K-12 learners and adult learners centered around the use of learners' experiences to scaffold new information, similarities in learning strategies (e.g., visual strategies), and the quality of information given to learners (e.g., meaningful, practical, relevant). Focal Participants' responses, related to learning strategies and quality of information, positively aligned with the majority of Experts' responses.



For example, four Focal Participants (George, Mike, Xeng, and Leighla) and one Expert (Mitch) felt types of learning strategies such as visual-based strategies could be used for all ages of learners, one Focal Participant (Cora) and one Expert (Barb) felt information shared with all ages of learners should be centered around information that is meaningful, practical, and relevant, and one Focal Participant (Elly) believed using learners' previously learned experiences was important for creating new learning. Both Focal Participant (Leonna) and Expert (Mary) did not report any impact of neuroeducation perspectives of learning towards learning being the same for K-12 learners and adult learners. For example, two out of three Experts agreed that learning is the same for all ages.

**Focal Participants: Neuroeducation versus non-neuroeducation.** After noting Focal Participants' themes related to their perceptions of learning for K-12 learners and adult learners, the researcher compared neuroeducation and non-neuroeducation groups of Focal Participants' responses to highlight any relationships. There did not seem to be any specific relationship amongst the responses given by concentration group. However, four out of seven Focal Participants, from both Ed.D. concentrations, felt that similar learning strategies could be used with K-12 learners and adult learners. For example, Mike (non-neuroeducation) and Leighla (neuroeducation) both mentioned the importance of incorporating visual-based strategies (such as drawing) into classroom instruction, when information was new for K-12 learners and adult learners.

The responses of other Focal Participants varied. For example, Elly (non-neuroeducation) recognized the importance of using K-12 and adult learners' previously learned experiences to build new learning and Cora (neuroeducation) felt information shared with K-12 learners and adult learners should include information that was meaningful, practical, and relevant for new

learning to be effective. Further, Focal Participants noted a variety of similarities towards learning between K-12 learners and adult learners.

**Research Question #3: In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?**

The third semi-structured interview question asked to Focal Participants investigated the impact of the course on adult learning theory with the neuroeducation perspective of learning on their implementations of neuroeducation-based strategies. Focal Participants' question asked:

*Did taking an adult learning class (in other words, andragogy) with a neuroeducation perspective of learning cause you to change your: a) professional practice? and b) personal life?*

Similarly, the third semi-structured interview question asked to Experts investigated the ways in which Experts' background in neuroeducation caused them to implement neuroeducation-based strategies into their lives. One of the several pieces of criteria for participants to be considered an Expert was that they had implemented neuroeducation-based strategies into their instructional practices (see Chapter Three); thus Experts' third semi-structured interview question was directed at what ways they implemented neuroeducation-based strategies, not *if* they implemented any neuroeducation-based strategies. Experts' question asked: *In what ways have you implemented neuroeducation-based perspectives in your: a) educational practice? and b) personal life?*

**Focal Participant Theme Related to Research Question #3**

Focal Participants' narratives regarding implementation strategies based from their perspectives of learning, as influenced by the adult learning class with a neuroeducation perspective of learning, included the theme: *visual-based learning*. The theme: *visual-based learning*, directly relates to the third research question.

**Visual-based learning.** Combined together, the responses within Focal Participants' narratives displayed a common theme related to visual-based learning. Essentially, incorporation of visual-based learning strategies into classroom practices or acceptance of visual-based products which displayed students' learning were significant themes within their narratives. Table 4.5 displays Focal Participants' prominent quotes in response to the theme: *visual-based learning*, as the theme related to the impact of a course on adult learning theory with a neuroeducation perspective of learning on their neuroeducation-related implementations. These quotes illustrate the impact towards Focal Participants' instructional practices, as indicated by comments by Xeng, Cora, and Leighla and towards the acceptance of students' visual-based products of learning, as indicated by comments from George and Elly. The theme of visual-based learning strategies was not present in the narratives of Focal Participants Leonna and Mike, however, Leonna specified that the target course helped validate the visual-based learning strategies she was already using in her educational setting. Incorporation of visual-based instructional strategies and acceptance of students' visual-based products of learning are possible indications of the target courses' impact on Focal Participants. Similarly, a common theme in Experts' narratives centered around visual-based learning as well.

Table 4.5

*Did taking an adult learning class (in other words, andragogy) with a neuroeducation perspective of learning cause you to change your: a) professional practice? and b) personal life?*

Focal	Participants	Prominent Quote
	Mike	Did not mention implementation of any visual-based strategies.
	Xeng	“Time to make this information as highly contextualized for its adult learners and making it meaningful for them...Let’s draw that out.”
	Leonna	“I always allowed the students multiple ways to show their learning, whether it be verbal or pictures or diagrams or acting, or that’s just been kind of the way I have taught.” “I already used much of it, just because I learn through visuals...”
	Cora	“...when we’re talking about a new concept I do have that available, they have that in front of them so they could write, they could draw, they could circle things and make arrows and underline and draw pictures or whatever.”
	Leighla	“When we do professional development for teachers, we actually utilize a lot of the visual Viconic learning methods... because for myself I was able to reflect on, okay, how am I as a learner and if I also need visuals; If I’m a visual learner, if I need things broken down then all students need that...” Within her personal life, “I think it was two to three weeks of...using bubble words and the trying to do that in context and using story form, and event-based...” “then we would do things like do an art project or do a drawing...”
	Elly	“My overall approach with kids and learning and have given lots of various medium to explore... we approach it through video, we approach it through writing, we approach it through reflection, we are approaching it through verbal articulation with our partners, we approach it through interviews at home so that they can get someone else's perspective.”
	George	“... they could create a video. They can create a model. They can create a 3D model or a two dimensional model... or they can show a pictorial model of what it is and how they’re understanding the concept.”

**Expert Theme Related to Research Question #3**

Experts' narratives regarding their implementation strategies based from their perspectives of learning, as influenced by a background in neuroeducation, included several themes, however, the theme: *visual strategies*, will be explored as it most directly relates to the third research question.

**Visual strategies.** Concentrated together, the responses within Experts' narratives displayed a common theme related to visual strategies. Basically, incorporation of visual-based learning strategies such as drawing and flowcharting, used to aid students' conceptual development, were important themes within their narratives. Table 4.6 highlights Experts' prominent quotes related to the theme *visual strategies* which stemmed from Experts' implementation of neuroeducation-based strategies. These quotes illustrate the influence of Experts' background in neuroeducation on their instructional practices, as indicated by comments from Mitch, Mary, and Barb regarding their incorporation of visual-based learning strategies such as drawing, flowcharting, or context-rich stories to aid student learning. Incorporation of visual-based strategies may signify possible influences of Experts' background in neuroeducation.

Table 4.6

*In what ways have you implemented neuroeducation-based perspectives in your: a) educational practice? and b) personal life?*

Expert	Prominent Quote
Mary	“We use a lot of drawings... instead of just copying...”
Mitch	“I want to support visual thinkers by really trying to make concepts visual, providing visual wherever possible. What does the concept look like, can they see my mouth when I’m doing instructions, so that they can overlap that shape with the shape of whatever else we’re doing. I also really try and bring in stories and stories that I’m telling, stories that kids are telling. I mean they can be stories from their own lives, other people’s stories that kind of thinking, but we really putting learning in a context... that allows them to refine their understanding of that concept over time.”
Barb	“...when I’m showing them [adult learners] a new concept, I’m flow-charting or drawing. I’m having them do multiple concrete experiences so that they can take away that real experience they had and connect it to the more abstract learning.”

**Impact of Neuroeducation Perspectives of Learning on Adult Learners’ Implementation Strategies**

Results from the third research question showed that Focal Participants used visuals within instructional practices or recognized the importance of student-generated visual, products to show their learning, or did not implement visuals into their lives. For example, three out of the seven Focal Participants’ practices were changed based from the implementation of visuals into their instructional practices. Xeng, Cora, and Leighla incorporated a variety of visual-based strategies such as drawing, flowcharting, and writing into their instructional practices to help their K-12 or adult learners learn. Two out of the seven Focal Participants reported no change towards implementation strategies based from the target course. Two out of the seven Focal

Participants (George and Elly) reported no change to their instructional practices. Focal Participants' responses, regarding their implementations of visual-based strategies and recognition towards the importance of student-generated, visual products which represents students' learning partially aligns with Experts' responses. For example, four out of the seven Focal Participants (George, Elly, Leonna, and Mike) did not implement any visual-based strategies into their instructional practices. However, all three Experts reported that a background in neuroeducation caused them to implement visual-based strategies into their instructional practices to help K-12 or adult learners learn which aligned with the impact of three Focal Participants (Xeng, Cora, and Leighla).

**Focal Participants: Neuroeducation versus non-neuroeducation.** After noting Focal Participants' visual-based themes, the researcher compared neuroeducation and non-neuroeducation groups of Focal Participants' responses to highlight any relationships. A comparison showed that Focal Participants who had a neuroeducation concentration were more likely to implement visual-based strategies when compared to non-neuroeducation, Focal Participants. For example, Xeng, Cora, and Leighla were each had a concentration in neuroeducation and implemented a variety of visual-based strategies to help their students learn. Additionally, the relationship between participants' neuroeducation concentration and their implementation of visual-based strategies was reflected in Experts' responses as well (i.e., each Expert had a concentration in neuroeducation and each implemented visual-based strategies).

Leonna, who had a non-neuroeducation concentration, implemented visuals into her instructional practice, however, she stated she originally taught to her strengths, which were grounded in visual-based instructional methods. Focal Participants, George, Mike, and Elly were each non-neuroeducation concentrations and did not directly implement visual-based learning

strategies into their professional or personal lives. However, after taking the class on adult learning theory with the neuroeducation perspective of learning, George, Mike, and Elly recognized the importance of visual-based learning in education and accepted their students' visual-based products which showed their students' learning.

**Research Question #4: In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?**

The fourth semi-structured interview question asked to Focal Participants investigated the impact of their neuroeducation-based strategies on those around them. Focal Participants' question asked: *If your perceptions about learning for yourself or others changed after taking a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, then how did that change impact: a) your K-12 or adult learners? b) your work colleagues? and c) your personal life?* Similarly, the fourth semi-structured interview question investigated the impacts of Experts' neuroeducation-based strategies on those around them. Experts' question asked: *How has implementation of your neuroeducation-based perspectives impacted: a) your adult learners (or K-12 learners)? and b) your work colleagues?*

**Focal Participant Themes Related to Research Question #4**

Focal Participants' narratives regarding the impacts of their implementation strategies on those in their professional and personal lives included the themes: *Expanding educators' understanding of learning* and *social and cognitive growth*. Both themes directly relate to the fourth research question and will be investigated.

**Expanding educators' understanding of learning.** Considered together, the responses within Focal Participants narratives revealed a common theme of expanding educators'



understandings of learning. In essence, changes in adults' behaviors, implementation of visual-based learning strategies such as drawing, and educators' increased interest in neuroeducation were important themes within their narratives. Table 4.7 displays Focal Participants' prominent quotes in response to the theme: *expanding educators' understanding of learning*, as the theme related to the impacts of their neuroeducation-related implementations. These quotes illustrate the perceived impacts of Focal Participants' implementation of neuroeducation-based perspectives of learning on their colleagues' thinking and practices as indicated by comments from Elly Leonna, and Cora surrounding their colleagues' increased interest in neuroeducation-based perspectives and comments from Xeng and Leighla related to their observation of a change in their colleagues' instructional practices. The theme of expanding educators' understanding of learning was not present within the narratives of George or Mike. Focal Participants' observed impacts from their implementation of neuroeducation-based perspectives of learning on their colleagues' interests and instructional practices may serve as indicators of the target courses' impact on Focal Participants thinking and instructional practices.

Table 4.7

*If your perceptions about learning for yourself or others changed after taking a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, then how did that change impact: a) your K-12 or adult learners? b) your work colleagues? and c) your personal life?*

Focal	Prominent Quote
Participants	Prominent Quote
Mike	Mike did not implement any neuroeducation-based strategies, therefore, had no impacts; however, he went on to say, “the neuro-ed class was definitely the stepping stone to make me a better person, but also to make me a better learner.”
Xeng	“People [Xeng’s colleagues] are becoming more aware about the importance of visual learning and visual learning systems.” “I see a lot more drawing. We’ve even added on our IEPs, an accommodation that’s pretty much...cartooning.”
Leonna	“they [adult learners] would ask my how my courses are. I said, ‘I’m learning a lot about myself in that class... interestingly one of my graduates entered into the neuroeducation program...”
Cora	“they [colleagues] seem engaged in it and could maybe pursue it,”
Leighla	“We’re seeing a lot more individualized approaches... teachers are actually having them create things together using the constructivist approach”
Elly	When referring to student-intervention teams, “teachers have been more likely to step up and ask for assistance... talking more about what is expected from students and what they need to do as the educator for the student.”
George	George did not see a change in his colleagues, “That takes a lot of momentum to change others, so what I’m still doing right now is just leading by example in certain ways and just sharing ideas or perspectives that hopefully others can use as well.”

**Social and cognitive growth.** Combined together, the responses within Focal Participants' narratives displayed another common theme related to K-12 learners' social and cognitive growth. Basically, themes surrounding K-12 learners' ability to form stronger relationships with others and an increased acquisition of language, were provided within their narratives. Table 4.8 displays Focal Participants' prominent quotes in response to the theme: *social and cognitive growth*, as the theme related to the impacts of their neuroeducation-related implementations. These quotes illustrate the perceived impacts of Focal Participants' implementation of neuroeducation-based perspectives of learning on their K-12 learners' social and cognitive growth as indicated by comments from Elly, Xeng, and Leighla surrounding an observed, positive impact on their K-12 students social and cognitive growth and George's observed positive impact on his K-12 students' cognitive growth. The theme social and cognitive growth was not present within the narratives of Mike, Leonna, or Cora. Focal Participants' observed impacts from their implementation of neuroeducation-based perspectives of learning on their K-12 learners' social and cognitive growth may serve as indicators of the target courses' impact on Focal Participants thinking and instructional practices.

Table 4.8

*If your perceptions about learning for yourself or others changed after taking a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, then how did that change impact: a) your K-12 or adult learners? b) your work colleagues? and c) your personal life?*

Focal	Participants	Prominent Quote
Mike		Did not mention any cognitive or social gains by K-12 learners.
Xeng		“I think it’s creating the impact of being healthier social beings, because they’re [K-12 learners] learning the importance of healthy relational boundaries, they’re learning what is a healthy relationship.” “I feel like they [K-12 learners] can, in an appropriate way, stop and ask a question, or stop and say, ‘I don’t think we should do it this way.’”
Leonna		Leonna worked with post-secondary leveled learners not K-12 learners.
Cora		Did not mention any cognitive or social gains by learners.
Leighla		“...especially our newcomer students, are really acquiring the language at a quicker pace, because we’ve incorporated some of the strategies...” which caused us to “see some improvements especially when we’re dealing with behavior.”
Elly		Elly noticed her students are more “relaxed,” “willing to take risks,” and are developing a “servant-type mentality” Elly felt the classroom environment “created a level of respect and willingness to think outside the box.” Students demonstrated care for students outside their class, “They wanted to really know how, collectively as a group, how they could reach out. Like, could we put a note on his desk? Could we make a poster for him?”
George		“...students are showing that they understand the concepts that I’m hoping them to learn.”

**Expert Theme Related to Research Question #4**

Experts' narratives regarding the impacts of their implementation strategies on those in their professional and personal lives included the themes: their colleagues' of K-12 learners' desire to *continue their learning*, K-12 learners' *raised thinking*, an increase in K-12 students' *pro-social behaviors*. Each theme related to the observed impacts on Experts' colleagues and K-12 learners was similarly observed by Focal Participants and similarly represented within their narratives as well. Each Expert theme is directly related to the fourth research question and will be explored. The themes *raised thinking* and *pro-social behaviors* will be combined to the same section and table for the purposes of uniformity with Focal Participants data.

**Continued learning.** Concentrated together, the responses within Experts' narratives revealed a common theme related to continued learning. Essentially, a common theme noted by Experts, within their narratives, was their colleagues' desire to learn more about neuroeducation. Table 4.9 highlights Experts' prominent quotes related to the theme *continued learning* which stemmed from the impacts of Experts' implementation of their neuroeducation-based strategies. These quotes illustrate the perceived impacts of Experts' implementation of neuroeducation-based perspectives of learning on their colleagues' thinking and practices as indicated by comments from Mitch and Barb surrounding their colleagues' increased interest in neuroeducation-based perspectives and changes to their instructional practices. The theme related to Experts' colleagues' continued learning was not present within the narrative of Mary. Experts' observed impacts from their implementation of neuroeducation-based perspectives of learning on their colleagues' interests and instructional practices may serve as indicators for the impact of Experts' background in neuroeducation on their thinking and instructional practices.

Table 4.9

*How has implementation of your neuroeducation-based perspectives impacted: a) your adult learners (or K-12 learners)? and b) your work colleagues?*

Expert	Prominent Quote
Mary	This theme was not present within Mary’s narrative.
Mitch	The science teacher after hearing about Mitch’s background in neuroeducation asked Mitch: “Hey, I’m going to teach this global warming thing, what do you think, how would you do it?” The science teachers’ response after implementing Mitch’s recommendations: “It’s amazing, like the kids all just put their phones away and didn’t even take them out to look at them!”
Barb	“I do have one colleague, who we work very closely together, and she has really changed her practice and gone to seminars... so that’s really exciting.”

**Raised thinking and Pro-social behaviors.** Considered together, the responses within Experts’ narratives highlighted a common theme surrounding K-12 learners’ raised thinking and display of pro-social behaviors. In essence, increased conceptual understandings, increased academic abilities, and more pro-social behaviors observed, were important themes revealed within their narratives. Table 4.10 highlights Experts’ prominent quotes related to the theme *raised thinking* and *pro-social behaviors* which stemmed from the impacts of Experts’ implementation of their neuroeducation-based strategies. These quotes illustrate the perceived impacts of Experts’ implementation of neuroeducation-based perspectives of learning on their K-12 learners’ thinking and pro-social behaviors as indicated by comments from Mitch and Barb surrounding their K-12 learners’ social and cognitive growth and comments from Mary regarding her observed positive impact on her K-12 learners’ cognitive growth. Experts’ observed impacts from their implementation of neuroeducation-based perspectives of learning on

their K-12 learners’ social and cognitive growth may serve as indicators for the impact of Experts’ background in neuroeducation on their thinking and instructional practices.

Table 4.10

*How has implementation of your neuroeducation-based perspectives impacted: a) your adult learners (or K-12 learners)? and b) your work colleagues?*

Expert	Prominent Quote
Mary	<p>“they feel like they have reached some kind of conceptual understanding of how to learn that language...” a “pathway for them, to continue learning a language.”</p> <p>Mary did not mention an observed behavioral change in her learners; however, she noted her class size continued to grow as more students had enrolled.</p>
Mitch	<p>“I think they’ve been more successful at acquiring concepts because I’ve been able to provide environments that are conducive to that.”</p> <p>“... their [adult colleagues] outcomes are better. They’re not compared necessarily to each other in some sort of antisocial competitive, negative way...”</p> <p>“...the respect that happened was just transformational...we [K-12 learners and Mitch as the educator] can each have this respect for each other as agents.”</p>
Barb	<p>“They do very well academically.”</p> <p>“...they [K-12 learners] gained greater social concept, so they tend to be calm and respect each other.”</p>

**Impacts of Neuroeducation-Based Perspectives and Strategies on Others**

Results from the fourth research question (impacts on colleagues and adult learners) showed that Focal Participants’ implementation strategies either increased their colleagues’ interest in neuroeducation, caused their colleagues to implement instructional changes, or had no change on their colleagues’ instructional practices. Three out of seven Focal Participants (Elly, Leonna, and Cora) noted a positive impact towards their colleagues’ interest in neuroeducation. Two out of seven Focal Participants (Xeng and Leighla) observed a change in their colleagues’

instructional practices. Lastly, two out of seven Focal Participants (George and Mike) observed no change in instructional practices from their colleagues. Focal Participants' responses, regarding the impacts of their implementation strategies on their colleagues partially aligned with Experts' responses. For example, two Experts (Mitch and Barb) observed a change to their colleagues' interest in neuroeducation and changes to their instructional practices similar to the five Focal Participants Elly, Leonna, Cora, Xeng, and Leighla.

Results from the fourth research question (impacts on K-12 learners) showed that Focal Participants' implementation strategies either raised K-12 learners' cognition, raised K-12 learners' cognition and social abilities, or had no impact on K-12 learners. Three out of seven Focal Participants (Leighla, Xeng, Elly) observed both social and cognitive growth from their K-12 learners. Three out of seven Focal Participants (Mike, Leonna, Cora) did not observe any impact on their K-12 learners. Focal Participants' responses, regarding the impacts of their implementation strategies on their K-12 learners partially aligned with Experts' responses. For example, two Experts (Mitch and Barb) observed both social and cognitive growth by their K-12 learners and one Expert (Mary) noted cognitive growth by her K-12 learners, similar to four Focal Participants (George, Elly, Xeng, and Leighla).

**Focal Participants: Neuroeducation versus non-neuroeducation.** After noting Focal Participants' themes related to the impacts of their neuroeducation-related strategies, the researcher compared neuroeducation and non-neuroeducation groups of Focal Participants' responses to investigate any relationships. There did not seem to be any relationship between Ed.D. concentration and Focal Participants' responses in relation to the impacts of their implementation strategies. However, Focal Participants whose time was spent not working directly with K-12 students were less likely to report any social or cognitive changes. For



example, neither Mike (non-neuroeducation) who worked as a K-12 administrator, Leonna (non-neuroeducation) who worked in post-secondary education, or Cora (neuroeducation) who worked as a K-12 teacher support specialist and then with post-secondary education students, mentioned a change socially or cognitively for their students. However, Leighla (neuroeducation) worked as a K-12 administrator and noticed social and academic changes in her students.

From another perspective, Focal Participants who implemented various forms of visual-based instructions into their practices tended to observe more of their colleagues implementing visual-based strategies as well. In addition, all Focal Participants who had a concentration in neuroeducation implemented visuals into their instructional practices and therefore saw their colleague change instructional practices as well. Coincidentally, Leonna (non-neuroeducation) implemented visuals into her instructional practices, which influenced an interest in one of her post-secondary students, but Leonna stated that she was teaching to her strengths, so using visuals in her instruction was natural for her.

### **Chapter Summary**

This chapter reported the results of this study. Reporting of results was structured by research question and the aligned semi-structured interview question for both Focal Participants and for Experts in the Field. Focal Participants and Experts are considered adult learners. In response to the first research question, participant narratives indicated adult learners reflected on their identities either as a learner or as an individual. In response to the second research question, participant narratives indicated that adult learners to perceived current learning processes and instructional practices as being the same or being implemented similarly for K-12 learners and adult learners. In response to the third research question, participant narratives indicated that

adult learners implemented visual-based learning strategies such as drawing and flowcharting into their professional work settings. In response to the fourth research question, participant narratives indicated that adult learners who implemented visual-based strategies influenced their colleagues' interest in neuroeducation-based perspectives of learning and implementation strategies as well as saw social and cognitive growth by their K-12 learners.

## Chapter Five: Discussion

This chapter provides an interpretation of the study's results aligned with the research questions and supported by literature. A qualitative narrative inquiry design was used to investigate the impacts of a neuroeducation perspective of learning on adult learners. This study was guided by the four research questions:

1. How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?
2. How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?
3. In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?
4. In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?

Furthermore, this chapter shares the limitations of this study (the time constraints of the Ed.D. program and limited before and after data points, participant temporal reflections and self-reported data, and potential researcher bias) makes recommendations for future research, addresses the implications of this study for professional practice, and ends with the researcher's concluding remarks.

### Neuroeducation Perspectives of Learning and Adult Learners' Identities

The first research question asked, *How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identities (i.e., belief systems)?* Participant narratives revealed that after a course on adult learning theory with a neuroeducation perspective of learning all seven Focal Participants reflected on aspects of their identities or actions

connected with their identities. Focal Participant, Cora originally felt her identity was determined through good grades and doing well on tests, then after taking the course with the neuroeducation perspective of learning, she questioned whether those things truthfully represented how she viewed herself. Cora concluded, good grades and doing well on tests did not contribute to her identity, rather, her love of learning and ability to ask questions did. Similarly, all three Experts felt their backgrounds in neuroeducation caused them to reflect on themselves as individuals. Expert Mitch felt that after his training in neuroeducation practices he had a better understanding of himself as a learner and as an individual. Regarding the first research question, Focal Participants' responses aligned with Experts' responses and showcased the impact of a neuroeducation perspective of learning on these adult learners' self-reflection.

Results gleaned from participant narratives related to the first research question on identity, showed that a neuroeducation perspective of learning appeared to engage participant reflection on their own identities either as a learner or as an individual. Self-reflection amongst educators is important as a relationship exists between educators' identities and the degree of students' social and academic successes (McKay & Dennett, 2009; Wagner, 2016). A relationship between educators' identities and students' successes exists because educators' identities influences their thinking, their behaviors, and the environment from which students are supposed to learn (Dweck, 2000; McKay & Dennett, 2009; Wagner, 2016). It is crucial that educators reflect on their identities so they do not place their values (or misbeliefs) onto their students who may have been raised differently. (Dweck, 2000; McKay & Dennett, 2009; Wagner, 2016). Therefore, it is important that educators understand and use a neuroeducation perspective of learning as a lens to better understand themselves.

### **Neuroeducation Perspectives of Learning and Adult Learners' Perceptions of Learning for K-12 Learners and Adult Learners**

The second research question asked, *How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?*

Participant narratives revealed that after taking a course on adult learning theory with a neuroeducation perspective of learning six of the seven Focal Participants believed the process of learning occurred similarly between K-12 learners and adult learners or learning instructional practices could be the same between K-12 learners and adult learners. For example, Focal Participant, Elly believed educators should utilize K-12 learners' and adult learners' previously learned experiences to help new learning occur. Likewise, narratives displayed that two of the three Experts believed learning within the classroom occurred similarly between K-12 learners and adult learners. For example, Expert, Barb said an andragogy (i.e., adult) perspective towards learning (such as learning that is meaningful, practical, relevant) could be used with K-12 students. Considering the second research question, Focal Participants' responses aligned with Experts' responses and displayed an influence of a neuroeducation perspective of learning on adult learners' perspectives of learning for K-12 learners and adult learners.

Results within participant narratives surrounding the second research question showed that a neuroeducation perspective of learning influenced participants to perceive learning processes and instructional practices as being the same for K-12 learners and adult learners. Narratives of adult learners participating in this study revealed they were influenced to perceive adult and child learning as the same, which is unique within education, as literature on adult (andragogy) and child (pedagogy) learning suggests a norm with appropriate andragogical and pedagogical practices (Brown, 2003; Rachal, 1994) as well as issues of fidelity related to

educators' implementation of appropriate andragogy and pedagogy related instructional methods (Monts, 2000). However, the results of this study suggest that adult learners influenced by neuroeducation perspectives of learning who are engaged in our K-12 and adult learning systems, may suggest otherwise.

Neuroeducation can be used as a lens to view learning as holistic, transcending age-specific instructional practices (Ashkanasy et al., 2000; Brown, 2003; Shenton, 2003). For example, learning literatures within cognitive psychology, neuroscience, and language acquisition domains (i.e., neuroeducation) present the development or process of learning as well as the acquisition of language as being the same between K-12 learners and adult learners. Research in neuroscience shows that humans take in information the same ways (Arwood, 2011; Bars & Gage, 2010; Gillett, 1989; Schunk, 2012); for example, as humans, we use our sensory receptors (i.e., eyes, ears, skin, nose, or mouth) to take in sensory inputs (e.g., light, sound, pressure, smell, or taste) from our environments which are then processed within the brain and contributes to neurobiological changes in the brain. A unified perspective of learning, grounded in neuroeducation perspectives, may address previous confusions held between andragogy and pedagogy beliefs around learning and instructional practices. The results of this study would certainly indicate further study on this approach is warranted.

Further, one learning theory called the NSLLT (Arwood, 2011) incorporates the domains cognitive psychology, neuroscience, and language acquisition (i.e., neuroeducation), highlights similarities of the interconnectedness of learning amongst K-12 learners and adult learners, and was highlighted within six out of ten participants' narratives in this study. Four Focal Participants noted either a need for the NSLLT within education to better help educators understand learning (Xeng, Leonna) or was credited for helping Focal Participants understand

learning better for themselves and others (Cora, Elly). The narratives of two Experts (Barb, Mary) similarly revealed a need for the NSLLT in education and revealed a potential positive impact on future educators if the theory were to be implemented into classroom instruction. Understanding learning as a unified process between K-12 learners and adult learners (e.g., NSLLT), can alleviate confusions between adult and child learning literatures as well as may guide educators' appropriate instructional implementations into their classrooms.

### **Implementation Strategies and Neuroeducation Perspectives of Learning**

The third research question asked, *In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?* Participant narratives revealed that after attending a course on adult learning theory with a neuroeducation perspective of learning four of the seven Focal Participants either incorporated visual-based strategies into their instruction or accepted students' visual-based learning products, which was represented by two Focal Participants. For example, Focal Participant, Xeng used drawing as a strategy to introduce new information and Focal Participant, George said his K-12 students showed their learning through models and presentations. Similarly, narratives revealed that, with a background in neuroeducation, all three Experts implemented visual-based learning strategies into their classroom instruction. For example, Expert, Mary had her student draw and connect foreign word's underlying meanings with their own conceptual understandings of the word. Considering the third research question, Focal Participants' responses partially aligned with Experts' responses and showed that neuroeducation may be influential towards adult learners' implementation of learning strategies grounded in neuroeducation.

Results within participant narratives surrounding the third research question showed that a neuroeducation perspective of learning influenced adult learners, somewhat, to implement

visual-based learning strategies such as drawing and flowcharting into their professional work settings. Expert and Focal participants felt educators who use visual-based learning strategies allow visual learners to utilize their learning system and research shows that the majority of students benefit from visual-based instruction; roughly 85 percent of learners today have visual learning systems, which means fewer than 15 percent of learning use sound to help them learn (Arwood, 2011; Arwood & Kaulitz, 2007; Lucas, 1980, 1991). Because English is a low context and auditory-based language, visual learners struggle conceptualizing information and need visual-based methods as supplements to help them learn new information typically grounded in auditory-based learning principles (Arwood, 2011; Arwood et al., 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017). Participant responses in this study suggest educators can incorporate visual-based instructional strategies such as VLMs®, flowcharting, picture dictionaries, and real-time drawings, to help visual learners learn as supported by previous studies into a neuroeducation approach to learning (Arwood, 2011; Arwood et al., 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Jaskowiak, 2018; Murphy, 2016; Xiang Lam, 2016).

Visual learning systems utilize visual-based sensory inputs (e.g., light particles which bounce off of objects and reveal objects' edges or mouth or body-based movements) from the environment to form neurobiologically meaningful perceptual patterns, which allows for concept and language acquisition (Arwood, 2011; Arwood & Kaulitz, 2007; Pulvermüller, 2013). Visual learners' language describes their mental images, videos, or mental shapes produced from external movements (each representing a learned experience) and is used to help them learn new information (Arwood, 2011; Arwood, Brown, Kaulitz, 2015; Arwood & Kaulitz, 2007; Arwood & Merideth, 2017; Pulvermüller, 2009). Therefore, educators who incorporate visual-based



learning strategies into their classroom instruction, as indicated by participant narratives in this study, allow visual learners to utilize their visual learning system and allows visual learners to acquire natural language, which will be used to help them grow socially and academically.

### **Participants' Perceived Impacts of Neuroeducation-Based Perspectives on Others**

The fourth research question asked, *In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?* Results from narratives revealed that five of the seven Focal Participants' felt their implementation of visual-based learning practices, grounded in neuroeducation, may have inspired a change in their colleagues' behaviors. Four of the seven Focal Participants who implemented visual-based learning strategies observed social and cognitive growth from their K-12 students and they attributed this change to their implementation of the neuroeducation-based practices. For example, Focal Participant, Leighla noticed her colleagues use more visual-based strategies in their instruction and Focal Participant, George noted that his K-12 students seemed to conceptually understand content better. Likewise, all three Experts, after incorporating visual-based learning strategies, noted a positive impact on either their K-12 students or their colleagues. The Experts, after incorporating visual-based learning strategies with their K-12 students, also observed student social and cognitive growth. As an example of a positive impact on her colleague, Expert, Barb mentioned how several of her colleagues had later attended neuroeducation conferences with her and Expert, Mitch recognized a positive impact on his K-12 student socially and academically. Focal Participants' responses partially aligned with Experts' responses and showed that visual-based instructional strategies, grounded in neuroeducation, may influence colleagues' instructional practices (five Focal Participant responses partially aligned with two Expert responses) and benefit K-12 learners'

social and cognitive growth (four Focal Participant responses partially aligned with three Expert responses).

Two out of the three Focal Participants (Xeng and Leighla) who had a concentration in neuroeducation and who implemented visual-based instructional practices into their practice, saw a change in their colleagues instructional practices. This finding, related to others' instructional practices changing noted within Experts' narratives (Mitch and Barb), suggests that adult learners with deeper understandings of neuroeducation and who implement neuroeducation-based learning strategies into their practices may be more likely to influence the practices of those around them. Literature suggests that educators' thinking or practices typically do not change when their education-related experiences are grounded in familiarity, instructional practices are based on their own learning strengths instead of their students' strengths, and educators' display a general lack of reflective inquiry for *why* they implement instructional practices into their classroom (Ashkanasy et al., 2000; Brown, 2003; Stitt-Gohdes, 2001). Therefore, continued learning in neuroeducation principles and implementation of neuroeducation-based practices can inform educators' instructional practices by providing potentially new and unfamiliar strategies based on students' needs that are acknowledged by the participants in this study as helping students grow socially and academically.

Additionally, participant narratives surrounding the fourth research question showed that seven out of ten adult learners felt their implementation of visual-based learning strategies, grounded in neuroeducation, impacted the social and cognitive growth of their K-12 students. Student academic and social growth are top priorities for most schools. Furthermore, schools often highlight a connection between students' academic learning or growth and social competence, but treat or intervene on students' academic and social struggles and competencies

separately (Gresham, 2015; Haynes, 2002). However, research on the acquisition of language (viewed through a neuroeducation lens for learning) highlights the interconnectedness of language and social competencies and language being used as a tool to drive new learning (Arwood, 2011; Bruner, 1975; Humphrey, 1976; Wanger, 2016). Research that used neuroeducation perspectives of learning as frameworks for investigating student academic and social outcomes, supports the findings from participants in this study who noted the interconnectedness between students' social and academic growth (Arwood & Merideth, 2017; Green-Mitchell, 2016; Jaskowiak, 2018; Robb, 2016; Xiang Lam, 2016).

### **Neuroeducation in Education**

The premise of this study was established based on a review of the literature that indicated educators' perceptions of learning were limited in a number of ways, including:

1. a lack of neurobiological learning content or information presented within teacher preparation programs, which contributes to educators' limited understandings of the learning process (Jeder, 2014; Jong, 2014; Leibbrand & Watson, 2010; Pratt, 1993),
2. a lack of information related to language acquisition and the connection between language acquisition and language function within teacher preparation programs, which limits educators' ability to provide effective learning experiences for students (Missett & Foster, 2015; Owens, 2010; Robb, 2016; Tivnan & Hemphill, 2005),
3. education-related experiences that are grounded in familiarity, are centered on educators' learning strengths instead of students' learning strengths, and lack reflective inquiry (Ashkanasy et al., 2000; Brown, 2003; Stitt-Gohdes, 2001),
4. and confusions regarding the learning tenets and practices held within two common learning frameworks (e.g., andragogy and pedagogy) used in education (Brown, 2003;

Davenport & Davenport, 1985; Holmes & Abington-Cooper, 2000; Knowles, 1980; Monts, 2000; Taylor & Kroth, 2009).

The first and second limitations listed above were highlighted within the narratives presented by Focal Participants providing further evidence of their impact on teaching and learning. A common theme that arose from Focal Participants' narratives but unrelated to the research questions was *a need for exploring neurobiological learning in education* (see Appendix I, research question #1). Focal Participants felt the target course on adult learning theory with the neuroeducation perspective of learning either informed their thinking about neurobiological learning processes or helped them recognize the importance for educators to understand learning from a neurobiological perspective. Similarly, Focal Participants' narratives revealed other themes, also outside of the scope of the research questions, *a need for learning theory in education* (see Appendix I, research question #1) and identification of *educational gaps for learning theory in education* (see Appendix I, research question #2). Focal Participants felt the target course informed their understanding of learning from a language acquisition perspective and allowed them to make better-informed instructional decisions, which was absent in previous trainings and teacher preparation programs they experienced and related to the third limitation towards educators' understanding of learning.

From the perspective of educators' limitations presented above, the results from this study are significant. Results from participants' narratives showed that neuroeducation, when used as a lens to view learning and inform instructional practices, was perceived by participants to address each limitation provided above. For example, the neuroeducation model presented in this study includes learning research from domains of cognitive psychology, neuroscience, and language acquisition; the first two limitations provided above stemmed from teacher preparation

programs' lack of neurobiologically-informed or language acquisition-informed content or information shared with educators. Due to the structure of neuroeducation, neurobiological and language acquisition perspectives of learning are naturally presented and incorporated into learners' understandings of learning.

Additionally, due to common practices and views held about learning in education such as teacher-centered, evidence-based models for learning, educators are less likely to self-reflect or question their instructional practices from diverse perspectives such as neuroscience and language acquisition, as cognitive psychology perspectives of learning and practices are the most common in education (Arwood, 2011; Arwood & Merideth, 2017; Arwood & Young, 2000; Biesta, 2010; Garrison, 2009; Green-Mitchell, 2016; Poulson, 2016; Robb, 2016). Again, neuroeducation as a model naturally expands and informs a learner's perceptions of learning theory and effective learning practices. Participants' narratives in this study showed that neuroeducation perspectives of learning influenced adult learners to self-reflect, informed their thinking about instructional practices, and implementation of a variety of visual-based learning strategies grounded in neuroeducation principles of learning. Narratives revealed that participants in this study who had a concentration in neuroeducation and implemented visual-based learning strategies both influenced their colleagues thinking and practices and observed, within their K-12 students, social and cognitive growth.

Finally, concerning the fourth limitation provided above surrounding educators' and researchers' confusions between appropriate learning tenets and practices for adult (andragogy) and child (i.e., K-12 or pedagogy) learning frameworks, neuroeducation as a model points to a possible solution. Neuroeducation perspectives of learning are transdisciplinary, meaning multiple domains of study are utilized; because multiple domains of study are utilized within the

model, learners are influenced to explore more definitions and perceptions of learning they may not have otherwise. For example, learners using a neuroeducation model to investigate learning, may find that many neuroscientists view learning as a single human process (e.g., using our five senses to take in sensory inputs from the environment) which does not differ by age (Elias, 1979; Fiser, et al., 2010; Gillett, 1989; Heeger, 2017; London, 1973; Pulvermüller & Fadiga, 2010; Schunk, 2012). Results from six out of seven narratives revealed that Focal Participants believed the target course influenced them to see learning processes as the same between K-12 learners and adult learners. Similarly, two out of the three narratives revealed that Experts' background in neuroeducation perspectives allowed them to view learning processes between K-12 learners and adult learners as the same.

Furthermore, Arwood (2011) incorporated neuroeducation perspectives of learning into her understanding of language acquisition and created the language-informed theory called Neuro-Semantic Language Learning Theory. The NSLLT (Arwood, 2011) highlights the relationship between language acquisition, cognition, and behavior and also depicts similarities for learning processes with neuro-typically functioning individuals, no matter their age. Results from four out of seven narratives revealed that Focal Participants recognized the potential impact of the NSLLT on educators' understanding of learning; two out of three Experts' narratives highlighted the need and potential positive impact of the NSLLT on educators' thinking and practice. Therefore, as a model to view learning as well as a model for informing educators' understandings of learning and effective classroom practices, neuroeducation may be beneficial for those who implement it, those who observe it being implemented, and for the K-12 learners whose educators incorporate it into their classroom practices.

**Why has thinking and practices around learning not changed?** Collectively, participants' narratives within this study revealed the potential of a neuroeducation perspective of learning towards addressing the previous list of limitations. However, since the premise of this study was based on the previous list of limitations, readers can assume that educators who work in the field of education or who are studying to become educators, may still be influenced by the same limitations used to drive this study. Furthermore, if literature, like what was presented in Chapter Two, showcases similarities in learning processes and practices between adult learners and K-12 learners (such as the acquisition of language, using information that is meaningful, practical, and relevant, or using learners' experiences to scaffold new learning) exists and research studies grounded in neuroeducation (like what was used in this study) exists as well as supports the literature displaying similarities in learning between various learners, *why does this list of limitations still exist?* To add insight to this conundrum, recalling the first research question is valuable.

There were four research questions explored in this study, the first research question investigated participants' identity as it related to neuroeducation. The researcher purposefully considered participants' identities within this study due to an understanding of the relationship between language acquisition, thinking, and behavior. In other words, understanding the relationship between language acquisition, thinking, and behavior can provide insight for understanding why changes towards thinking and practices have not occurred in education.

First, if language is acquired within social settings, represents social and cultural norms, shapes our thinking and beliefs, and influences our behaviors (Arwood, 2011; Bruner, 1975; Chomsky, 1975; Frith & Frith, 2007; Halliday, 1977; Humphrey, 1976; Wanger, 2016), then a paradigm shift in thinking and practice must consider these components. Creating a change in

thinking and practice within education must also consider educators' self-efficacy or belief to produce desired effects (Bandura, 1977; Bandura & Wessels, 1997). If educators do not believe in the practices they implement (e.g., instructing K-12 learners with andragogical principles of learning), the positive intents of the practices are lost and educators' preconceived notions persist (Stein & Wang, 1988; Tschannen-Moran et al., 1998; Turner et al., 2011). Therefore, beliefs around instructional practices and student learning contribute to the limited change regarding thinking and practice within education and should be challenged (Cooper, 2007; Garcia et al., 2010).

The binding component within this complex relationship between what we think, believe, and do in education is *language*. Ironically, it is through the use of language that self-reflection and the exploration of ourselves (and our preconceived beliefs), others, and our interactions with others, can a paradigm shift in thinking and practices in education occur; however, changing teachers' thinking and practices takes time and needs continued support (Gregory et al., 2014; Hall & Hord, 2001; Tunks & Weller, 2009). Participants' narratives in this study revealed that neuroeducation perspectives of learning encouraged self-reflection and challenged their perceptions of learning for adults and K-12 learners; participants also felt they were influenced to change their instructional practices based from the neuroeducation perspectives of learning.

### **Limitations**

There are a number of limitations bound to this qualitative research study. Limitations included: time constraints of the Ed.D. program, no pre-test for the target course was used to the Focal Participants of this study, varying degrees of participants' temporal reflection, self-reported data, in other words, there was a difficulty towards distinguishing sole influences of previous neuroeducation courses on Focal Participants' responses to semi-structured interview



questions versus influences of the adult learning course, and the potential of researcher bias due to the researcher's position about neuroeducation.

The adult learning class, Adult Learning, Group and Organizational Dynamics, is part of the neuroeducation track of the doctoral program in which the participants are enrolled. Further, the neuroeducation tract is one of four doctoral program tracts in the university's three-year doctoral program. The program's time constraints and step-by-step requirements (for example, receiving IRB approval before giving the semi-structured interviews with participants) limited the researcher's access to and availability for working with participants. The doctoral program's time constraints limited the researcher's ability to give pre-interviews to measure adult learners' perceptions of learning associated with the adult learning class with a neuroeducation lens both before and after the target course was experienced as participants had completed the adult learning class before the researcher's study had begun and IRB approval had been obtained. Further, all data collected by the researcher occurred within a four-month period which did not allow for other data to be collected through classroom observation or follow-up interviews that would have enabled more longitudinal analysis.

Three of the seven Focal Participants within this study chose to be a part of the neuroeducation area of concentration within the program and therefore had taken more neuroeducation classes, which may have resulted in a more thorough or deeper understanding of neuroeducation principles and theories than those associated with the target adult learning class. This varied degree of exposure to neuroeducation principles created the possibility of differing perceptions of learning among the Focal Participants and presented challenges in considering data across all participants.

Experts were asked to reflect on the impacts of their background in neuroeducation on their thinking and the impacts of neuroeducation-based implementation strategies, such as drawing and flowcharting, had on those in their professional and personal lives. Similarly, Focal Participants were asked to reflect on the impacts of a one semester adult learning course with a neuroeducation perspective of learning on their thinking and the impacts neuroeducation-based strategies, such as drawing, diagrams, cartooning, had on those in their professional and personal lives; the data collected from participants' narratives were temporal and may not have been as accurately remembered compared with experiences that occurred more closely to the study's implementation timeline.

There is always chance in qualitative research, for researcher bias to affect the collection of data as well as the study's outcomes (Merriam, 2009). As noted within the Role of the Researcher section, the researcher had a background which inspired him to participate in the university's neuroeducation program. The researcher had taken neuroeducation courses at the university and therefore had a pre-established notion of the impacts that a neuroeducation perspective could have towards the transformation of adult learners' perceptions of learning. The researcher also felt that the Pacific Northwestern University's interpretation of neuroeducation played a crucial role towards informing educational theory and practice. Therefore, it was essential for the researcher to reflect on his biases towards the study and utilize other experts' (graduate course instructors, graduate students, Experts in the Field) opinions and perspectives of the study's findings in order to alleviate any initial researcher bias (Creswell, 2014).

It is important to continuously reflect on researcher bias and the translations of the data collected in order to maintain the trustworthiness and reliability of study and its findings (Creswell, 2014). Another way biases held by the researcher could have been alleviated was

through double-coding. Double coding helps reduce researcher bias towards data translations by obtaining an additional, non-biased professional's interpretations of themes within participant narratives (Creswell, 2014). Due to limitations of time surrounding the university's Ed.D. program, the researcher was unable to have participants' narratives double-coded. Future research may consider double-coding as a means to reduce any researcher bias towards the topic.

### **Recommendations for Future Research**

Logically, next steps beyond this study would be to attempt to address the limitations previously mentioned where possible. Future researcher could include longitudinal research and analyze neuroeducation concentration participants' perspectives of learning throughout the Ed.D. program (three years), giving a pre-interview (first year, prior to first neuroeducation course), a mid-program interview (second year), and a post-program interview (third and final year of Ed.D. program) to see how participants' perspectives changed throughout the process of acquiring more neuroeducation-related information. By conducting a longitudinal study, researchers would have more time to reflect upon the findings and potentially move beyond perceptions of success over three years versus only six months of implementing the new approach.

Research could also collect artifacts and data from participants outside of the university setting providing additional qualitative data (e.g., K-12 or adult students' perceptions about their educators' neuroeducation-based strategies) to be used to make more informed conclusions about the impact of the approach. Quantitative data could also be used to help inform the findings by incorporating results from K-12 students' assessments and standardized test scores and adult students' achievement scores as well where available.

### **Implication for Professional Practice**

This study sought to investigate and understand learning from a different perspective (neuroeducation) other than what is commonly practiced in education. The researcher hoped to provide educational researchers and practitioners, through an investigation of learning from a different perspective, with a more complex and holistic interpretation of learning and effective learning practices. The researcher wanted to contribute to a paradigm shift for understanding learning in education that challenged traditionally-held perspectives of learning and practices used to display student learning.

This study was guided by a transdisciplinary model of learning called, neuroeducation. The neuroeducation model used this study incorporated the domains of cognitive psychology, neuroscience, and language to inform educational theory and practice (Hook & Farah, 2013; Jeder, 2014; Tommerdahl, 2010). Broadly speaking, the researcher wanted to display to readers a practical application of the neuroeducation model as a lens for examining learning and perception, as well as the theoretical and philosophical learning frameworks supporting andragogy and pedagogy. The terms learning and perception and theoretical and philosophical learning frameworks andragogy and pedagogy were ultimately additional lenses through which to view this study's findings.

The neuroeducation model also served to highlight the importance of educator self-reflection as an influencer of student success and towards recognizing and understanding the missing links (i.e., the neurobiological understandings of learning and language used as a translator of understanding learning and student behavior) within educators' understandings of learning. The literature underpinning this study (Bruner, 2001; Coe et al., 2014; Dweck, 2000; Goddard et al., 2000; McKay & Dennett, 2009; Sylwester, 1995; Wagner, 2016) and the findings

from the study, echoed an importance for educators to reflect on their understandings about learning and the connection between their instructional practices for K-12 and adult learners and their social and academic success. In conducting this study I came to understand better the disconnected approach to learning (cognitive psychology-based, behaviorism, stimulus-response) and assumed-to-be effective instructional practices (lecture-based, input-output, standardized testing) and was allowed to share an additional interpretation of the interconnected nature of learning (functional language displays internal cognitive abilities) and the application of effective learning (e.g., information is meaningful, practical, relevant and uses learners' learned experiences) into educational practice.

The results within the narratives of this study showed that Focal Participants believed they were positively impacted by an adult learning course with an implementation of a neuroeducation perspective of learning and Experts also reported being positively impacted from their courses in neuroeducation perspectives of learning. Narratives surrounding neuroeducation perspectives of learning revealed that Focal Participants and Experts reflected on their previously held beliefs about learning as well as provided them an additional perspective of learning that seemed to be beneficial to those within their professional and personal lives, when implemented. Therefore, other educators may reap the benefits displayed within this study by using a neuroeducation perspective of learning to help self-reflect on their currently held beliefs about learning and their instructional practices used; educators (e.g., individual and professional growth) and their students (e.g., social and academic) may also benefit from the literature and results of this study.

Educators who take the time to investigate understandings of learning and practice methods of effective learning produced from a neuroeducation model can start to recognize the

interconnectedness of language, learning, and social contexts. In other words, language (i.e., functional language) is used for learning, language is learned with social contexts, and social contexts can use language to enhance learning (Arwood, 2011; Bedny & Caramazza, 2011; Bookheimer, 2002; Carter, 2014; Chomsky, 1975; Egorova et al., 2016; Frith & Frith, 2007; Gallistell & Matzel, 2013; Halliday, 1977; Mahon & Caramazza, 2008; Pulvermüller, 2005; Pulvermüller, 2013; Pulvermüller et al., 2009). Educators who recognize and understand the relationship between language, learning, and social contexts can hold accountable their thinking and instructional practices used which may increase the likelihood of student success.

### **Concluding Remarks**

The old adage, “Everyone is unique in their own way.” is a phrase most people grew up hearing or have used a time or two within various settings. It is interesting to this researcher, however, that somewhere along the way, the phrase lost its meaning and intent once it hit school grounds and classroom doors. Rather, an underlying message many students hear in education today reflects one of sameness or being standard. It is inevitable that a student’s uniqueness would be stripped when housed within a learning setting that revolves around standardization. Further to the notion of standardization removing students’ uniqueness, students’ identities are negatively impacted as well. When (not if) a student makes a mistake in school, his or her identity will be shaped by the interpretations of learning held within that institution and by the interpretations and actions of their educators in response to that mistake; if all educators within that school share similar views of learning, the student may grow up under a false concept of identity and maybe never truly reach their full potential in life.

It is up to educators to investigate and understand learning from a variety of perspectives, to understand their own thinking and the impacts of their thinking on their students, and to make

more informed decisions around instructional practice; because educators' thinking and actions literally shapes the minds of individuals who grow up and go out into the world. Think about it this way, a person most likely would not take some horrific medical news from a doctor without getting a second opinion or go out and buy the first car they have ever driven without driving a couple more cars, so why do educators (or the systems they work in) view instructional practice and learning (as applied to infinitely different individuals) from only one perspective? Maybe a better question to ask might be, why are many educators not equipped with understandings of learning held outside of traditionally and commonly practiced perspectives of learning held in education?

With the remarkable responsibility placed on educators to shape the minds of those venturing into society, this researcher felt privileged to conduct this study which sought to investigate learning from a holistic perspective and to also help inform educators' instructional practices. This study produced several positive findings. Findings from this study certainly point to the understanding that neuroeducation, as a model to investigate learning, not only recognized the issues or gaps held within educational literature and perspectives of learning used in education, but may also present a means to address the gaps in literature around neuro-educational best practices in pedagogy and andragogy. The researcher found that participants within this study indicated they were positively impacted by the adult learning class with the neuroeducation perspective of learning moving them to implement a change in their thinking about learning and the practices they used in their professional and personal lives.

This study provided further confirmation that this neuroeducation model (i.e., cognitive psychology, neuroscience, language) can holistically inform educational theory and practice. Neuroeducation as a model to view learning and educational practice is crucially needed in

education today; educators, schools, and most importantly, students can all benefit. As one of the Experts in this study remarked:

It would be a *disservice* and I almost want to use a stronger word than that. I think it would be *awful* to not have that [neuroeducation] available to people, who are going to be in leadership or working with children. I'm like, "How do you have that [information about neuroeducation] and know that this knowledge exists, that the outcomes are what they are from what I've seen in the research and then keep that away from a bunch of people who are going to be experts in education..."



### References

- Alvidrez, J., & Weinstein, R. S. (1999). Early teacher perceptions and later student academic achievement. *Journal of educational psychology, 91*(4), 731.
- Amsterlaw, J., & Wellman, H. (2006). Theories of mind in transition: A microgenetic study of the development of false belief understanding. *Journal of Cognition and Development, 7*, 139–172.
- Ansari, D. & Coch, D. (2006). Bridges over troubled waters: Education and cognitive neuroscience. *Trends in Cognitive Sciences, 10*(4), 146-151.
- Arasteh, A. (1953). *Foundations of modern educational methods*. Retrieved from ProQuest Digital Dissertations. (UMI DP69483)
- Arwood, E. (1991). *Semantic and pragmatic language disorders* (2nd ed.). Gaithersburg, Md: Aspen Publishers.
- Arwood, E. (2011). *Language function: An introduction to pragmatic assessment and intervention for higher order thinking and better literacy*. Philadelphia, PA: Jessica Kingsley Publishers.
- Arwood, E., & Kaulitz, C. (2007). *Learning with a visual brain in an auditory world*. Shawnee Mission, KS: Autism Asperger Publishing Co.
- Arwood, E., & Merideth, C. (2017). *Neuro-education: A translation from theory to practice: A brain-based teaching guide for the remediation of language literacy, behavior support, mental health, and academic challenges*. Tigard, OR: Arwood Neuro-Viconics.
- Ashkanasy, N. M., Wilderom, C. P., & Peterson, M. F. (2000). *Handbook of organizational culture and climate*. London, England: Sage.

- Austin, J.L. (1962). *How to do things with words: The William James lectures, 1955*. Clarendon Press, Oxford.
- Baars, B., & Gage, N. (2010). *Cognition, brain, and consciousness: Introduction to cognitive neuroscience*. San Diego, CA: Elsevier.
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.
- Bandura, A., & Wessels, S. (1997). *Self-efficacy* New York, NY: W.H. Freeman & Company.
- Barsalou, L. W., Simmons, W. K., Barbey, A. K., & Wilson, C. D. (2003). Grounding conceptual knowledge in modality-specific systems. *Trends in cognitive sciences*, 7(2), 84-91.
- Bear, M. F., Connors, B. W., & Paradiso, M. A. (2001). *Neuroscience: Exploring the brain* (Second ed.). Philadelphia, PA: Lippincott Williams & Wilkins.
- Bedford, F. L. (1993). Perceptual learning. *The psychology of learning and motivation*, 30, 1-60.
- Bedny, M., & Caramazza, A. (2011). Perception, action, and word meanings in the human brain: The case from action verbs. *Annals of the New York Academy of Sciences*, 1224, 81–95. <http://dx.doi.org/10.1111/j.1749-6632.2011.06013.x> (Review).
- Bookheimer, S. (2002). Functional MRI of language: new approaches to understanding the cortical organization of semantic processing. *Annu. Rev. Neurosci.*, 25, 151–188.
- Borman, G., Hewes, G., Overman, L., & Brown, S. (2003). Comprehensive school reform and achievement: A meta-analysis. *Review of Educational Research*, 73, 125-230.
- Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experiences, and school*. Washington, D. C.: National Academy Press.

- Breen, M. P. (1991). Understanding the language teacher. *Foreign/second language pedagogy research*, 213-233.
- Brewer, W. F. (1974). There is no convincing evidence for operant or classical conditioning in adult humans. In *Cognition and the Symbolic Processes*, ed. WB Weimer, DS Palermo, P. 1-42. Hillsdale, NJ: Erlbaum
- Brooks, J. G., & Brooks, M. G. (1993). *In search of understanding: The case for constructivist classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.
- Brown, B.L. (2003). Teaching Style Versus Learning Style (Myths and Realities No.26). Educational Resources Information Centre ERIC.
- Brown, K. M. (2010). *The influence of demographic variables on the perceptions of teachers regarding effective pedagogical practices*. Retrieved from ProQuest Digital Dissertation (UMI 3447441)
- Brun, C. F. (2016). *A practical guide to evaluation*. New York, NY: Oxford University Press.
- Bruner, J. (1991). The narrative construction of reality. *Critical Inquiry*, 18, 1-21.
- Bruner, J. S. (1975). The ontogenesis of speech acts. *Journal of child language*, 2(1), 1-19.
- Bruner, J. S. (2001). *Language, culture, self*. Thousand Oaks, CA: SAGE Publications Inc.
- Buehl, M. M., & Fives, H. (2009). Exploring teachers' beliefs about teaching knowledge: Where does it come from? Does it change?. *The Journal of Experimental Education*, 77(4), 367-408.
- Burns, A. (1992). Teacher beliefs and their influence on classroom practice. *Prospect*, 7(3), 56-66.
- Cabeza, R., Locantore, J.K., & Anderson, N.D. (2003). Lateralization of prefrontal activity during episodic memory retrieval: Evidence for the production-monitoring hypothesis.

- Journal of Cognitive Neuroscience*, 15, 249–259.
- Calderhead, J. (1996). *Teachers: Beliefs and knowledge*. New York: Simon & Schuster Macmillan.
- Carter, R. (2014). *The human brain book: An illustrated guide to its structure, function, and disorders*. New York, NY: DK Publishing
- Chao, L. L., & Martin, A. (2000). Representation of manipulable man-made objects in the dorsal stream. *Neuroimage*, 12, 478-484.
- Cheng, T. (2016, January). Same word, different meanings: Common miscommunications between neuroscience and society [Web log post]. Retrieved from <https://www.learningandthebrain.com/blog/2016/01/>
- Chomsky, N. (1959). A review of BF Skinner's Verbal Behavior. *Language*, 35(1), 26-58.
- Chomsky, N. (1965). *Aspects of the Theory of Syntax*. Cambridge: University Press.
- Chomsky, N. (1975). *Reflections on language: The hidden lectures*. New York: Pantheon Books.
- Chowdhury, S., & DeAngelis, G. (2008). Fine discrimination training alters the causal contribution of macaque area MT to depth perception. *Neuron*, 60, 367–377.
- Clandinin, D. J., & Connelly, F. M. (2000). *Narrative inquiry: Experience and story in qualitative research*. San Francisco, CA: Jossey-Bass.
- Coe, R., Aloisi, C., Higgins, S., & Major, L. E. (2014). *What makes great teaching? Review of the underpinning research*. Retrieved from <https://www.suttontrust.com/wp-content/uploads/2014/10/What-makes-great-teaching-FINAL-4.11.14-1.pdf>
- Cohen, G. (2000). Hierarchical models in cognition: Do they have psychological reality? *European Journal of Cognitive Psychology*, 12, 1-36.

- Comer, J., Haynes, N., Joyner, E., & Ben-Avie, M. (1996). *Rallying the whole village: The Comer process for reforming education*. New York, NY: Teachers College Press.
- Conway, M. A. (1992). A structural model of autobiographical memory. In M. A. Conway, D. C. Rubin, H. Spinnler, & W. A. Wagenaar (Eds.), *Theoretical perspectives on autobiographical memory* (p. 167-193). Dordrecht: Kluwer Academic.
- Cooper, J. E. (2007). Strengthening the case for community-based learning in teacher education. *Journal of Teacher Education*, 58(3), 245-255.
- Cowan, N. (1988). Evolving conceptions of memory storage, selective attention and their mutual constraints within the human information-processing system. *Psychological Bulletin*, 104, 163-191.
- Cozolino, L., & Sprokay, S. (2006). Neuroscience and adult learning. *New Directions for Adult and Continuing Education*, 2006(110), 11-19.
- Craik, F. I. (2002). Levels of processing: Past, present... and future? *Memory*, 10(5-6), 305-318.
- Creswell, C.W. (2014). *Research design: Qualitative, quantitative, and mixed methods approaches*. (4th ed.) Thousand Oaks, CA: SAGE Publications.
- Cromer, R. (1974). The development of language and cognition: The cognition hypothesis. *New perspectives in child development*, 184-252.
- Cumming, A. (1989). Student teachers' conceptions of curriculum: Toward an understanding of language-teacher development. *TESL Canada Journal*, 7(1), 33-51.
- Curran, T. (2000). Brain potentials of recollection and familiarity. *Memory & Cognition*, 28, 923-938.
- Damasio, A. R., & Geschwind, N. (1984). *Annu. Rev. Neurosci*, 7, 127.

- Dana Foundation. (2009). *Publications*. Retrieved from <http://www.dana.org/Publications/ReportDetails.aspx?id=44335>
- Danielson, K. (2016). *Literacy content and core practices: Teacher educator pedagogy as the bridge between knowing and doing*. Retrieved from ProQuest Digital Dissertations (10138447)
- Davenport, J., & Davenport, J. A. (1985). A chronology and analysis of the andragogy debate. *Adult Educational Quarterly*, 35(3), 152-159.
- Deligianni, F., Senju, A., Gergely, G., & Csibra, G. (2011). Automated gaze-contingent objects elicit orientation following in 8-month-old infants. *Developmental Psychology*, 47, 1499-1503.
- Denzin, N. K., & Lincoln, Y. S. (2005). *The Sage handbook of qualitative research* (3rd ed.). Thousand Oaks, CA: Sage.
- Dewey, J. (1938). *Experience and education*. New York: Simon and Schuster.
- Dinishak, J. (2016). The deficit view and its critics. *Disability Studies Quarterly*, 36(4), 1041-5718.
- Dove, M. J., Pearson, L. C., & Hooper, H. (2010). Relationship between grade span configuration and academic achievement. *Journal of Advanced Academics*, 21(2), 272-298.
- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child development*, 82(1), 405-432.
- Dweck, C. (2000). *Self-Theories: Their role in motivation, personality, and development*. New York: Psychology Press.

- Edelenbosch, R., Kupper, F., Krabbendam, L., & Broerse, J. E. W. (2015). Brain-based learning and educational neuroscience: Boundary work. *Mind, Brain, and Education*, 9(1), 40-49.
- Egorova, N., Shtyrov, Y., & Pulvermüller, F. (2016). Brain basis of communicative actions in language. *NeuroImage*, 125, 857-867.
- Elias, J. L. (1979). Critique: Andragogy revisited. *Adult Education*, 29(4), 252-256.
- Ellemers, N., Spears, R., & Doosje, B. (2002). Self and social identity. *Annual review of psychology*, 53(1), 161-186.
- Enríquez, L. (2017). Fractal: An educational model for the convergence of formal and non-formal education. *Open Praxis*, 9(4), 375-386.
- Erickson, H. L. (2008). *Stirring the head, heart, and soul: Redefining curriculum, instruction, and concept-based learning* (3<sup>rd</sup> ed.). Thousand Oaks, CA: Corwin Press.
- Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance improvement quarterly*, 6(4), 50-72.
- Fischer, K., Goswami, U., Geake, J. & The Task Force on the Future of Educational Neuroscience. (2010). The future of educational neuroscience. *Mind, Brain, and Education*, 4, 68-80.
- Fiser, J., Berkes, P., Orbán, G., & Lengyel, M. (2010). Statistically optimal perception and learning: from behavior to neural representations. *Trends in cognitive sciences*, 14(3), 119-130.
- Freire, P. (1970). *Pedagogy of the oppressed* (30th ed.). New York, NY: Continuum.
- Frith, C., & Frith, U. (2005). Theory of mind. *Current Biology*, 15(17), 644-645.

- Frith, C. D., & Frith, U. (2007). Social cognition in humans. *Current Biology*, 17(16), R724-R732.
- Gainotti, G., Ciaraffa, F., Silveri, M. C., & Marra, C. (2009). Mental representation of normal subjects about the sources of knowledge in different semantic categories and unique entities. *Neuropsychology*, 23(6), 803.
- Gallistel, C. R., & Matzel, L. D. (2013). The neuroscience of learning: Beyond the Hebbian Synapse. *Annu. Rev. Psychol.*, 64, 169-200.
- García Carrasco, J., Hernández Serrano, M. J., & Martín Garcia, A. V. (2015). Plasticity as a framing concept enabling transdisciplinary understanding and research in neuroscience and education. *Learning Media and Technology*, 40(2), 152-167.
- Garcia, E., Arias, M. B., Harris Murri, J., & Serna, C. (2010). Developing responsive teachers: A challenge for a demographic reality. *Journal of Teacher Education*, 61(1-2), 132-142.
- Garrison, M. J. (2009). *A measure of failure: The political origins of standardized testing*. New York, Albany: SUNY Press.
- Geake, J. G. (2004) Cognitive Neuroscience and Education: Two-way traffic or one-way street? *Westminster Studies in Education*, 27:1, pp. 87–98
- Gillett, G. (1989). Perception and neuroscience. *The British Journal for the Philosophy of Science*, 40(1), 83-103.
- Goddard, R. D., Hoy, W. K., & Hoy, A. W. (2000). Collective teacher efficacy: Its meaning, measure, and impact on student achievement. *American Educational Research Journal*, 37(2), 479-507.



- Goldberger, N., Tarule, J., Clinchy, B., & Belenky, M. (1995). *Knowledge, difference, and power: Essays inspired by women's ways of knowing*. New York: Basic Books.
- Goldman, A. I. (2012). Theory of mind. *The Oxford handbook of philosophy of cognitive science*, 402-424.
- Goldstone, R. (1998). Perceptual learning. *Annual Review of Psychology*, 49, 585–612.
- Goodale, M. A., Milner, A. D., Jakobson, L. S., & Carey, D. P. (1991). A neurological dissociation between perceiving objects and grasping them. *Nature*, 349, 154-156.
- Gottfried, A. E. (1985). Academic intrinsic motivation in elementary and junior high school students. *Journal of Educational Psychology*, 77, 631–645.
- Gregory, A., Bell, J., & Pollock, M. (2014). How educators can eradicate disparities in school discipline: A briefing paper on school-based interventions. *Discipline Disparities Research to Practice Collaborative*, 1-15.
- Green-Mitchell, A. (2016). An Investigation of Language Acquisition as an Antecedent to Pro-Social Development for Secondary Students at Risk for Behavior Disorders. *Graduate Theses and Dissertations*. 6.
- Greeno, J. G., Collins, A. M., & Resnick, L. B. (1996). Cognition and learning. In D. C. Berliner & R. C. Calfee (Eds.), *Handbook of educational psychology*. New York: Simon & Schuster Macmillan.
- Gresham, F. (2015). Evidence-based social skills interventions for students at risk for EBD. *Remedial and Special Education*, 36(2), 100-104.
- Griffiths, O., & Mitchell, C. J. (2008). Selective attention in human associative learning and recognition memory. *Exp. Psychol: Gen.*, 137, 626-648.
- Griner, A. C., & Stewart, M. L. (2012). Addressing the Achievement Gap and Disproportionality

- Through the Use of Culturally Responsive Teaching Practices. *Urban Education*, 48(4), 585–621.
- Gu, Y., Liu, S., Fetsch, C., Yang, Y. Fok, S., Sunkara, A., et al. (2011). Perceptual learning reduces interneuronal correlations in macaque visual cortex. *Neuron*, 71, 750-761.
- Guba, E.G. (1981). Criteria for assessing the trustworthiness of naturalistic of naturalistic inquiries. *Educational Communication and Technology Journal*, 29, 75-91.
- Hagen, M, & Park, S. (2016). We knew it all along! Using cognitive science to explain how andragogy works. *European Journal of Training and Development*, 40(3), 171-190.
- Hall, G., & Hord, S. (2001). *Implementing change: Patterns, principles and potholes*. Boston, MA: Allyn and Bacon.
- Halliday, M. A. K. (1977). *Learning how to mean: Explorations in the development of language*. New York: Elsevier.
- Hamre, B., & Pianta, R. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development*, 72, 625-638.
- Hanson, A. (1996). *The search for a separate theory of adult learning: Does anyone really need andragogy?* New York. Routledge.
- Hardiman, M., Rinne, L., Gregory, E., & Yarmolinskaya, J. (2011). Neuroethics, neuroeducation, and classroom teaching: Where the brain sciences meet pedagogy. *Neuroethics*, 5(2), 1-9.
- Hattie, J. (2012). *Visible learning for teachers: Maximizing impact on learning*. New York, NY: Routledge.
- Haynes, N. M. (2002). Addressing students' social and emotional needs: the role of mental health teams in schools. *Journal of health & social policy*, 16(1-2), 109-123.

- Heeger, D. J. (2017). Theory of cortical function. *Proceedings of the National Academy of Sciences*, *114*(8), 1773-1782.
- Heller, J. (2004). *Catch-22*. New York: Simon & Schuster Paperbacks.
- Henschke, J.A. (1998). Historical antecedents shaping conceptions of andragogy: A comparison of sources and roots. Paper presented at the International Conference on Research in Comparative Andragogy, Radovljica, Slovenia.
- Hickey, D. T. (1997). Motivation and contemporary socio-constructivist instructional perspectives. *Educational Psychologist*, *32*(3), 175-193.
- Hill, L. H. (1998). Changes of the Human Mind. *Adult Education Quarterly*, *49*(1), 56-64.
- Hill, I. (2012). Evolution of education for international mindedness. *Journal of Research in International Education*, *11*(3), 245-261.
- Holly, M. L., Arhar, J. M., & Kasten, W. C. (2009). *Action research for teachers traveling the yellow brick road* (Third Edition). Boston, MA: Pearson.
- Holmes, G., & Abington-Cooper, M. (2000). *Pedagogy vs. andragogy: A false dichotomy?*. Retrieved from <https://scholar.lib.vt.edu/ejournals/JOTS/Summer-Fall-2000/holmes.html#davenport1985>
- Hook, C. J., & Farah, M. J. (2013). Neuroscience for educators: What are they seeking, and what are they finding? *Neuroethics*, *6*(2), 331–341. doi: 10.1007/s12152-012-9159-3
- Horowitz, F. D. (1992). John B. Watson's legacy: Learning and environment. *Developmental Psychology*, *28*(3), 360.
- Humphrey, N. K. (1976). The social function of intellect. In *Growing points in ethology* (pp. 303-317). Cambridge University Press.

- Immordino-Yang, M. H. (2011). Implications of affective and social neuroscience for educational theory. *Educational Philosophy and Theory*, 43(1), 98-103.
- James, P. (1997). Narrative and cultural change: Enabling transformative learning for adults. *Australian Journal of Adult and Community Education*, 37, 135-143.
- Jaskowiak, E. (2018). "Is it his language?" A Neuroeducation Approach to Exploring the Connection Between Levels of Language Function and Prosocial Concepts for Elementary Students Identified with Emotional and Behavioral Disorders. *Graduate Theses and Dissertations*. 39.
- Jeder, D. (2014). Transdisciplinarity—The advantage of a holistic approach to life. *Procedia-Social and Behavioral Sciences*, 137, 127-131.
- Johns Hopkins School of Education. (2018). *Neuro-Education initiative*. Retrieved from <http://education.jhu.edu/research/neuro-education-initiative/>
- Jong, E. (2014). Neuroscience research and post-secondary education: How do adult educators perceive neuroscience research in informing educational practices? Annual Conference Proceedings: Canadian Association for the Study of Adult Education/ L'Association Canadienne pour les Étude De L'éducation des Adults.
- Kanselaar, G. (2002). Constructivism and socio-constructivism. *Constructivism and socio-constructivism*, 1-7.
- Karamian, A. I., Fanardijian, V. V., & Kosareva, A. A. (1969). Neurobiology of cerebellar evolution and development. American Medical Association, Chicago. *Pavlova*, 7, 733.
- Knowles, J. G., & Holt-Reynolds, D. (1991). Shaping pedagogies through personal histories in pre-service teacher education. *Teachers College Record*, 93, 87–113.

- Knowles, M. (1973). *The adult learner: A neglected species*. Houston, TX: Gulf Publishing Company.
- Knowles, M. S. (1970). *The modern practice of adult education: Andragogy versus pedagogy*. Oxford, England: Association Press.
- Knowles, M. (1980). *The modern practice of adult education: From pedagogy to andragogy*. Englewoods Cliff, NJ: Cambridge Adult Education.
- Knowles, M. (1984a). *Andragogy in Action*. San Francisco: Jossey-Bass.
- Knowles, M. (1984b). *The adult learner* (3rd ed.). Houston, TX: Gulf Pub.
- Knowles, M. S. (1989). *The making of an adult educator: An autobiographical journey*. Jossey-Bass Inc Pub.
- Knowles, M.S., Elwood, R., Holton III R, & Swanson A. (1998). *The Adult Learner: The Definitive Classic in Adult Education and Human Resource Development*. 5th edition, New York: Heinemann.
- Knowles, M., Holton, E., & Swanson, R. (2005). *The adult learner: The definitive classic in adult education and human resource development*. 6th Edition, New York, NY: Routledge.
- Koizumi, H. (2003). The concept of developing the brain: A new natural science for learning and education. *Brain & Development*, 26, 434-441.
- Kolb, D. (1984). *Experiential learning: Experience as a source of learning and development*. Upper Saddle River, NJ: Prentice Hall.
- Kolb, A. Y., & Kolb, D. A. (2005). Learning styles and learning spaces: Enhancing experiential learning in higher education. *Academy of Management Learning & Education*, 4, 193-212.

- Kolb, A., & Kolb, D. (2009). The learning way: Meta-cognitive aspects of experiential learning. *Simulation & Gaming, 40*(3), 297-327.
- Kuhl, P. K. (2000). A new view of language acquisition. *Proceedings of the National Academy of Sciences, 97*(22), 11850-11857.
- Kuhl, P. K. (2007). Is speech learning 'gated' by the social brain?. *Developmental science, 10*(1), 110-120.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. London: Cambridge University Press. doi:10.2307/2804509
- Law, C., & Gold, J. (2009). Reinforcement learning can account for associative and perceptual learning on a visual-decision task. *Nature Neuroscience, 12*, 655-663.
- Leaton, R. N., & Supple, W. F. (N.D.) *Science*, in press.
- Lee, C. (1998). The adult learner: Neglected no more. *Training, 35*(3), 47-52.
- Leibbrand, J., & Watson, B. (2010). *The road less traveled: How the developmental sciences can prepare educators to improve student achievement: Policy recommendations*. Retrieved from <https://files.eric.ed.gov/fulltext/ED550407.pdf>
- Lesser, E. L., & Storck, J. (2001). Communities of practice and organizational performance. *IBM systems journal, 40*(4), 831-841.
- Levin, R. A. (1991). The debate over schooling: Influences of Dewey and Thorndike. *Childhood Education, 68*(2), 71-75.
- Levin, T., & Nevo, Y. (2009). Exploring teachers' views on learning and teaching in the context of a trans-disciplinary curriculum. *Journal of Curriculum Studies, 41*(4), 439-465.
- Limb, C. (2010). Why neuroeducation? *New Horizons for Learning, VIII*(1).
- Lindeman, E. C. L. (1926). *The meaning of adult education*. New Republic: New York.

- London, J. (1973). Adult education for the 1970's: Promise or illusion? *Adult Education*, 24(1), 60-70.
- Lucas, E. (1980). *Semantic and pragmatic language disorder*. Rockville, MD: Aspen Systems Corporation.
- Lucas, E. (1991). *Semantic and pragmatic language disorder*. Rockville, MD: Aspen Systems Corporation.
- MacGill, B. (2016). A paradigm shift in education: Pedagogy, standpoint and ethics of care. *International Journal of Pedagogies and Learning*, 11(1), 238-247.
- Maddalena, L. (2015). *What the #!\$% is andragogy? (Pedagogy for grownups)*. Retrieved from <https://refworks.proquest.com/library/read/doc:5a1327bce4b03a0f90255f9c/>
- Mahon, B.Z., & Caramazza, A. (2008). A critical look at the embodied cognition hypothesis and a new proposal for grounding conceptual content. *Journal of Physiology Paris*, 102(1-3), 59-70.
- McCabe, A., & O'Connor, U. (2014). Student-centered learning: The role and responsibility of the lecturer. *Teaching In Higher Education*, 19(4), 350-359.  
Doi:10.1080/13562517.2013.860111
- McGilvray, J. (2005). *The Cambridge companion to Chomsky*. Cambridge: University Press.
- McGrath, V. (2009). Reviewing the Evidence on How Adult Students Learn: An Examination of Knowles' Model of Andragogy. *Adult Learner: The Irish Journal of Adult and Community Education*, 99, 110.
- McKay, R. & Dennett, D. (2009). The Evolution of misbelief. *Behavioral and Brain Sciences*, 32, 493-561.

- Meltzoff, A. N., Kuhl, P. K., Movellan, J., & Sejnowski, T. J. (2009). Foundations for a new science of learning. *Science, New Series*, 325(5938), 284-288.
- Merriam, S. B. (2001). Andragogy and self-directed learning: Pillars of adult learning theory. *New directions for adult and continuing education*, 2001(89), 3-14.
- Merriam, S. B. (2009). *Qualitative research: A Guide to design and implementation*. San Francisco, CA: John Wiley & Sons, Inc.
- Merriam, S. B., Caffarella, R. S., & Baumgartner, L. (2007). *Learning in adulthood: A comprehensive guide* (3rd ed.). San Francisco: Jossey-Bass.
- Mezirow, J. (1997). Transformative learning: Theory to practice. *New Directions for Adult and Continuing Education*, 74, 5–12. doi:10.1002/ace.7401
- Miles, M., Huberman, M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook* [third edition]. Thousand Oaks, CA: SAGE Publishers.
- Milner, B. & Petrides, M. (1984). *Trends Neurosci*, 7, 403.
- Missett, T. C., & Foster, L. H. (2015). Searching for Evidence-Based Practice: A Survey of Empirical Studies on Curricular Interventions Measuring and Reporting Fidelity of Implementation Published During 2004-2013. *Journal of Advanced Academics*, 26(2), 96-111. doi:10.1177/1932202x15577206
- Monts, B. (2000). Andragogy or pedagogy: A discussion of instructional methodology for adult learners. *Unpublished paper, Illinois State University*.
- Moore, J. (1987). The roots of the family tree: A review of four books on the history and nature of behaviorism. *The Psychological Record*, 37(4), 449-470.
- Morgan, H. (2003). *Real learning: A bridge to cognitive neuroscience*. Lanham, MD: Scarecrow Education.



- Moseley, R., & Pulvermüller, F. (2014). Nouns, verbs, objects, actions, and abstractions: Local fMRI activity indexes semantics, not lexical categories. *Brain & Language, 132*, 28-42.
- Muijs, D. (2011). *Doing quantitative research in education with SPSS* (2nd edition). Thousand Oaks, CA: SAGE Publications Inc.
- Murphy, S. C. (2016). The promise and pitfalls of neuroeducation as a grounding for instructional practices: An exploration of K-12 application and assessment. *Graduate Theses and Dissertations, 19*. Retrieved from <http://pilotscholars.up.edu/etd/19>
- Neuroeducation. (2018). In *Definitions*. Retrieved from <http://www.definitions.net/definition/NEUROEDUCATION>
- Neuroeducation. (2018). In *Wiktionary*. Retrieved from <https://en.wiktionary.org/wiki/neuroeducation>
- Neuroeducation. (2018). In *Your Dictionary*. Retrieved from <http://www.yourdictionary.com/neuroeducation>
- Oleson, A., & Hora, M. T. (2014). Teaching the way they were taught? Revisiting the sources of teaching knowledge and the role of prior experience in shaping faculty teaching practices. *Higher Education, 68*(1), 29-45.
- Owens, D. D. (2010). Commercial Reading Programmes as the Solution for Children Living in Poverty. *Literacy, 44*(3), 112-121. doi:10.1111/j.1741- 4369.2010.00548.x
- Paleeri, S. (2010). Chomskyan Cognitivism and Linguistic: Irreproachable Ideals for Educational Psychology and Designing Learning. *i-Manager's Journal on Educational Psychology, 4*(3), 21.
- Patton, M. Q. (2002). *Qualitative research and evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage.

- Peirce, C. S. (1902). *Logic as semiotic: The theory of signs*.
- Peirce, C. S. (1905). Issues of pragmatism. *The Monist*, 15(4), 481-499.
- Piaget, J. 1936. The origins of intelligence in children. (Trans, by Margaret Cook.) New York: International Universal Press, 1952.
- Piaget, J. (1959). *The language and thought of the child* (3rd ed. [rev. and enl.] ed.). London: Routledge & Kegan Paul.
- Piaget, J. (1969). *The Mechanisms of Perception*. London: Routledge and Kegan Paul.
- Popkewitz, T. (1998). Dewey, Vygotsky, and the social administration of the individual: Constructivist pedagogy as systems of ideas in historical spaces. *American Educational Research Journal Winter*, 35(5), 535-570.
- Popkewitz, T., & Brennan, M. (1998). *Foucault's challenge: Discourse, knowledge and power in education*. New York: Teachers College Press.
- Poulson, M. (2016, October 15). [Lecture]. Functional assessment: Curriculum and instruction for diverse learners. University of Portland.
- Pratt, D. D. (1993). Andragogy after twenty-five years. *New directions for adult and continuing education*, (57), 15-23.
- Pulvermüller, F. (1999). Words in the brain's language. *Behav. BrainSci.*, 22, 253–336.
- Pulvermüller, F. (2005). Brain mechanisms linking language and action. *Nature reviews. Neuroscience*, 6(7), 576.
- Pulvermüller, F. (2012). Meaning and the brain: The neurosemantics of referential, interactive, and combinatorial knowledge. *Journal of Neurolinguistics*, 25(5), 423–459.  
<http://dx.doi.org/10.1016/j.jneuroling.2011.03.004>.

- Pulvermüller, F. (2013). Semantic embodiment, disembodiment or misembodiment? In search of meaning in modules and neuron circuits. *Brain & Language*, *127*, 86-103.
- Pulvermüller, F., & Fadiga, L. (2010). Active perception: sensorimotor circuits as a cortical basis for language. *Nature Reviews Neuroscience*, *11*(5), 351.
- Pulvermüller, F., Kherif, F., Hauk, O., Mohr, B., & Nimmo-Smith, I. (2009). Distributed cell assemblies for general lexical and category-specific semantic processing as revealed by fMRI cluster analysis. *Hum. Brain Mapp.*, *30*, 3837–3850.
- Rachal, J. R. (1994). *Andragogical and pedagogical methods compared: A review of the experimental literature* (Report). Hattisburg: University of Southern Mississippi. (ERIC Document Reproduction Service No. ED 380 566)
- Rachal, J. R. (2002). Andragogy's detectives: A critique of the present and a proposal for the future. *Adult Education Quarterly*, *52*(3), 210.
- Rappolt-Schlichtmann, G., Boucher, A. R., & Evans, M. (2018). From deficit remediation to capacity building: Learning to enable rather than disable students with dyslexia. *Language, speech, and hearing services in schools*, *49*(4), 864-874.
- Reas, E.T., & Brewer, J.B. (2013). Retrieval search and strength evoke dissociable brain activity during episodic memory recall. *Journal of Cognitive Neuroscience*, *25*, 219–233.
- Reed, E. S. (1996). *Encountering the world: Toward an ecological psychology*. New York: Oxford University Press.
- Rev. (2019). *Security & privacy at Rev*. Retrieved from: <https://www.rev.com/security>
- Reisberg, D. (2013). *The Oxford handbook of cognitive psychology*: Oxford University Press.
- Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. *Handbook of research on teacher education*, *2*, 102-119.

- Robb, B. E. (2016). A paradigm shift in classroom learning practices to propose methods aligned with a neuroeducation conceptual framework. *Graduate Theses and Dissertations. 2*. Retrieved from <http://pilotscholars.up.edu/etd/2>
- Roberson, D. (2002). *Andragogy in color*. Retrieved from <https://refworks.proquest.com/library/read/doc:5a135895e4b0c5584aef010c/>
- Roberts, T. G. (2003). An interpretation of Dewey's experiential learning theory. *Opinion Papers*.
- Ross, J. A. (1994). *Beliefs That Make a Difference: The Origins and Impacts of Teacher Efficacy*. Retrieved from <https://files.eric.ed.gov/fulltext/ED379216.pdf>
- Rizo, F. M. (1991). The controversy about quantification in social research: an extension of Gage's "Historical Sketch". *Educational Researcher*, 20(9), 9-12.
- Saldaña, J. (2013). *The coding manual for qualitative researchers*. Thousand Oaks, CA: SAGE Publications Inc.
- Saldaña, J. (2016). *The coding manual for qualitative researchers*. London: SAGE Publications Ltd.
- Saunders, C. E. (1991). Pedagogy vs. andragogy: Are we treating our student like children? *Military Intelligence Professional Bulletin*, 17(1), 42.
- Schenck, J., & Cruickshank, J. (2015). Evolving Kolb: Experiential education in the age of neuroscience. *Journal of Experiential Education*, 38(1), 73-95.
- Scheurman, G. (1998). From behaviorist to constructivist teaching. *Social Education*, 62, 6-9.
- Schunk, D. H. (2012). *Learning theories an educational perspective sixth edition*. Pearson.

- Scott, S. M. (1991). Personal transformation through participation in social action: A case study of the leaders in the Lincoln Alliance. Unpublished doctoral dissertation, University of Nebraska, Lincoln.
- Searle, J. R. (1969). *Speech acts: An essay in the philosophy of language*. London: C.U.P.
- Shanks, D. R. (2010). Learning: From association to cognition. *Annual review of psychology*, 61, 273-301.
- Shenton, A.K. (2003). *Strategies for ensuring trustworthiness in qualitative research projects*. Retrieved from <https://pdfs.semanticscholar.org/452e/3393e3ecc34f913e8c49d8faf19b9f89b75d.pdf>
- Siegler, R. S. (2002). *Microgenetic studies of self-explanations*. In N. Granott & J. Parziale (Eds.), *Microdevelopment: Transition processes in development and learning* (pp.31–58). New York: Cambridge University.
- Skerry, A., Lambert, E., Powell, L., & McAuliffe, K. (2013). The origins of pedagogy: Developmental and evolutionary perspectives. *Evolutionary Psychology*, 11(3), 550-572.
- Skinner, B. F. (1953). *Science and human behavior*. Simon and Schuster.
- Skinner, E. A., & Belmont, M. J. (1993). Motivation in the classroom: Reciprocal effects of teacher behavior and student engagement across the school year. *Journal of Educational Psychology*, 85, 571-581.
- Skrandies, W., Jedynak, A., & Fahle, M. (2001). Perceptual learning: psychophysical thresholds and electrical brain topography. *International Journal of Psychophysiology*, 41(2), 119-129.
- Smith, M. (2003). Communities of practice, the encyclopedia of informal education. Retrieved from [www.infed.org/biblio/communities\\_of\\_practice.htm](http://www.infed.org/biblio/communities_of_practice.htm).

- Sommer, A. (2017). How experiences influence and inform school principals' actions to further develop teachers' instructional practice. Retrieved from ProQuest Dissertations & Theses Global. (AAT 10264582)
- Stein, M. K., & Wang, M. C. (1988). Teacher development and school improvement: The process of teacher change. *Teaching and Teacher Education, 4*(2), 171-187.
- Stern, H. H., Stern, H. H., Tarone, E. E., Stern, H., & Yule, G. (1983). *Fundamental concepts of language teaching: Historical and interdisciplinary perspectives on applied linguistic research*. Oxford University Press.
- Stitt-Gohdes, W.L. (2001). Business education students' preferred learning styles and their teachers' preferred instructional styles: Do they match? *Delta Pi Epsilon Journal, 43*(3), 137-151.
- Sweet, A. P., Guthrie, J. T., & Ng, M. M. (1998). Teacher perceptions and student reading motivation. *Journal of Educational Psychology, 90*(2), 210.
- Sylwester, R. (1995). *A celebration of neurons: An educator's guide to the human brain*. Alexandria, VA: ASCD.
- Taylor, E. (2000). Fostering Mezirow's transformative learning theory in the adult education classroom: A critical review. *The Canadian Journal for the Study of Adult Education, 14*(2), 1-28.
- Taylor, B., & Kroth, M. (2009). Andragogy's transition into the future: Meta-analysis of andragogy and its search for a measurable instrument. *Journal of Adult Education, 38*(1), 1-11.
- Taylor, K. (2006). Brain function and adult learning: Implications for practice. *New Directions for Adult and Continuing Education, 2006*(110), 71-85.

- Thompson, R. F. (1986). The neurobiology of learning and memory. *Science*, 233, 941-948.
- Thorndike, E. L. (1898). Animal intelligence: An experimental study of the associative processes in animals. *The Psychological Review: Monograph Supplements*, 2(4), i.
- Thorndike, E. L., Bregman, E. O., Tilton, J. W., & Woodyard, E. (1928). *Adult Learning*. New York: Macmillan.
- Thorndike, E. L. (1932a). *A teacher's word book of the twenty thousand words found most frequently and widely in general reading for children and young people*. New York, NY: Teachers College, Columbia University.
- Thorndike, E. L. (1932b). Reward and punishment in animal learning. *Comparative Psychology Monographs*, 8(4), 65.
- Tivnan, T., & Hemphill, L. (2005). Comparing Four Literacy Reform Models in High- Poverty Schools: Patterns of First-Grade Achievement. *The Elementary School Journal*, 105(5), 419-441. doi:10.1086/431885
- Tokuhama-Espinosa, T. (2008). Summary of the international Delphi expert survey on the emerging field of neuroeducation (Mind, Brain, And Education/Educational Neuroscience). *Unpublished document*.
- Tommerdahl, J. (2010). A model for bridging the gap between neuroscience and education. *Oxford Review of Education*, 36(1), 97-109.
- Tschannen-Moran, M., Woolfolk Hoy, A. & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. *Review of Educational Research*, 68, 202 - 248.
- Tunks, J., & Weller, K. (2009). Changing practice, changing minds, from arithmetical to algebraic thinking: An application of the concerns-based adoption model (CBAM). *Educational Studies in Mathematics*, 72, 161-183.

- Turner, K. M. T., Nicholson, J. M., & Sanders, M. R. (2011). The role of practitioner self-efficacy, training, program, and workplace factors on the implementation of an evidence based parenting intervention in primary care. *Journal of Primary Prevention, 32*(2), 95-112.
- Valencia, R. R. (2012). *The evolution of deficit thinking: Educational thought and practice*. London and New York: RoutledgeFalmer.
- Visser, J. (1999) Overcoming the underdevelopment of learning: a trans-disciplinary view. Paper presented at the Annual Meeting of the American Educational Research Association, Montreal, Canada. ERIC ED 433 361.
- Vygotsky, L. S. (1962). *Thought and language*. Cambridge, MA: MIT Press.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological process*. Cambridge, MA: Harvard University Press.
- Vygotsky, L. S. (1981). *The genesis of higher mental functions*. In Wertsch, J.V. (Ed.), *The concept of activity in Soviet psychology* (pp. 144-188). Armonk, NY: M.E. Sharpe.
- Wagner, K. M. (2016). *The Mindfully Embedded Classroom: An Investigation of the Mindfulness Traits, Philosophies, and Practices of High School Teachers*. *Graduate Theses and Dissertations*. 11.
- Wandell, B. A., & Winawer, J. (2011). Imagining retinopic maps in the human brain. *Vision Research, 51*, 718-737. Doi:10.1016/j.visres.2010.08.004
- Wellman, H. M. (2014). *Making minds: How theory of mind develops*: Oxford University Press.
- Wellman, H. M., & Liu, D. (2007). Causal reasoning as informed by the early development of explanations. *Causal Learning: Psychology, Philosophy, and Computation*, 261-279.



- Wenger, E. (1998). Communities of practice: Learning as a social system. *Systems thinker*, 9(5), 2-3.
- Wentzel, K. (2003). Are effective teachers like good parents? Teaching styles and student adjustment in early adolescence. *Child Development*, 73(1), 287-301.
- Wijayanti, D. N. (2012). *The essay of behaviorism theory of language teaching and learning*. Retrieved from <https://mydreamarea.wordpress.com/author/mydreamarea/page/2/>
- Williams, J. J., & Lombrozo, T. (2013). Explanation and prior knowledge interact to guide learning. *Cognitive psychology*, 66(1), 55-84.
- Wilson, C. (2006). *No one is too old to learn (Neuroandragogy: A theoretical perspective on adult brain functions and adult learning)*. Lincoln, NE: iUniverse.
- Wohlwill, J. (1958). The definition and analysis of perceptual learning. *Psychological Review*, 65(5), 283-295.
- Wolfe, P. (2010). Brain matters: Translating research into classroom practice. Retrieved from: <http://www.ascd.org/Publications/Books/Overview/Brain-Matters-Translating-Research-into-Classroom-Practice-2nd-Edition.aspx>
- Worlfgang, B. (2006). *Noam Chomsky*. London: Reaktion Books.
- Xiang Lam, C. (2016). Investigating semantic alignment in character learning of Chinese as a foreign language: The use and effect of the imagery based encoding strategy. *Graduate Theses and Dissertations*. 1.
- Yeo, C. H., Hardiman, M. J., & Glickstein, M. (1985). *Exp. Brain Res.*, 60, 87.
- Zull, J. (2002). *The art of changing the brain*. Sterling, VA: Stylus.

## Appendix A: Email: Experts

Hello,

My name is Matt Thul. I am in the process of collecting data for my dissertation. I am contacting experts in the field who have graduated from the Pacific Northwest University's neuroeducation program and either have or currently are working with adult learners. Below are more details about my study. The attached document is your consent to participate in this study as an expert in the field. I am thanking you in advance for your willingness to participate!

**Purpose of the study:** To investigate the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b) perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings.

**Your role in this study:** As an expert in the field, your role in this study will be to:

- 1) Help the researcher check over or refine the semi-structured interview questions for focal participants of the study;
- 2) Participate in an expert-focused, semi-structured interview investigating your current perceptions of neuroeducation learning and applications into your professional and personal life.

**How anonymity will be accomplished:** Pseudonyms will be used to protect the identities of all participants. Within the dissertation, the university name will be anonymized.

**Why your responses matter?** Your narratives will help share with professionals a holistic perspective of learning, provide perceptions into meaningful instructional practices you currently use, and serve as a point for which the researcher will triangulate with supporting literature surrounding holistic instruction and the perceptions and implementation strategies of graduate students (focal participants) who received an adult learning class emphasizing the understanding of learning from a neuroeducation framework.

**How to participate?** Participating as an expert in this study is completely voluntary. The interview and semi-structured interview revisions should take 10-15 minutes each to complete. There are 7 interview questions total. More information regarding initial communication with the researcher is provided in the attached consent form. There are no known risks for participating in this study. The results of this study may be used in reports, presentations, and publications but the researcher will not identify you or your institution. Phone and in-person responses will be audio-recorded for validity purposes and secured on a password-protected device.

To participate:

- 1) Please download the attached document;
- 2) Answer highlighted areas and type your name at the bottom of the document signifying your consent to participate;
- 3) Send the document back to the researcher as an attachment in the response email.

To not participate:

- 1) Respond to this email saying you will not be participating in this study.

Thank you for your consideration to participate in my research study. If you have any additional questions for me, please email or call me. This study has received IRB approval.

Thank you for your willingness to participate in my study as an expert in the field,

Matt Thul

**Appendix B: Consent Form: Experts**

Thank you for your willingness to participate in Matt Thul’s dissertation study. By typing your name below, you are signifying you have read the information provided to you in the initial email from the researcher and are giving your consent to participate in his study as an expert in the field. **This study includes participation in a:**

- 1) 10-15 minute, semi-structured interview and;**
- 2) 10-15 minute, check-over or refinement of semi-structured interview questions for focal participants**

Findings from the study will be included in my dissertation, which can be individually distributed upon request.

**Choose either to participate in an in-person interview or an interview over the phone.**

Would you like to interview in-person (mark with an **X**): Yes: \_\_\_\_\_ No: \_\_\_\_\_  
**Or**, would you like to participate over the phone (mark with an **X**): Yes: \_\_\_\_\_ No: \_\_\_\_\_

**Please include a phone number to best reach you: (\_\_\_\_)\_\_\_\_ - \_\_\_\_\_**

**Please include a day and time that works best to reach you: \_\_\_\_\_**

Interviews, both in-person and over the phone, will be audio recorded for validity purposes and secured on a password-protected mobile device in sole possession of the researcher.

**Please type your first and last name signifying your consent to participate in Matt Thul’s dissertations study:**

**First Name:** \_\_\_\_\_ **Last Name:** \_\_\_\_\_

Thank you for your willingness to participate in my study! I will be contacting you shortly to either set up a meeting time/place to conduct the semi-structured interview (as indicated above) or I will be calling you to conduct the interview over the phone (as indicated above) in which case I will send the semi-structured interview questions for the focal participants of the study so you can view them on your computer while we are talking on the phone. I look forward to hearing from you!

Thank you,  
 ~Matt Thul

### Appendix C: Semi-Structured Interview Questions: Experts

**About my study:** One purpose of my study is to investigate how an adult learning class with a transdisciplinary (i.e., neuroeducation) perspective of learning impacted adult learners' perceptions of learning and how they implemented those perceptions into their professional and personal lives. As a pacific northwest university Ed.D. graduate who has worked with or currently is working with adult learners and uses neuroeducation perspectives of learning within your instruction, your narratives are very important. **The first couple questions** are about your current job and your interest in neuroeducation, **then the next several questions** attempt to better understand your perceptions of learning, how you apply them, and their impacts on others around you.

#### Demographic Questions: Experts in the Field

##### **Tell me about your current job...**

- Profession/ Title
- Roles/ Responsibilities
- Work Hierarchy?
- K-12 Learners or Adult Learners?
- Years worked with this age of learner?

##### **Tell me about your interest in neuroeducation...**

- What made you choose neuroeducation as a tract selection?
- How many pacific northwest university, Ed.D. Neuroeducation courses did you take?

Semi-Structured Interview Questions: Experts in the Field (say... Now getting into the interview questions; each question is going to be related to neuroeducation in some way. Just to remind you, your identity won't be shared with anyone; your responses and demographic information won't be connected with your identity in any way, your cohort number won't be identified, and your real name won't be used in the study.)

1. For this question I want you to think about how you view yourself; **has a background in neuroeducation impacted who you are (in other words, your belief systems)?** (In what ways? or Why not?)
2. This question considers your perceptions of learning; **how has a background in neuroeducation influenced how you perceive learning occurs:**
  - a. for K-12 learners?
  - b. for adult learners?
  - c. within the field of education?
  - d. within your personal life?
3. This question considers your perceptions of learning and its implementation; **in what ways have you implemented neuroeducation-based perspectives in your:**
  - a. educational practice?
  - b. personal life?
4. This question considers your implementations of neuroeducation-based perspectives and their impacts on others; **how has implementation of your neuroeducation-based perspectives impacted:**
  - a. your adult learners (or K-12 learners)?
  - b. your work colleagues?
5. This question considers the potential impacts of an adult learning class with a neuroeducation perspective of learning on adult learners; **can one semester-long, adult learning class on adult learning theory (in other words, andragogy) with a neuroeducation perspective of learning cause a change in:**
  - a. adult learners' perceptions of learning for others? How? (or Why not?)
  - b. adult learners' professional or educational practice? How? (or Why not?)
  - c. adult learners' perceptions of learning for themselves? How? (or Why not?)

**Appendix D: Semi-Structured Interview Questions Refinement Protocol: Experts**

After the initial contact with experts in the field (setting up a time and place to meet or a time to talk over the phone), experts will be given the opportunity to help the researcher refine the interview questions that will be used on the focal participants of the study. The researcher will have each expert:

- **Read each question and give their input regarding terms used within the questions** (e.g., transdisciplinary); if an expert selects to participate over the phone, the researcher will send the semi-structured interview questions to the expert, in an email, one day before the designated meeting so the expert can directly see and review the questions in-person.
- **Experts can volunteer to participate in answering each question** to help give the researcher an idea for the length in time it takes to complete and generate ideas for possible responses **or the expert can give the researcher an estimated time of completion of the semi-structured interview questions by the focal participants.** The researcher would then adjust the allotted time scheduled for completion in the first part of focal participants' interviewing process (e.g., "Interviews will attempt to be accomplished within 15 minutes, therefore...").

Experts will be reminded before the refinement process that they will be audio recorded for validity and transcription purposes.

**Appendix E: Email: Focal Participants**

Dear Graduate,

My name is Matt Thul. I am in the process of collecting data for my dissertation. If you remember back to your last class, one of your cohort members passed around a paper asking for your name, email, and phone number, in regards to your willingness to participate in my study. Below are more details about my study. The attached document is your consent to participate. I am thanking you in advance for your willingness to participate!

**Purpose of the study:** To investigate the extent to which adults participating in a semester long course on adult learning theory with a neuroeducation approach to learning experienced changes in (a) perceptions of their identity; (b) perceptions of learning theory in professional and personal settings; (c) professional and personal implementation of learning theories; and (d) the perceived impacts of their implementations on those in their professional and personal settings.

**How findings will be disseminated:** The themes and transcriptions from your narratives will initially be shared with you over the phone or in person during the completion of member checks. Findings from the study will also be included in my dissertation, which can be individually distributed upon request.

**How anonymity will be accomplished:** Pseudonyms will be used to protect the identities of all participants. Within the dissertation, your cohort number and university name will be anonymized.

**Member checks:** Agreeing to participate in the study also means that you are agreeing to participate in a member check. Member checks reduces researcher bias and allows you the opportunity to extend on and clarify transcriptions and themes identified by the researcher. Member checks will be completed after the researcher has used an open-coding method to generate themes from your initial responses to the semi-structured interview questions.

**Why your responses matter?** Your narratives will help introduce professionals to a perspective of learning which can influence learning perceptions and change practices, narrow the gap of confusion surrounding adult and child learning theories, inform educational theory and practice centered around holistic learning, and provide students with meaningful and long-term learning opportunities.

**How to participate?** Participating in this study is completely voluntary. The interview and member check should take 10-15 minutes each to complete. There are 3 interview questions total. More information regarding initial communication with the researcher is provided in the attached consent form. There are no known risks for participating in this study. The results of this study may be used in reports, presentations, and publications but the researcher will not identify you or your institution. Phone and in-person responses will be audio-recorded for validity purposes and secured on a password-protected device.

To participate:

- 1) Please download the attached document;
- 2) Answer highlighted areas and type your name at the bottom of the document signifying your consent to participate;
- 3) Send the document back to the researcher as an attachment in the response email.

To not participate:

- 1) Respond to this email saying you will not be participating in this study.

Thank you for your consideration to participate in my research study. If you have any additional questions for me, please email or call me. This study has received IRB approval.

Thank you for your willingness to participate in my study,

Matt Thul

**Appendix F: Consent Form: Focal Participants**

Thank you for your willingness to participate in Matt Thul's dissertation study. By typing your name below, you are signifying you have read the information provided to you in the initial email from the researcher and are giving your consent to participate in his study. **This study includes participation in a:**

- 1) 10-15 minute, semi-structured interview and;
- 2) 10-15 minute, member check

The semi-structured interviews and member checks are completed at different occasions.

The themes and transcriptions from your semi-structured interview will initially be shared with you during the member checks either over the phone or in-person (depending on your preferred means to participate, signified below - phone or in-person). Findings from the study will also be included in my dissertation, which can be individually distributed upon request.

**Choose either to participate in an in-person interview or an interview over the phone.**

Would you like to interview in-person (mark with an **X**):                      Yes: \_\_\_\_\_ No: \_\_\_\_\_  
**Or**, would you like to interview over the phone (mark with an **X**):                      Yes: \_\_\_\_\_ No: \_\_\_\_\_

**Please include a phone number to best reach you: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_**

**Please include a day and time that works best to reach you: \_\_\_\_\_**

Interviews and member checks, both in-person and over the phone, will be audio recorded for validity purposes and secured on a password-protected mobile device in sole possession of the researcher.

**Please type your first and last name signifying your consent to participate in Matt Thul's dissertations study:**

**First Name:** \_\_\_\_\_ **Last Name:** \_\_\_\_\_

Thank you for your willingness to participate in my study! I will be contacting you shortly to either set up a meeting time and place to conduct the semi-structured interview (as indicated above) or will be calling you to conduct the interview over the phone (as indicated above). I look forward to hearing from you!

Thank you,  
 ~Matt Thul

## Appendix G: Semi-Structured Interview Questions: Focal Participants

**About my study:** The purpose of my study is to investigate how an adult learning class with a neuroeducation perspective of learning impacted adult learners' perceptions of learning and how they implemented those perceptions into their professional and personal lives. **The first few questions** are job and graduate school-related, **then the next several questions** attempts to understand the impacts that the adult learning class with the neuroeducation perspective had on your perceptions of learning, how you applied them, and their impacts on others around you.

### Demographic Questions: Focal Participants

**First, think back to when you were in the adult learning class...**

**Were you employed at that time?**

- a. If *yes*: **tell me about that job...**
  - Profession/ Title/ Roles/ Responsibilities/ Work Hierarchy
  - If in education: K-12 or Adult Learners?
  - Years worked at that job?
- b. If *no*: **tell me about your previous job before the adult learning class...**

**Are you currently employed?**

- c. If *yes*: **is it the same job as you previously mentioned?**
- d. If *no*: **tell me more about your current job...**

**What was your pacific northwest university, Ed.D. tract selection and what was your interest in it?**

**How many pacific northwest university, Ed.D. neuroeducation courses did you take?**

Semi-Structured Interview Questions: Focal Participants (say... Now getting into the interview questions; each question is going to be related to the adult learning class with a neuroeducation perspective of learning, in some way. Just to remind you, your identity won't be shared with anyone; your responses and demographic information won't be connected with your identity in any way, and your real name won't be used in the study.)

In one of your core pacific northwest university Ed.D. courses called *Adult Learning, Group and Organizational Dynamics*, you and your class, over one semester, investigated various adult learning theories while also incorporating a transdisciplinary view of learning called, Neuroeducation.

1. For this question I want you to think about how you view yourself; **did taking an adult learning class with a neuroeducation perspective of learning cause you to reflect on who you are (in other words, your belief systems)?** (In what ways? or Why not?)
2. This question considers your perceptions of learning; **did a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, influence how you understand the learning process occurs:**
  - a. for K-12 learners? How? (or Why not?)
  - b. for adult learners? How? (or Why not?)
  - c. within your profession? How? (or Why not?)
  - d. within your personal life? How? (or Why not?)
3. This question considers your perceptions of learning and its implementation; **did taking an adult learning class (in other words, andragogy) with a neuroeducation perspective of learning cause you to change your:**
  - a. professional practice? How? (or Why not?)
  - b. personal life? How? (or Why not?)
4. This question considers your implementations of neuroeducation-based perspectives and their impacts on others; **if your perceptions about learning for yourself or others changed after taking a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, then how did that change impact:**
  - a. your K-12 or adult learners?
  - b. your work colleagues?
  - a. your personal life?



### **Appendix H: Member Check Protocol: Focal Participants**

Member checks will be used as an opportunity for focal participants to extend on or clarify themes and transcriptions generated by the researcher.

After the researcher has used an open-coding method to generate themes for each semi-structured interview question, each focal participant will be called (during their individually-preferred time indicated on their consent form) to either perform the member check at that time or to set up a time in the future to perform the member check.

The researcher will read each question (not demographic-related) and its researcher-generated theme(s) and related transcriptions and state:

- **Tell me more about the theme (e.g., andragogical learning tenets, etc.) as indicated in question (e.g., 6b).**
- **Your response for question 6b was (e.g., read response to question 6b); is there anything you would add or that you feel needs further clarification?**

Focal participants will be reminded before the member check that they will be audio recorded for validity and transcription purposes.

### **Appendix I: Focal Participants and Expert Narratives**

The following narratives were transcribed from responses to the semi-structured interview questions asked to the two groups of this study: *Focal Participants* and *Experts in the Field*. This study used a qualitative narrative inquiry design and was guided by the four research questions:

1. How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identity (i.e., belief systems)?
2. How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?
3. In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?
4. In what ways do adult learners' neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?

The narratives are structured by research question which are aligned with the semi-structured interview questions asked to both participant groups. Each item compares Focal Participants' responses with the Experts' responses in an attempt to better understand the impacts of the class on adult learning theory with the neuroeducation perspective of learning on Focal Participants.

**Research Question #1: How does a neuroeducation perspective of learning impact adult learners' perceptions of their own identities (i.e., belief systems)?**

#### **The Focal Participants: Identity**

The first question, within the semi-structured interview asked to Focal Participants, investigated the impact of the course on adult learning theory with the neuroeducation

perspective of learning on their identities. The question asked: *Did taking an adult learning class with a neuroeducation perspective of learning cause you to reflect on who you are (in other words, your belief systems)? (In what ways? or Why not?)*. The Focal Participants' narratives in response to this question are provided below.

### **Mike**

Mike believed the class on adult learning theory caused him to acknowledge his needs as a learner. Learners should understand their learning needs before they are able to teach, according to Mike. Mike thought about his experience in the adult learning class and concluded that it challenged him. Mike went on to say, "I think it challenged me at my core... and the reason I say that is because I pride myself in being a lifelong learner and this particular class helped me to look at my mind and my brain." Mike reflected about himself as a person (e.g., culturally), a student, and as an educator and administrator and noted that he has always enjoyed learning. More specifically, the adult learning class helped him think about his brain, how he is "...wired" (neurobiologically), and how understanding himself better cognitively, as a learner, affects his learning. The class helped him realize and appreciate that he learns differently than others; for example, Mike said it was brought to his attention, while in the adult learning class, that he tends to use his hands a lot when speaking and that he also tends to speak really loud, which according to him and then instructor is a cultural attribute. Mike stated, "...the way that I learn is very different..." and "I think this class helped me to appreciate the fact that you know... I learn differently, you know?" Before attending the adult learning class, Mike noted that he had never heard someone explain that learning and teaching are different, which "was like a huge epiphany" for him and his understanding of learning and teaching.

**Xeng**

The adult learning class with the neuroeducation perspective of learning caused Xeng to reflect on the specific types of communication she used herself and within her profession and helped her identify some of her previously held belief systems around learning. Xeng noted that understanding different communication styles such as authoritarian and authoritative really helped her think about how she communicates with others as well as how she could make a change with the groups of people she works with in education that go beyond just teaching. Xeng noted, “Covering different communication styles, I think that was something that I really thought, ‘Oh my gosh. I’ve got to remember why I can teach this people this way which is more authoritative.’ And “...how can I go and bring this knowledge that I have acquired recently into a larger audience?” After taking the adult learning class with the neuroeducation perspective of learning, Xeng felt the need to bring that knowledge to a larger audience, especially adults. Xeng noted that the adult learning class helped her identify and name some of her previously held beliefs and helped give her direction for communicating with her K-12 learners and with her colleagues; beliefs that she could still identify with but that were “tweaked” and informed through a neuroeducation lens or perspective of learning. More specifically to the neuroeducation perspective, Xeng stated:

the NSLLT is what I’m talking about when I say learning theory; other learning theory is presented, but it doesn’t tie in together all theories and are missing the language acquisition piece. Without those things it is mostly observation on behavior. We now know or understand how learning occurs more neurobiologically; without this is like trial and error.

**Leonna**

The adult learning class with the neuroeducation perspective of learning caused Leonna to reflect on her experiences as a K-12 student and who she is as an educator within her profession. As Leonna reflected on her experiences in the adult learning class she found herself wishing she was taught differently as a K-12 student:

I do remember sitting in the class [adult learning class with the neuroeducation perspective of learning] and wishing that I had been taught differently when I was a child, because I kept referring back to the way I learned in my K through 8 and K through 12 education, all the misconceptions that I had as a student. I felt a bit of regret, if only I would have had a teacher who did x, y, z. Or, if only I would've been able to learn this way... I wished I would have learned from teachers who treated me with a better understanding of learning theory so that I wouldn't have gone into my prior education and profession with gaps in my learning.

Leonna then reflected on her understanding of learning and her ability to instruct as a professional after having received the adult learning class:

Professionally I felt the same way in that I couldn't deliver the quality education to my teacher candidates, my students in higher ed, as well as my tenures in teaching high school, but more specifically in teaching my teacher candidates to be the best teacher they can in the classroom because of what I missed as a student. It was kind of this overarching feeling of regret.

Leonna stated that as a learner she felt that she had gaps in her own learning because her K-12 teachers did not know about learning theory and therefore did not understand learning; as an educator she felt like she was not fully educated because learning theory was not included in her

training and so she felt unequipped (prior to taking the adult learning class) to provide quality instruction or guidance for her teacher candidates. Leonna noted that the adult learning class was the first time she ever heard about the Neuro-Semantic Language Learning Theory.

### **Cora**

Cora reflected back on her experiences within the adult learning class with the neuroeducation perspective of learning and stated that the class helped her separate her “who’s” (who she believes herself to be as a learner) and her “what’s” (i.e., her products of learning; university degrees). Cora considered how she was raised when she was a child and concluded that based from her environment, she identified herself value or worth based from the things she was able to do or produce; Cora stated:

I was the brainy kid. So grades were really important, doing well on the test was really important. Knowing things was really important and that I saw myself as the smart kid. Right? And then taking this class you start thinking about okay, but you know if I don’t have those what’s [products of learning, good grades], then who am I really and what does that mean? And so, it was interesting.

Cora noted that she still thinks of herself as one of the “smart kids” but that her thinking has shifted. Cora stated she identifies as being smart now because she is a “thinking person” and a “curious person” and as someone who “wants to see all perspectives,” not just because she feels like she “knows things” or has accomplished a lot academically. Cora said that it feels better to identify herself as a curious person or as an inquirer versus as a person who is smart because she knows “a lot of things.”

**Leighla**

The adult learning class with the neuroeducation perspective of learning caused Leighla, as someone who learned English as her second language, to reflect on her understandings and beliefs surrounding language acquisition, neurobiological learning, as well as hers and the ELL students' journey in her district. Leighla stated, "...this definitely caused me to reflect on kind of my belief systems around how I view language acquisition. Also, to reflect on my journey in learning different languages." Leighla believed that every educator should have understanding of neurobiological learning and stated, "Every student can benefit and applies to all students, how we learn, this can be applied to any content area. Looking at the processes for the brain and analyzing how it would impact their students' brain." The adult learning class caused Leighla to question her fluency levels in different languages, "...wow, if I had learned strategies about neuroeducation back then, I'm wondering if I would've been more fluent" and made her question if her ELL students would be better off as learners as well instead of being taught with traditional, "behavioristic" learning strategies such as repeating and memorizing, which was "the way I was taught" Leighla said. Leighla reiterated that analyzing learning theories within the neuroeducation was beneficial towards her understanding how learning and language acquisition occurred neurobiologically because of the neuroscience perspective of learning that was missing from her teacher training:

... there are other ways that students learn... by using their senses, their sensory systems, and understanding how the brain acquires concepts and language that there are certain strategies that you can attach to that, that could actually help kids learn, and that it's different for every student...now we have to start teaching them differently...making

sure that they're learning in a way that matches their linguistic repertoire and what they come to us with.

### **Elly**

After taking the adult learning class with the neuroeducation perspective to learning, Elly felt like a hole in her understanding of learning was filled. The neuroscience or "brain component," as Elly stated, "definitely opened up a new way to think about learning and how the process does have the brain component." An understanding of learning "is everything, how a brain categorizes and process is the entire process, what is really happening in the brain." She said the class and the NSLLT helped her change the way she approached students. Elly reflected back on one of her experiences, while taking the adult learning class, about a student in her school who had received multiple interventions and had not made any progress:

So while I was working, in that class, we actually had a young boy who was receiving lots of interventions. We were working with him on the SST team and he still wasn't making any progress... As I started taking that course...it was eye-opening because we were able to put the visual images and have him do things physically with his hands and create pictures of things, even if it was just like a circle, like he couldn't identify a circle, but as soon as we started connecting the brain mapping and doing those components, he was able to do it and he started making progress, and before we were kind of at a stalemate.

The adult learning class provided Elly with another approach to aid her students with in their learning.



**George**

The adult learning class with the neuroeducation perspective to learning caused George to recognize and reflect on his agency. “Separating your self-worth...the *who*, from your self-esteem and the *what*,” George noted, “was a good point of reflection.” George reiterated, “Just considering the differences between self-worth, how you value who you are in compared to how you value your achievements;” was an important component he took away from the adult learning class.

**The Experts in the Field: Identity**

The first question, within the semi-structured interview asked to Experts, investigated the impact of their background in neuroeducation on their identities. The question asked: *Has a background in neuroeducation impacted who you are (in other words, your belief systems)?* The Experts’ narratives in response to this question are provided below.

**Mary**

The pacific northwest university’s Ed.D. neuroeducation program positively impacted Mary in a number of ways including her perceptions of herself as an educator, researcher, practitioner, and as a person. One way Mary was impacted by the neuroeducation program was related to her core identity. Mary stated: “...the neuroeducation background helped me to have me think more about myself.” Mary was able to reflect and recognize herself from a cultural perspective, as someone who speaks multiple languages, and as someone who can “see how images and semiosis has been so universal across cultures linguistically,” to reach learners on a universal level. Mary described herself as an “international being” instead of simply one culture in particular. Mary also sees herself as a researcher in neuroeducation:

I regard myself more of a researcher in neuroeducation, as well as a practitioner, who would like to continue on this track to advocate our students' need to not just learn by curriculums, learn by those routines, but by understanding about themselves...

**Mitch**

As someone who had enrolled and graduated from the Ed.D. neuroeducation program, Mitch felt as though he had made the right decision regarding his educational practice, but also felt as though he was impacted on a personal level which helped him in a variety of ways. Mitch talked about how the neuroeducation perspective to learning changed how he viewed several things.

It [neuroeducation] tremendously shifted my understanding of how humans acquire knowledge, concepts, abilities, my own background, my own strengths, my own capabilities. It's been empowering for me. It's been empowering to my ability to help others recognize their own growth capacities and why maybe certain educational programming didn't work for them in the past, but can work for them. It taught me a lot about my own learning and really, I think also kind of philosophically, there's this component of valuing people and their development of knowledge and all people as learners, who really I think do it...it is so powerful and I think advanced me so much in terms of my own values and care for people...

**Barb**

Barb had seen firsthand, the impact that the neuroeducation practices had on her K-12 students, but Barb also noted a change in herself based from her experience with neuroeducation. Barb mentioned that growing up and as an adult, she always had a very positive outlook in life, but with the inclusion of neuroeducation in her life she stated:

...the neuroeducation information has helped me really understanding, if I understand how people learn, and understanding that everybody can learn, it shifts how you think of people. At heart, it shifts, not only you recognize that you can learn, that you have value, and that your perceptions are valid. So all those things became more clear to me through the years. That all those things about myself were positive, which allowed me to be more positive with other people.

**Research Question #2: How does a neuroeducation perspective of learning influence how adult learners perceive learning occurs for K-12 learners and adult learners?**

**The Focal Participants: Perspectives of Learning Process**

The second question, within the semi-structured interview asked to Focal Participants, investigated how a course on adult learning theory with a neuroeducation perspective of learning influenced how the learning process occurs. The question asked: *Did a class on adult learning theory (in other words, andragogy) with a neuroeducation perspective of learning, influence how you understand the learning process occurs: a) for K-12 learners? b) for adult learners? c) within your profession? and d) within your personal life?* The Focal Participants' narratives in response to these questions are provided below.

**Mike**

Mike's understanding of the concept of learning continued to expand as he related it with K-12 learners, adult learners, and with his colleagues in his previous work setting and with himself as a person. Among Mike's first considerations, was his perspective of learning for his K-12 learners, as affected by the adult learning class and stated, "you're not really learning something new if it's not practical and relevant." He mentioned the importance, for the K-12 learner, to learn information that can be used after learning it. Mike shared a story about one of

his former K-12 students who had reached out to him later in the student's academic career because of Mike interpretations. The K-12 student remembered Mike's way of thinking and sought him out for advice (preferred over the student's parents) later on in his post-secondary career. Mike said, "I felt as though I became not only the lead learner for someone in K-12 but I am still the lead learner of people that are outside of K-12 now."

Getting adult learners to learn, according to Mike, was more difficult because of their already established ways of thinking. Mike stated, "they already think they have what they need to know," which makes it difficult to convince them with new pieces of information. However, Mike reiterated, adults do not understand how the brain operates, which is important for understanding learning. Therefore, adult learners have to be introduced to new information about the brain; how this introduction of new information occurs is similar to what an educator would do with their second or their grade learner, through use of visual-based strategies such as drawing, according to Mike. "Drawing is vital to how we understand."

Mike then considered his colleagues' understanding of learning in the K-12 school setting and said, "...these teachers did not have it right." Mike noted that the teachers often struggled with how they, as educators, learned and therefore were not able to connect that understanding of how they learn with how their class of 30 students learn. Mike said that he thought it was *pivotal* for educators to understand how they learn before they are able to teach others. Mike went on to say that some of the teachers he worked with had 25 and 30 years of teaching experience, yet those teachers' students still displayed opportunity and educational gaps:

...you have some students that are failing, some students in the middle of the road and some students that are always being successful. Why is that? Why is that if this teacher that's been teaching for 25, 30 years has these gaps in the kids learning? A) I don't think

you can blame the kid. B) Part of me says is the teacher teaching? Are they teaching from their strengths or their weaknesses? Are they teaching just from how their brain is wired to a group of 30 kids that are not wired like them at all?

Mike went on to say, as he admitted:

...there was a time when I was a teacher in the classroom that I taught from my strengths and I put that expectation onto my learners...and now I know why they were failing because I expected them to be just like me, and they're thinking, like, what is wrong with this guy, this is the hardest class ever...If I'm the expert, I should figure out a variety of ways to help my students come up. I should be helping them come up this ladder of being a lifelong learner.

Mike then thought about himself and his needs as a learner and mentioned the importance for information to be relevant and practical as well as for letting go of old habits or information that is not helping him grow. Mike reiterated the importance, especially for educators, in understanding yourself as a learner before working with or helping K-12 or adult learners learn.

### **Xeng**

Xeng believed that the neuroeducation perspective of learning incorporated in the adult learning class caused her to reflect on her understanding of the communication styles she used in her profession as well as the belief systems she held regarding the process of learning and also allowed her to further consider her perceptions of the learning process for various-aged learners, the perception of learning used within her profession, and her perceptions of learning for herself. Xeng noted that for K-12 learners and largely within the teaching profession, there is a relationship between behaviorism and authoritarian-based communication. Xeng said, "I notice the further, deeper you get into a behavior class, the more authoritarian the teaching becomes for

some reason.” “For me, a big take away with going into these behavior rooms, was trying to make the shift of less authoritarian and let’s get more into building relationships and building connections, and let’s start talking about problem solving.” Xeng mentioned the need for the information that is presented to K-12 learners to be meaningful, practical, and relevant. She said:

That’s something that I really kept in the back of my mind for every single lesson I was making for my students, and the students I work with have very low communication abilities anyway, so I really had to try to tap into, how is this practical for them? How is this meaningful?

The concept of learning, according to Xeng, is the same for adult learners as it is for K-12 learners. Xeng said:

... it was the same idea... I still can’t just spout out information, and assume that they’re [the adult learners] going to get it without context or anything, which is sometimes the platform we use a lot in professional developments or whatever. Time to make this information as highly contextualized for its adult learners and making it meaningful for them...let’s draw that out.

Xeng noted that there is a learning curve, when she shares the neuroeducation perspective of learning, with her students’ parents, but sharing the neuroeducation perspective of learning has helped strengthen her relationship with her husband regarding their communication. Concerning students’ parents, Xeng thought that a barrier seems to exist between what the school and the educators want for their students and what the parents understand of their child and what they think their children are capable of doing; “Sometimes there's a learning curve, or there's this barrier between maybe what the school would like to try with their child, and what the parent's understand of their child, or what the parent's understand that their child can do or can't do.”

Xeng said, it is the “idea that I’ve gotta bring where I am sometimes down to where the parent is, and then together we have to have this... discussion that brings us both to a place that we can have an actual conversation about their child.” Xeng’s husband is also an educator. Both Xeng and her husband have benefited from talking and learning more about neuroeducation perspectives presented in the adult learning class; it has helped us “communicate better in our relationship” and “understand each other better, so that we could accomplish more things...”

### **Leonna**

While Leonna attended the adult learning class, her background in science, anatomy, and physiology helped verify some of the perceptions of learning she already had for K-12 learners, she was able to scaffold some of her background to help her better understand how adults learn, and the class helped her acknowledge herself as a visual learner. “I think my health, and anatomy, and physiology background really helped because when [the adult learning class instructor] was speaking about the brain, it made sense because I understood the language she was using.” The adult learning class verified Leonna’s previously-established perceptions of learning for K-12 learners from her background and training in the sciences. The learning theory provided in the adult learning class helped her “scaffold some new terms and understanding...” for K-12 learners. However, as a profession who was trained to work with K-12 learners, Leonna did not feel like she had a good understanding of how adults learn, however, she felt she was able to effectively link the adult learning theory, provided in the class, with her own personal adult experiences. Leonna noted that she was hesitant to apply her neuroeducation understanding of learning to her profession because she had only received one class at the time and felt as though she needed more information and resources. Leonna said, “Wow, this is really helping

me personally. But I felt hesitant to present it as fact because I was unsure myself ‘cause I only had one class.”

Leonna felt confirmed as a learner after taking the adult learning class with the neuroeducation perspective of learning. Leonna acknowledged gaps in her understandings of learning due to her background as a K-12 and post-secondary learner who was taught from teachers who lacked a neuroeducation-based understanding of learning or learning theory. So as a K-12 learner and an adult learner, she felt as though there was something wrong with the way she felt she needed to learn. After the taking the adult learning class, she learned more about needs as a learner. She said, “I felt like I had several aha moments for why I am, I think the way I think because I’m very visual. I’m very concrete sequential. But I also see in pictures.” The neuroeducation learning theory provided in the adult learning class, according to Leonna:

...supported the idea that’s [a visual based way of learning] an okay way to learn, where that has never been, I always thought I was odd that I thought in pictures a lot. I’m very, very visual. That, it just confirmed to me that, that the way that I learned is not necessarily quote end quote, ‘a bad way.’ It is a way.

### **Cora**

Cora’s perception of her identity as an individual and as a learner shifted after taking the adult learning class with the neuroeducation perspective of learning, which then influenced her perceptions of learning for K-12 learners, adult learners, and learning within her profession. Cora noted that by watching her non-neuroeducation cohort members, within the adult learning class, discuss their thinking around neuroeducation-based principles of learning and their attempts to grasp what the NSLLT it meant to them as learners and professionals, she got “a deeper



understanding of what I thought about K-12 learners.” Cora shared a discussion from her cohort within the adult learning class related to initial reading instruction for K-12 learners:

...everybody was saying that well you can't learn how to read unless you have the letter sounds, and then we'll have a discussion, well actually you can, and people do, and are there other methods to teach reading, are there other supplemental things we can do for the kids who don't get the sound-symbol correspondence piece?

As a K-12 educator support specialist, Cora noted that she had always been a staff member to supplement learning, but when she considered how learning occurred for adults, she admitted that she had never actually thought about how adults learned because all of her training had been focused around learning for K-12 learners. Cora reflected back to the adult learning class and said, “I think the thing that comes away for me when I'm looking at now that I am instructing adults is the whole meaningful, relevant, and useful.” Cora reflected on the impact of information being meaningful, relevant, and practical and then reconsidered learning for K-12 learners:

This [information being meaningful, relevant, practical] is useful because it will help them get somewhere or help them accomplish a task within this greater goal of theirs. And just the idea that we don't afford that to kids, that was just kind of a mind blown moment for me, I said “oh my gosh, well you know that this is what adults need and want or they will check out. Why do we somehow think that that's not what kids need and want or they'll check out?”

Cora reflected on the content of learning for adults and then connected her understanding of learning for adults with what she understood about learning for K-12 learners. Cora then extended her understanding of learning for K-12 learners and adult learners to what learning

looks like within her profession and made a new connection. Cora said, "...that was kind of mind blowing to me..." that:

...what if we applied some adult learning theory to students [K-12] and how would that change what we're doing? You know? And so when I observed kids in the classroom or when I coach people who are going to go work with kids and more emphasizing this has to be relevant to them, this has to be meaningful to them or they're not gonna give you, you're not gonna learn about them what you're trying to learn because you're going in there to try to figure out what makes a kid tick and you're not going to get in unless you can bring these with you.

### **Leighla**

Leighla's beliefs about language acquisition shifted after taking the adult learning class with the neuroeducation perspective of learning and also influenced her perspectives of learning and language acquisition for K-12 learners. Leighla mentioned, as an educator, she had been taught in a behavioristic-type way, where repeating and memorizing was an effective means of learning. After taking the adult learning class, Leighla recognized that K-12 students learn in a variety of ways such as through their sensory systems. Leighla also learned that "understanding how the brain acquires concepts and language" could actually help K-12 students learn. She stated that learning should be done by the students, in other words, "it's not just teachers just teach and tell kids what to do" but that learning for the students must be neurobiologically meaningful, utilize their "linguistic repertoire," and the experiences they come to school with. Considering education for K-12 learners, Leighla said, "we have to start teaching them differently."

Leighla's perceptions of teaching and learning for K-12 learners shifted, which Leighla believed caused a perceptual change for teaching and learning for her educational professionals she worked with and how learning can be represented within her profession. As a visual learner with an understanding of the impact of using visual-based instruction on learning, Leighla realized that her educational professionals could benefit as well. Leighla stated:

When we do professional development for teachers, we actually utilize a lot of the visual Viconic learning methods... because for myself I was able to reflect on, okay, how am I as a learner and if I also need visuals; If I'm a visual learner, if I need things broken down then all students need that... we really try to incorporate neuroeducation in there, so it's not just heavy on the presenter talking at the teachers or any adults that we have, we're really apply what we're doing with the kids with teachers. So neuroeducation is translational, definitely, across all learners.

English tends to be taught differently within schools and districts but what Leighla noticed is missing is the neuroeducation lens for language acquisition. Within her profession, Leighla noted the importance of focusing on language function rather than language structures. "After taking this class [the adult learning class], what we've noticed is that using the structure of the language is not going to help with acquisition because it's very pattern-focused." Leighla mentioned that in the "traditional approach" of teaching language, teaching sentence structures is the dominant practice used to help students learn (e.g., circling and conjugating verbs and filling in the blanks to replicate a structure-related patterns); "...what's missing from some of these classes is the neuroed lens..." As a parent, the lack of neuroeducation perspectives for learning being used in language classes caused Leighla to supplement her children's learning with neuroeducation-based practices such as Viconic Language Methods.

**Elly**

The neuroeducation perspective of learning incorporated within the adult learning class supported Elly's perceptions of learning for K-12 learners and adult learners and added new avenues to help her K-12 learners. "Most teachers are always looking for a way to reach that kiddo..." Elly said it increased her level of advocacy with her K-12 students and gave her "hope" and "excitement because there was another avenue of something else to explore, something else to delve into." As a K-12 educator, she shared her neuroeducation resources and thinking with her colleagues in order to support their learning and increase their ability to help their students. A common component towards the learning process that K-12 learners share with adult learners, according to Elly, are the experiences the learners bring to the learning setting. "I don't care if it's an adult learner or if it's a child learner. What you bring to the table is your experiences." Elly noted a difference between K-12 learners and adult learners which was that adult learners have more connections compared to K-12 learners due to their age, therefore, learning, in the sense of neurobiological connections may be easier; however, learning as an adult learner may be more "difficult because they're more stuck in their ways."

Elly reflected on how learning viewed within education and felt as though the neuroeducation perception of learning is missing within teacher education; "I just don't think there is enough of it... it wasn't in our learning theory classes." Elly stated that she felt neuroeducation learning theory should be "the foundation of what we [educators] do." And though educators within the field use vocabulary from particular research theorists, the translational piece of learning from the language domain, used in the neuroeducation perception of learning, is absent within education. The lack of neuroeducation perspectives in education is ultimately a "...disservice to our teachers." Teachers "need to know, they need to have more

avenues that they can access.” Elly felt that educators need to do a better job in teaching their students, exploring and understanding the process of learning, and understanding better the effects of teaching a certain way impacts students. For Elly, her thinking towards learning, after taking the adult learning class, is constant, “I’m constantly now diagnosing why am I doing what I’m doing and how does that process happen?” When before Elly thought education was “something that you do to provide information, to provide access for information and it’s really not. It’s about how we bring the access of the information to you...and processing as an individual.”

Elly’s perceptions of learning, based from the adult learning class, transferred into her personal life as well. Her understanding of learning has made her “very aware of what, how, and why I do things, and labeling for me my process, how I think things through, the way I organize, why I organize it the way I organize” it. Elly stated that it was not until the adult learning class that she started to realize how her brain is actually working to help her learn, she realized that her “brain is grasping at different pieces of information all of the time... it just seemed...natural when I would look at kids and notice the traits, but I couldn’t notice them within myself.”

### **George**

George believed the adult learning class caused him to identify and separate his understandings of *who* versus *what* which then influenced his perceptions of learning for his K-12 school students and helped him identify a trait of learning needed for adult learners. George said that the adult learning course helped him “realize how much behaviors that we really use school-wide...or within our profession and how that’s not necessarily the best method to help people learn.” George shared his understanding of the connection between learning and language, based from what he learned in the adult learning class, and applied his thinking

towards his K12 school students and said our students make “meaning out of patterns that they’re building over time and then when they assign some meaning to that are able to finally express that in the form of language.” The process of learning is strengthened by the usage of “different context” and through visitation of “concepts in different ways,” noted to George. As he considered his understanding of learning for his K-12 school students, George noted an important factor that he believed needed to be present in learning for adult learners to be impacted, which was the need for a “transformation.” “one of the things that struck me a little differently with adult learners... for it [learning] to be really impactful, it had to be one of those transformational experiences...” George felt that for adult learners to show learning, there had to be a lasting impact on the adult learner, which would have to have been based from a “sense of transformation or a sense of change... a shift in your paradigm or thinking.” George thought further about the process of learning and recognized similarities between K-12 learners and adult learners and stated, “The learning process itself, the activities and the environment can be similar.”

George applied his perceptions of learning within the field of education and within his personal life and noted the effect of standards and expectations within the field of education on students’ learning and a need for variety for strengthen learning. George considered his understanding of learning and experience working within the field of education and identified a desire amongst educators to want to teach a particular way, but ultimately felt as though educators are bound by standards and expectations that are established for them by the education system itself:

I think some people are torn, torn between wanting to provide more experiences for students, build their understanding to show alternate ways of expressing their learning

and things, but we just get into a bind in this era of standards and accountability in that at the end of the day we have to have them take these tests, and we have all these content standards we need to knock off. From a teacher control perspective, some behaviorism appears to check the boxes there, even though from what I have learned, that's not helped the students, but I can see why it's a default for people.

George identified a need amongst educators to want to use variety and diversity in their teaching topics and instruction and was saw a similar need which played out in his personal life as well. When he considered his need to want to improve an aspect of his own life, George reflected on his understanding of the concept of *practice*, after taking the adult learning class. George attributed his change in understanding of the term practice to the adult learning class and said, "Practice isn't necessarily always a good thing unless you're making micro-adjustments to what you're actually practicing and throwing in new situations." George said he makes micro-adjustments when he practices training for sports in that he does not just repeat the same motions over and over again, rather he adds in different variables.

### **The Experts in the Field: Perspectives of Learning Process**

The second question, within the semi-structured interview asked to Experts, investigated how their background in neuroeducation influenced how they viewed the learning process occurs. The question asked: *How has a background in neuroeducation influenced how you perceive learning occurs: a) for K-12 learners? b) for adult learners? c) within the field of education? and d) within your personal life?* The Experts' narratives in response to these questions are provided below.

**Mary**

Mary's perspectives of learning for K-12 learners were impacted by the neuroeducation program in a way which created a need for her to recognize students' levels of thinking and learning as well as a need to want to increase students' levels of thinking, learning, and language usage.

For me, I was a language teacher, so I observed my students learning from the beginning of that certain language, to an advanced level of a language. I can apply it by using neuroeducation theory... of which level, which stage they are at. Are they at sensory? It is a sensory level, it is a perceptual level, and how can I increase their level of thinking into conceptual understanding?

Mary's understanding of students' levels of learning, "sensory," "perceptual," allowed her the opportunity to first recognize the students' level of thinking or conceptual understanding and then be able to "increase their understanding...increase their use of a language to express themselves." In regards to students' level of thinking and learning, Mary went on to say: "I think this is the most important part for me in my classroom, is that understanding about levels of learning, and helping students at different levels to achieve a better level."

Mary's perspective of learning for adult learners is not as strong as her perspectives towards K-12 learners as she stated: "I'm still testing neuroeducation on my adult students." However, Mary emphasized the importance of the adult learners' previously learned experiences as being an important factor towards creating new learning. "...they [adult learners] are pretty much impacted by what they learned before, so if they have a background in psychology or some backgrounds of language, I found it's easier or they can absorb neuroeducation... want to learn more about neuroeducation." Mary noted that when considering learning for adult learners, it is



important to make learning practical and relevant. When she reflected on one experience she had with a previous adult learner who had an interest in neuroeducation, Mary said:

There was one assignment and she asked the students to read, an ESL student to read some passages. The ESL students gave her some kind of feedback, that she just realized that, “Oh, this is something that can be applied to neuroeducation from the core.” She said this from her paper, and she wrote on her paper, and it was a shock for her.

As Mary reflected on this experience she was really happy as she was able to help her student clarify and reflect on an interest of hers that was relevant and practical to what she was doing as a student of neuroeducation and as an ESL educator.

### **Mitch**

Mitch’s perspectives of learning for K-12 learners were also impacted by the neuroeducation perspective to learning. Mitch claimed, “It helped me get away from this developmental, deficit-based model...” where students are asked to build up or learn from their weaknesses, “to recognizing that the human brain generally develops through or builds through inputs and things, but that those things have to be meaningful;” by giving students more of something that is not meaningful to them, creates a negative learning experience. Mitch stated that when he utilized neuroeducation principles, as a school they were able to step outside of the typical school system where students either fail or achieve and came to a place where educators and their students felt as though they were in a community based on learning and respect for one another as agents.

It was so powerful and so I still try and use that. I use it a bit when I work with adult learners as well, but having that background of being able to really use my background as a classroom teacher, but then build on that was I guess, I cherish that change that

happened for me and the experiences that I got to have and the experiences my students had as I went through that program. It really changed my teaching. It also helped me better understand how somebody can be a teenager, but not exhibit the same actions, concept acquisition, all kinds of things as another teenager or somebody could be an adult and that development isn't this automatic thing...I don't know why that wasn't part of what I did before, but I'm so glad it is now.

Mitch's perspectives of learning for adult learners is similar to that of K-12 learners regarding how he views learning and how a learner can be transformed through meaningful practice. Mitch mentioned that since he now has (through his studies and application of neuroeducation-based principles of learning with his K-12 learners) a neuroeducation understanding of learning, he can apply this with his adult learners (e.g., educators) as well.

Mitch stated:

...repeating isn't knowing and knowing that learning builds on kind of the existing schema of the learner, what they already have previously learned and that in many respects, what adult learners benefit from is similar to what kids benefit from and what motivates adult learners often, the opportunity for autonomy and mastery and there's some purpose in the learning really motivates younger learners too.

Mitch reflected on his own growth as an adult learner, in regards to the neuroeducation perspective of learning, and felt as though he should share his story of transformation regarding his views and practice with his adult learners serving as educators in his school.

I now have this story of a radical transformation that I have done and I can really share that with people. I can say, "Hey, I was this person, I was doing pretty good and then, I kind of turned my world around a little bit based on this stuff I was learning." Even

though what I was doing previously kind of aligned with my values, what I was able to do going forward with that additional information that additional knowledge from the neuroeducation perspective that was really powerful because I got to really go to the next level on how well my teaching practice could reflect my value of care for all learners and my belief that all learners have the capacity to be parts and members of our community of learners.

Having utilized neuroeducation-based perspectives of learning as an educator in a K-12 setting and now as an assistant principle in a K-12 setting with educators, and as someone who has worked with adult learners at the university level, Mitch's perspective of learning associated within the field of education also transformed. Mitch stated:

I think education and learning are not synonyms and my knowledge from the neuroeducation program and my study of neuroeducation, maybe I thought before that they weren't quite synonyms, but now I'm like, "No these things are not synonyms." Teaching is not the same as learning... as I learned about the development of agency...the development of pro-social concepts, pro-social agency, I think there's so much stuff that we do in the educational system that isn't about that...it certainly doesn't reflect to my knowledge what best practice according to neuroeducation would be if we want all learners to develop to their maximal cognitive capacity and their ability to be pro-social with others.

### **Barb**

As Barb reflected on her personal views of herself, which were impacted by a background in neuroeducation, she also noted an impact towards how she views learning for K-

12 learners. Barb stated that a background in neuroeducation completely influenced how she views K-12 learners:

It's [neuroeducation] completely influenced the way I look at children. Understanding conceptual acquisitions to pre-operational, concrete, formal, from understanding the concept development on social aspects, and understanding how kids are going to gain those concepts about their *who* [identity] as well... knowing that those go hand-in-hand... that you can't separate behavior from the learner and how all the concepts grow... understanding that I'm in a really critical place... of actually helping them gain the neuroanatomy in order to grow their concepts through the growing of concepts, and that's really exciting.

Similar to the impacts that neuroeducation had on Barb's views of learning for K-12 learners, Barb's views of learning for adult learners was impacted from a background in neuroeducation. Barb said she uses the same neuroeducational principles of learning for adults that she does for K-12 learners because at the essence of learning for both K-12 learners and adult learners is that learning should be meaningful and relevant. "I took a lot of the same principles, because the principles of andragogy are the same as for children really, which is that learning should be meaningful and relevant, honestly." When further considering how adults learn, Barb stated:

...we all have, and even adults more so, have these biases that we need to break through, and that we need to wrestle with, and that there is definitely an intellectual conflict going on when adult learners are grappling with new ideas. So, that influenced the way I would approach adults who are learning something new as well.

Using information that is meaningful and relevant is an important component of learning to consider when new information is presented to K-12 and adult learners.

A background in neuroeducation affected how Barb operates in her personal life, including her marriage and how she raises her son. Barb stated that she has been able to utilize her knowledge of learning, based from a neuroeducation perspective, and how having that knowledge impacts how she views and interacts with peoples' behaviors including her husband and son. Barb has been able to recognize and better understand how her husband learns and thus better understand how he thinks and acts, which has positively impacted communication between them. Barb stated, "my husband's a visual [learner]...I have auditory concepts...we have to clarify communication in different ways, which is actually really positive." Barb and her husband's son has been able to improve his language function based from the interactions Barb and her husband have with their son; Barb stated:

...the way we have chosen to raise our child and how our understanding of how language is actually acquired, and how we can help our son use language to help mediate his behavior and his choices, understanding the difference between the *who's* and the *what's* and to help him not see himself as bad or as good, but just having choices in life.

Barb also mentioned that her background and understanding of neuroeducation-based principles for learning has helped her with other members of her family. Barb said, "...it helps me not pick fights I can't win, because somebody just isn't there conceptually. Not in a negative way, but in an intelligent way."

**Research Question #3: In what ways does a neuroeducation perspective of learning cause adult learners to implement change in their professional and personal lives?**

**The Focal Participants: Implementation Strategies**

The third question, within the semi-structured interview asked to Focal Participants, investigated how or if their neuroeducation perspectives of learning influenced them to implement a change in their lives. The question asked: *Did taking an adult learning class (in other words, andragogy) with a neuroeducation perspective of learning cause you to change your: a) professional practice? and b) personal life?* The Focal Participants' narratives in response to these questions are provided below.

### **Mike**

Mike implemented a change in his professional life based from his perspectives of learning for himself, his K-12 students, and for his colleagues. As an administrator, Mike felt that he should share his neuroeducation-perspectives of learning with his colleagues. Every Friday, Mike said, he and his other administrator colleagues would have administrator meetings; Mike would share the articles and other readings from his adult learning class, with his colleagues (curriculum and counseling-related). Though, they would never read them (generally due to article's length) Mike felt like he had a "window of opportunity" to help his colleagues better understand their own learning needs as adults.

### **Xeng**

Xeng's personal-held beliefs and perspectives of learning were influenced by the neuroeducation perspectives of learning which then influenced Xeng's professional practice and how she communicates with others. Xeng mentioned the importance of taking time to consider how the lessons she was creating fit with her students' needs. When she created her students' lessons, she would ask herself, "Was this important to them; did this have meaning to them, and if so what's the purpose of it?" She mentioned that as a teacher-support specialist, her time working with her students was limited, therefore, falling back into old habits of providing her

students with less thoughtful work was an easy thing to do. Xeng stated, “It’s easy to go back to the old ways of just, I found something, here’s a worksheet.” Xeng also put thought into how she communicates with others. Xeng mentioned that she wanted to focus more on building relationships with her students, therefore, the way she talked with them changed into an “authoritative style.” Xeng also put thought into how she communicated with her husband. When she considered the use of neuroeducation-based perspectives into her relationship with her husband she acknowledged that they both have different learning systems, “He is auditory, and this is why he’s obsessed with time, and he can’t let anything go. And I’m completely visual;” So, meaningfully thinking about how they communicate with each other is important. Xeng gave a story as an example to prove her point towards the importance of understanding each other’s learning systems and how they communicate with each other:

Okay, so when we’re in the car and I’m the one giving directions, how can I give you directions that is going to make the most sense? How I want them is not how he wants them, so we have to make that really clear, so we don’t get in an argument later about me not giving him enough heads up if there’s a left turn or whatever.

Spending time considering her learning system (i.e., visual) and her husband’s learning system (i.e., auditory) helped prevent unnecessary arguments and helped their relationship be healthier. Xeng’s consideration towards the relevancy, practicality, and meaningfulness of the work she provided to her students’ impacted her students in a variety of ways as well.

### **Leonna**

The adult learning class with the neuroeducation perspective to learning allowed Leonna the opportunity to reflect on her needs as a learner, confirmed several of her science-related understandings of learning she acquired as an adult learner and educator, and caused her to

identify instructional and personal implementations of her visual-based learning she has used. Leonna believed that teachers tend to “teach the way we love to learn;” therefore, as an educator Leonna said that she was already implementing visual-based strategies into her classroom instruction. Leonna stated, “I always allowed the students multiple ways to show their learning, whether it be verbal or pictures or diagrams or acting, or that’s just been kind of the way I have taught.” As an Ed.D. student, Leonna utilized her strength as a visual learner to help her organize, write, and defend her dissertation. Leonna reiterated her need to *see* her thinking while she worked on her dissertation; she made visual connections between her qualitative data, “I had my whole hallway filled with pictures... I drew pictures on my posters. I took a pictures of my whole hallway and sent it to my dissertation chair.” Leonna noted that several people believed Excel or some other program would be more efficient in helping her organize and analyze her data, however, due to the adult learning class with the neuroeducation perspective of learning, Leonna had recognized and confirmed herself as a visual-based learner so she used her visual-based method. Later, while defending her dissertation, Leonna noted that even though she had to use one of her less-preferred methods to present her work (PowerPoint), she felt comfortable using it because of how she originally organized and analyzed her data. Leonna stated:

...when I actually defended my dissertation, of course you use PowerPoint, you follow all the guidelines you’re supposed to follow. In my mind, when I saw a PowerPoint that had a picture or words, I visualized all the illustrations that I had had on that wall over those nine months to be able to express a story, to be able to clearly share a narrative that makes sense.



**Cora**

After Cora thought about her perceptions of learning for K-12 learners, adult learners, and within her profession, she shared the perceptions of learning she held within her personal life. Cora applied her understandings of “who’s” and “what’s” to her own children and the types of colleges her children might attend. As a child, Cora had instilled in her that the “what’s” or the accomplishments were important to have in order to feel good about herself, but as an adult with an understanding of learning that has allowed her to separate her “who’s” and “what’s” she realized that even though one of her children could have attended Stanford University, she (Cora’s daughter) “had no interest in it because of her personal reality about not wanting to be in a high pressure situation” and Cora was okay with that. Cora said, “I’m not gonna push for something that I thought in my upbringing that was an achievement...I don’t need to want that for my daughter.”

The adult learning class with the neuroeducation perspective of learning allowed Cora the opportunity to reflect on her perceptions of learning for K-12 learners and to learn more about the process of learning for adults and within her profession. However, in her professional role as a coordinator of educator support specialists, Cora recognized the difficulty in implementing an instructional change and the ease of falling back into old habits. As a coordinator, Cora trained new educator support specialists into the district:

...the inclination was to dump all this info on them and expect them to learn it. And that worked for some people but it didn’t work for everybody and I don’t think I stopped and said, “oh wait, what about andragogy?” you know and all that, but wait a minute there’s got to be a better way to this and definitely kind of structuring things for them so that well why would it be helpful for you to learn this information?

As a professional training new employees into the district, Cora remembered what she had learned in the adult learning class and approached her trainings differently. Cora utilized conversations more in her trainings and gave the employees more information about why they were learning the things she was sharing with them and how that would affect their students. As an adjunct professor Cora used visual-based strategies to help her post-secondary students learn. In Cora's university class, her students used various visuals (e.g., "graphic organizers") to help them better understand the content Cora shared within her class; "...when we're talking about a new concept I do have that available, they have that in front of them so they could write, they could draw, they could circle things and make arrows and underline and draw pictures or whatever."

As a parent, Cora shared her understandings of learning and types (e.g., authoritarian and authoritative) of communication with her children. Cora acknowledged that one of her children (who had an authoritarian teacher) could rationalize or make sense out of how the authoritarian teacher taught, but her other child had difficulty understanding the expectations of her authoritarian teacher. Cora said that a discussion about authoritarian versus authoritative personalities and communication with her struggling child helped her consider ways to navigate through her classroom teacher's expectations and find a way to be successful.

### **Leighla**

Leighla believed the adult learning class with the neuroeducation perspective of learning influenced her perceptions of learning for K-12 learners, adult learners, learning within her profession, and how learning is accomplished within her personal life which she believed caused her to implement neuroeducation-based practices within her practice and personal life. Professionally, Leighla and her student-evaluation teams use neuroeducation-based principles to

help them make more informed decisions on whether or not a student has a “language disorder, communication disorder,” if “they are special ed,” or if they just “need time to learn a language” because the strategies they are using are not “tapping into their sensory systems.” Leighla noted that the student-evaluation team could not really make an informed decision about a student if the student’s teacher had not shifted their practice to match that of the student’s learning system. Leighla said that they also work with local professionals who utilize neuroeducation-based principles of learning when they come across students who are more difficult to evaluate. Within her personal life Leighla helped with her children’s language acquisition and implemented neuroeducation-based strategies such as Viconic Language Methods, bubbling words, using rich contextual language, and using stories. “I think it was two to three weeks of...using bubble words and the trying to do that in context and using story form, and event-based.”

### **Elly**

Elly’s perceptions of learning for K-12 learners, adult learners, and how she has viewed it within her personal life caused her to implement a change in her expectations of how learning is displayed in her K-12 classroom, has inspired her to continue understanding learning theory for herself, and caused her to share her perspectives of learning with her husband and child. Before the adult learning class her expectation for how her K-12 students displayed their learning in class was “really rigid,” she expected her students to follow a rubric based from her expectations for their learning. Elly’s standards for how her K-12 students’ could display their learning, after taking the adult learning class, encouraged various mediums. Elly stated:

My overall approach with kids and learning and have given lots of various medium to explore... we approach it through video, we approach it through writing, we approach it through reflection, we are approaching it through verbal articulation with our partners, we

approach it through interviews at home so that they can get someone else's perspective...  
then we would do things like do an art project or do a drawing...

Students have a choice to show what they have learned through approaches such as creating videos, writing, reflecting or discussing with the teacher or their peers, conducting interviews, drawings, or creating art projects. Elly noted that how her K-12 students choose to present their learning is no longer important, however, she noticed that her K-12 students still want to know “if their thinking is right;” Elly’s typical response to those students is “your thinking is your thinking and it develops as you go along.” Within her personal life, Elly shared her perspectives of learning with her husband and son. Elly noted that her husband, as an alternative learner, could benefit from understanding more about the neuroeducation perspective of learning and her son could develop a different perspective and value for education by viewing education from a neuroeducation lens.

### **George**

George felt the adult learning class caused him to reflect on his perceptions of learning for K-12 learners, adult learners, within his profession, and within his personal life, which then caused him to implement a change in his professional practice. Identifying and separating his *who's* and *what's* was an important realization for George and was a base for his change in educational practice. George said, “I started with trying to address their *who* or self-worth or how they valued who they are and strengthening the relationships that I have within the classroom with my students and trying to make it, ensure that it’s a safe space for them to take risks...” As a part of his need to help students feel safe, recognize their self-worth, and respect their thinking, George said he made sure to allow alternative ways for his students to display their learning, “... they could create a video. They can create a model. They can create a 3D model or a two

dimensional model... or they can show a pictorial model of what it is and how they're understanding the concept.”

### **The Experts in the Field: Implementation Strategies**

The third question, within the semi-structured interview asked to Experts, investigated the ways in which neuroeducation-based perspectives were implemented in their lives. One criteria for participants to be considered an Expert was that they had implemented neuroeducation-based strategies into their instructional practices (see Chapter Three). The question asked: *In what ways have you implemented neuroeducation-based perspectives in your: a) educational practice? and b) personal life?* The Experts' narratives in response to these questions are provided below.

#### **Mary**

As a researcher and practitioner of neuroeducation in an ESL learning environment, Mary, implemented a number of neuroeducation-based, visual strategies. Everything in the last three years of Mary's bilingual program was based on neuroeducation, which even included how she solved her own questions or problems. “Even though I have a lot of questions...I always can use neuroeducation to answer my questions.” As a researcher of neuroeducation Mary could translate research, literature, and studies from multiple fields of study including cognitive psychology, neuroscience, and language to help her find answers to her questions. Mary utilized a number of visual-based, neuroeducation-supported strategies as an ESL educator which included: a connection of visual images with their meanings, and drawings which helped students decode the language studied in their class, instead of just copying letters and symbols (which, Mary said, is a common practice on classrooms like hers). “We use a lot of drawings... instead of just copying...” When her students used visual, neuroeducation-based strategies such

as finding the underlying meanings within the language and drawings to help students visually understand abstract concepts, her students were then later able to use specific words in written and oral sentences.

### **Mitch**

Over the years, Mitch has been able to continue to improve his practice with K-12 learners and now with adult learners through implementations of neuroeducation-based practices. As someone with a background in neuroeducation who has continued to research and translate learning through a neuroeducation lens, Mitch understands that a large percentage (roughly 95%) of learners utilize a visual learning system. What this has looked like in Mitch's practice is when possible, he makes things visual; whether it is through movies, pictures, flowcharts, stories, or from shapes generated by movements. Mitch stated:

I want to support visual thinkers by really trying to make concepts visual, providing visual wherever possible. What does the concept look like, can they see my mouth when I'm doing instructions, so that they can overlap that shape with the shape of whatever else we're doing. I also really try and bring in stories and stories that I'm telling, stories that kids are telling. I mean they can be stories from their own lives, other people's stories that kind of thinking, but we really putting learning in a context... that allows them to refine their understanding of that concept over time.

One example of a visual strategy Mitch uses with his adult learners is by getting them to think about their thinking, and by challenging their own conceptual understandings:

One of the examples I use a lot with some of the adult learners I talk to is that my *beach*, if I think about a beach in my head, my beach is a different beach than they think about if I ask them to think about a beach probably, but that we can talk about our beaches and we

can get to that like shared understanding of what *beach* is. Then, we can really get to this formal level as well about what would a beach be like on Mars?

Getting his adult learners to conceptualize different forms of beaches by first recognizing that people mentally imagine different beaches, Mitch is able to utilize and share his background and understandings of learning levels (i.e., pre-operational, concrete, formal) related to a neuroeducation perspective of learning with his adult learners and raises their cognition. Mitch did note that he typically expects adult learners to have “slightly higher cognitive and language levels” than K-12 learners, since the adults have already established themselves as educational professionals (e.g., having went through college or university training/ schooling). He went on to say:

I don't think college graduate is directly equal to having a certain levels of cognition. I also don't think it's completely equitable to having certain like acquisition of pro-social concepts...with adult learners, often given the situations I'm in, I expect a little bit more of them. That said, it's not always the case.

Mitch went on to say that he knows of several K-12 learners who are really ahead in their thinking and could easily benefit from any type of adult professional development experience, even more so than some adult learners he knows, therefore, again implying that educational attainment does not imply a certain level of cognition.

Just as Mitch noted his implementations of neuroeducation-based practices as an educational professional, he has also been able to implement his neuroeducational understandings of learning on a personal level. Mitch's emphasis towards adding value to people was re-highlighted:

...I want to say I forgive people for not having different information and I don't know it's even my place to forgive them, but I try and view things that people are doing as products of the information they have and the opportunity to change information using neuroed strategies; I'll tell my story to a group of adults, who are educational professionals; stories are a neuroeducational technique as stories kind of generally can be. I think that is powerful. I'll do the same thing with interpersonally outside of the field of education. I feel like if I tell my own story, I open that possibility that things aren't necessarily about who's right and wrong, but here's information I have and here's some perspective and tell me more about your perspective and that kind of thing.

**Barb**

Neuroeducation has influenced Barb's views of how learning occurs for K-12 learners, for adult learners, and members of her family, which in turn has impacted her professional instructional practice and the things she does in her personal life. Neuroeducation has influenced Barb so much that she said it is a part of her life and shapes the way she interacts everyone in her life including her family, friends, and colleagues. Due to this influence in her thinking, Barb said she has implemented neuroeducation-based practices in each of those areas of her life as she stated:

Oh, it's constant. I can't *not* live it now. From the way I approach planning an adult class to help people along that journey, to the way I interact with my family, my friends, my colleagues, I can't think of one way I haven't implemented neuroeducation-based practices.

Considering Barb's K-12 learners, she mentioned that using neuroeducation-based strategies such as Viconic Language Methods (VLMs®) are important, as they help her students "work



through their problems to see the *who* of each other.” Barb mentioned that with adult learners she tends to talk more, but also applies the same practices that she does with her K-12 learners; Barb said:

...when I’m showing them [adult learners] a new concept, I’m flow-charting or drawing. I’m having them do multiple concrete experiences so that they can take away that real experience they had and connect it to the more abstract learning. So the same principles of learning apply [comparing K-12 learners to adult learners] ...

Barb mentioned that the implementations of neuroeducation-based practices within her personal life include: drawing out situations with her son, to show him different strategies for learning as well as using other VLMs® such as verbal flow-charting, which is a visual-based strategy that allows for higher cognition to take place for visual learners.

**Research Question #4: In what ways do adult learners’ neuroeducation perspectives of learning impact those around them (e.g., K-12 learners, adult learners, colleagues, personal lives)?**

#### **The Focal Participants: Impacts of Implementation Strategies**

The fourth and final question, within the semi-structured interview asked to Focal Participants, investigated the impact of their neuroeducation-based implementation strategies on those around them. The question asked: *If your perceptions about learning for yourself or others changed after taking a class on adult learning (in other words, andragogy) with a neuroeducation perspective of learning, then how did that change impact: a) your K-12 or adult learners? b) your work colleagues? and c) your personal life?* The Focal Participants’ narratives in response to these questions are provided below.

**Mike**

Mike felt the neuroeducation perspective of learning, incorporated in the adult learning class, caused him to reflect on himself as a learner, caused him to think about his perspective of the learning process for his K-12 students as well as his colleagues, which caused him to share the neuroeducation perspective of learning with his colleagues. Mike's perspective of learning and implementations of those perspectives impacted a number of people. As an administrator, considering quantitative data, Mike mentioned he did not have any formal assessment data from which he could compare the impacts of sharing his neuroeducation perspective of learning with his K-12 learners; however, Mike did mention that he felt many of his K-12 students must have had been impacted because the K-12 learners had reached out to him later on for advice and wanted to further understand his way of thinking. Mike stated:

I can definitely say that I do believe that it impacted them in such a way that those K-12 learners who are now in college are still seeking me out and wanting to connect...I noticed that they were connecting with me, not because of what school I went to. They weren't connecting with me because of what I was wearing or who my parents were, anything like that. They were connecting with me because they had learned something from me and I was, I wasn't a threat to them. I was someone that they could bounce ideas off or opinions, I was someone that could be very real and transparent with them, and there was value in that.

Mike then considered how he felt his colleagues had been impacted through him sharing his neuroeducation perspective of learning. Mike mentioned that his colleagues had displayed some interest in wanting to know more about the neuroeducation perspective of learning he had been learning about in the adult learning class, so they asked Mike to give a presentation on it; Mike

noted that it was only a 10-minute presentation and he was not given a lot of time to prepare for it. Mike said, “I was on display,” and said, “basically...if there’s something you don’t understand...or “if someone doesn’t know the answer to a particular question I think you need to find a way to help that person get it.” Mike then reflected back on what he had learned about himself from taking the adult learning class and said, “...I’ve got to tell adults that hey, sometimes you gotta peel back some layers and be transparent and be vulnerable...that make you feel like hey, I’m not where I should be.” Mike admitted that he is still “a work in progress” and needs to go back and review some of the material presented in that class, but “that the neuro-ed class was definitely the stepping stone to make me a better person, but also to make me a better learner.”

### **Xeng**

Xeng used neuroeducation as a lens to question and change her communication style with her students and within her personal life and used neuroeducation as a lens to view the quality of work she implemented within her profession. Students Xeng worked with and those of whom she talked with, after having utilized neuroeducation as the lens for interpretation, were impacted in a number of ways which included the strengthening of relationships, increasing students’ cognitive capacities, and the willingness of others to change and continue to grow as professionals. Xeng noted that her shift in communication style with her students, from authoritarian (which according to Xeng, was the experience most students had in school) to authoritative (which Xeng said, “is a big shift from the typical behaviorism style that you use a lot in schools), caused her students to be “healthier social beings” because they learned, “the importance of healthy relational boundaries” and they learned what healthy relationships were. Xeng’s students were also impacted cognitively from the shift in her communication style to authoritative; Xeng noted,

“I feel like they can, in an appropriate way, stop and ask a question, or stop and say, ‘I don’t think we should do it this way.’ And I’d say, ‘Okay, well let’s talk about it.’”

The change in Xeng’s communication with her students and the impacts that had on her students was witnessed by and influenced her colleagues as well. Xeng has been able to share her neuroeducation perspectives of learning with her colleagues and feels very fortunate to have done so, “I know there have been other colleagues of mine, who are neuro educators, who don’t have support, by their admin or by their teachers.” Xeng went on to say that through this shared collaboration, her colleagues’ interests have shifted, “People are becoming more aware about the importance of visual learning and visual learning systems.” Xeng has seen more of her colleagues using visual-based strategies, “I see a lot more drawing.” and some visual-based strategies (e.g., cartooning) have been added, as accommodations, to students’ IEPs to help more holistically understand and help the student in need. Xeng was excited to add that, “they [the intervention team] just added a section about language on there [the students’ IEP accommodation checklist], and I’m super pumped, because that’s been what I talk about for the last three years.” Xeng then considered how her own children have been impacted by how she communicates and through her use of visual-based strategies and said her son (who is the youngest), “knows nothing other than being talked to with a lot of rich visual language...” and “his language is so further advanced than my daughter, and she’s not a slouch in the language department.” Xeng acknowledged that both her children have visual learning systems and that it is normal for them to draw things out and “try to tell me things” through those drawings.

### **Leonna**

Leonna’s understanding of learning she gained from the adult learning class with the neuroeducation perspective verified some of her previously-acquired perspectives of learning,

helped confirm her as a visual learner and the visual-based strategies she used as a professional, and had an impact on those in her professional and personal life. Leonna considered her professional role and felt as though she had become a better director because, “I was better able to understand, not only my adult students, but also my faculty that worked under me.” Leonna shared a story of the impact that her neuroeducation-based thinking had on one of her graduate students. Leonna’s graduate student came to her and wanted to talk about what she (Leonna) had learned in the adult learning class so that she (the graduate student) could understand the neuroeducation perspective of learning better; according to Leonna, the graduate later “entered into the neuroeducation program the next year.” Leonna’s student was influenced to want to continue her learning in neuroeducation. Leonna went on to say that the neuroeducation perspective of learning, “opened her eyes to the understanding that I can help them learn a new way...” and recognized the gap and need for higher education educators to understand learning theory. “...they don’t know the brain necessarily ‘cause they didn’t sit in, in neuroed class,” stated Leonna. Leonna then acknowledged the impact the adult learning class had on her ability to be patient:

I think it [neuroeducation] gives me and has allowed me more patience with other people

because I feel like it has opened my eyes to accept and understand that we don’t need to change the way people learn. We need to understand the way people learn. Once we understand the way they learn, then we can be facilitators of that learning process. But if you think everybody needs to be like yourself or learn in one particular way, then you have already blocked the opportunity for them to learn.

**Cora**

Cora implemented several neuroeducation-based learning strategies within her professional and personal life. Cora's strategies included: emphasis of reflection for adult learners' thinking, an incorporation of andragogical-related principles of learning (e.g., information given is meaningful, practical, and relevant, discussion) with K-12 learners and adult learners, incorporation of visual-based instructional methods such as drawing and flowcharting, and consideration of communication methods (e.g., authoritarian and authoritative) towards the shaping of her daughters' identities and values. Cora stated that an incorporation of relevancy and practicality to new content information in her colleagues' training sessions seemed useful, versus doing the sit-and-get, lecture-based strategy she previously used with them. Cora observed that several of her colleagues were influenced, "they seem engaged in it and could maybe pursue it," after she switched her training style from more of an authoritarian-based style (e.g., sit-and-get, lecture-based) to an authoritative style (e.g., discussion-based, interactive). Cora noticed a change in one of her daughters' thinking as well. Cora's oldest daughter, who had no problem navigating an authoritarian-based classroom setting and who also was proud of her good grades in school, one day had a traumatic brain injury (TBI). The TBI caused Cora's daughter to miss some schooling and also impacted her daughter's ability to do the work at the level she previously had done before the TBI. Cora said that her daughter (after Cora had talked with her about separating her who's from her what's) still tried to get good grades, but she no longer stressed to the same degree if she received a lower grade. Cora said that her daughter felt that if she did her best in the class, that was more important than getting a good grade to prove she did well. Cora mentioned that her daughter said, "I am not my grades," which, Cora said,

was not something she would have heard from her daughter before she shared neuroeducation-related perspectives towards learning and identity.

### **Leighla**

Leighla's neuroeducation-based perspectives of learning and implementations of those perspectives impacted those in her professional and personal life. Leighla admitted that she does not yet have any quantitative assessment data for her K-12 learners after she had her language educators implement neuroeducation-based practices, but that there is some evidence of its success. K-12 learners have been exiting out of their language programs and educators have been seeing improvements in student behaviors. Leighla stated, "...especially our newcomer students, are really acquiring the language at a quicker pace, because we've incorporated some of the strategies..." which caused us to "see some improvements especially when we're dealing with behavior." Leighla has seen educators starting to use more visual-based strategies such as drawing out the students' thinking when students are displaying inappropriate behaviors. Leighla mentioned that educators have noticed their students are starting to understand their thinking in relation to inappropriate school behavior. Educators are also starting to understand "the big picture" about students' learning systems and how learning should be individualized. Leighla said:

We're seeing a lot more individualized approaches and also seeing a lot of, "I'm not creating these anchor charts. I'm not creating these sentence frames. I'm not creating posters and just putting them up on the wall for students to use." Teachers are actually having them create things together using the constructivist approach, so that the work is reflective of what the students did together with the teacher.

Leighla noticed a change in the educators' thinking in that they are asking more questions and not as quick to label a student with a disability. "They're really pausing and thinking about, okay, what is it about my instruction that maybe is not helping the student to acquire the language?" stated Leighla. Within Leighla's personal life, she has seen a change in one of her child's reading ability. Over one of her daughter's kindergarten winter break, Leighla used Viconic Language Methods such as word bubbling and included more context and stories formats for the words her daughter was learning in her grade at the time; after a couple weeks, her daughter was right "on par" with her reading fluency compared to her other peers.

### **Elly**

After Elly implemented a change into her K-12 education setting and within her personal life, she noticed her K-12 students and colleagues were impacted. Elly noted that her K-12 students were most noticeably impacted social and emotionally. After implementing a change in her standards for how her K-12 students could show their learning Elly noticed her students are more "relaxed," "willing to take risks," and are developing a "servant-type mentality" where they are not just worried about themselves but are more willing to help others. This type of classroom environment, according to Elly, "has opened up an element of leadership and mentoring for those kids that are already there and a new access point for kids who were struggling before."

Elly felt like her classroom environment "created a level of respect and willingness to think outside the box." Elly shared a story about how her students handled a fight on the school playground which involved students from a different class within the school. She said:

...there was a fight on the playground on Friday, and the boys, also their peer in another classroom, and when they came back in they were really emotional about it and they



wanted to talk... so we had a community circle and the thing that they wanted to talk about was how they helped that boy who got so frustrated and how he could be served better by telling them that he looks nicer, that he has cool shoes, or that they could invite him to play somewhere, rather than avoid him and stay away from him and not be his friend. They wanted to really know how, collectively as a group, how they could reach out. Like, could we put a note on his desk? Could we make a poster for him?

Elly recognized those student behaviors as being atypical for that age group and attributed the experience to the level of comfort that was established in her classroom; “a lot of learning happens when your brain feels comfortable and you’re not longer feeling scared... I wouldn’t have thought of those things as an element of learning prior to this course,” stated Elly.

The implementation of neuroeducation-based practices into her classroom impacted Elly’s students and her colleagues. Inspired by the various cultures of students represented within Elly’s classroom, value towards diversity was practiced. One method of placing value in diversity was through culturally-diverse greetings by the students. Elly noted that it was common for her students to greet each other in a different language, then she noticed that her students had started greeting other teachers in the hallways as well. It was “spilling out to the staff because when I talked to them about white western culture and what teachers traditionally expect is like for you to make eye contact and say good morning and use their name because they love to be recognized” her students started practicing it outside the classroom. Elly said, “the teachers are like, ‘Wait, what?’” and were surprised to have an interaction with a student where the student initiated the greeting, looked them in the eye, and said hello. Elly also noticed that “teachers have been more likely to step up and ask for assistance... talking more about what is expected from students and what they need to do as the educator for the student.”

Personally, Elly has felt she has had to “tiptoe” around how she talks to or decides to give advice to her husband or son. Elly said, “being mom versus teacher, or being wife versus mentor. It’s a different dynamic, so it’s a lot harder. She feels as though she wanted to give useful advice but also did not want to feel like she was talking down to anyone or making either her husband or son feel “inadequate.” Therefore, finding the balance in how she speaks with her family is important.

### **George**

George believed his perceptual changes of learning related to the concepts of *who’s* and *what’s* caused him to change his instructional practice as a K-12 educator which then impacted his K-12 students. George noted that by allowing his students to show their learning in a variety of ways and by highlighting their self-worth, he had created a safe environment for his students to take risks in their learning; his students then, according to George, seemed more interested in what they were learning in class as well as seemed happy to come to class and participate more while in class. He also noted that his students were cognitively stronger, “students are showing that they understand the concepts that I’m hoping them to learn.” George noted that he had not seen any change in his colleagues, “That takes a lot of momentum to change others, so what I’m still doing right now is just leading by example in certain ways and just sharing ideas or perspectives that hopefully others can use as well.”

### **The Experts in the Field: Impacts of Implementation Strategies and Course on Adult Learning Theory with Implementation of Neuroeducation Perspective of Learning on Focal Participants**

The fourth question, within the semi-structured interview asked to Experts, investigated the impact of their neuroeducation-based implementation strategies on those around them. The

question asked: *How has implementation of your neuroeducation-based perspectives impacted: a) your adult learners (or K-12 learners)? and b) your work colleagues?* An additional, fifth question, was added to Experts' semi-structured interview. Because the concentration of each Expert in the Ed.D. program was neuroeducation, and Focal Participants' concentrations were both neuroeducation and non-neuroeducation-related, the Experts were asked whether or not they felt a one semester course on adult learning theory would be impactful for learners with a non-neuroeducation concentration. Therefore, Experts' closing responses stem from the semi-structured interview question: *Can one, semester-long, adult learning class on adult learning theory (in other words, andragogy) with a neuroeducation perspective towards learning cause a change in: a) Adult learners' perceptions of learning? How? (or Why not?) and b) Adult learners' professional or educational practice? How? (or Why not?).* Experts' responses to the fifth question may provide a deeper understanding for any lack of influence of the course on adult learning theory on Focal Participant perspectives of learning or lack of neuroeducation-related implementation strategies into their professional or personal lives. The Experts' narratives in response to these two questions are provided below.

### **Mary**

After having implemented neuroeducation, visual-based strategies, Mary noticed a change in her K-12 learners. Her students went from copying words, phrases, and symbols within her language class to purposefully connecting those words, phrases, and symbols with their cultural meanings and had started to draw pictures to help them mentally visualize the meaning behind those things. This change in her students' practice reflected on their thinking as well; so much so, that Mary has been contacted several years later from several of her former students, who wanted to know and understand more about the strategies Mary shared with them

as students in her class so they could use them in their continued learning of that language as now, adult learners in universities. Mary thinks one of the reasons for the lasting impact on those students is because, “they feel like they have reached some kind of conceptual understanding of how to learn that language...” a “pathway for them, to continue learning a language.” This was true as Mary has been contacted by over five different students saying they have enrolled at a university level for the language Mary taught them in their previous grades. “Every student I met in the build later, they said they want to continue learning the language in four years, even college.” The excitement of learning within Mary’s school had spread, and by her second year after implementing neuroeducation-based strategies, Mary’s classroom more than doubled in size (her first year had eight students and her second year had over 20 students). Mary noted that due to her position and mobility as an ESL teacher in her building, she was not able to connect with many of the classroom teachers or her other colleagues and therefore, she was unaware of the impact her neuroeducation practices had on others around her, other than her immediate students.

Having considered Mary’s education and work background, her expertise in utilization of neuroeducation-based theories to solve problems and implementation of neuroeducation-based practices, and her observed impact of those practices on those around her the researcher wanted to gauge Mary’s opinion of whether or not she thought a one semester-long, adult learning class with a neuroeducation perspective of learning could be impactful for adult learners in an Ed.D. program. As an Expert in the Field, with several years of experience working with K-12 learners and adult learners, Mary has been able to first hand implement and see the impacts of her neuroeducation-based practices and understanding of the NSLLT and its four levels of language acquisition on others, therefore, she holds a unique perspective towards the potential impact that this adult learning class could have on other adult learners. Mary recalled that her Ed.D. adult

learning class with the neuroeducation perspective of learning talked a lot about learning. She said talking about the definition of learning was important to her then and she still considers it to be important to her now. She said, a lot of educators take learning for granted.

We [educators] don't actually know what is learning. But from that course, I remember exactly, where learning starts, and how do we perceive learning for ourselves, as well as how our students in our classroom started to learn. That is the very important moment for me, to understand about this core concept.

Mary was a neuroeducation track, Ed.D. student, meaning she received all six required neuroeducation courses. However, the adult learning class with the neuroeducation perspective of learning was and still is a core class within the Pacific Northwest University's Ed.D. program, meaning, all concentration tracks (Continued Administrator License and Initial Administrator License) of cohort members are required to take that class, whether they have a background in neuroeducation or not. Mary noted, that adult learning class was difficult for them (the non-neuroeducation track cohort members). "What I remembered, at that time I have taken her courses for about one or two years, so I think I had a better foundation than those people who just came from leadership track... so it was difficult for them." Therefore, Mary was unsure of whether or not a one semester-long adult learning class with a neuroeducation perspective to learning could have an impact on each adult learners' (non-neuroeducation track) perceptions of learning for themselves and others and how those perceptions of learning would be implemented in their professional settings.

### **Mitch**

After having implemented neuroeducation principals, visual-based strategies with Mitch's K-12 learners and adult learners serving as educators, Mitch recognized a positive

impact on K-12 learners and adult learners including higher concept acquisition and fewer antisocial behaviors. Mitch stated, “I think they’ve been more successful at acquiring concepts because I’ve been able to provide environments that are conducive to that.” Having provided environments that were conducive to successful acquisition of concepts for his K-12 learners helped Mitch recognize a change in those learners’ thinking. His K-12 students also displayed greater levels of respect for themselves and others, “...the respect that happened was just transformational...we can each have this respect for each other as agents.” When he used neuroeducation as a lens to analyze his lessons in the classroom, he was better able to understand why some lessons did well and others did not. Regarding Mitch’s adult learners who are educators, after implementing neuroeducation ways of thinking, Mitch noticed that the educators were no longer comparing themselves to one another in an “antisocial competitive negative way” but were given the opportunity to allow them to learn and develop their own thinking based from what their previously learned experiences as educators and students themselves.

Mitch spoke more towards the impacts of neuroeducation perspectives on his educational colleagues and mentioned that there are different ways to provide useful information and have it still cause a positive impact. For example, Mitch said:

I tell people things sometimes in kind of almost passing when they ask questions that are apparently kind of enlightening or so I’m told sometimes. I’m like, “Oh, well 95% of people use a visual metacognitive system, so you can do this.” It’s like two sentences and they’re like, “Oh wow that totally changed my perspective.” It’s like, “Why don’t you use the podcast with middle schoolers and tell them to like close their eyes and picture things, especially given some for the number for like auditory impairment that’s under-diagnosed,” like yes, kids will fall asleep when that happens because they’re not doing

anything. I drop these little things and people are like, “Oh, that’s really kind of profound.”

Some educators Mitch has worked with took more direct approaches towards changing their instruction practice. One teacher Mitch worked with that came from the East coast, was a science teacher (and a good one according to Mitch), had been introduced to neuroeducation through Mitch, and directly asked, “Hey, I’m going to teach this global warming thing, what do you think, how would you do it?” A collaborative interaction between the science teacher and Mitch afforded the science teacher with additional neuroeducation support and instruction. After a follow-up with that science teacher, Mitch said the teacher was ecstatic and said, “It’s amazing, like the kids all just put their phones away and didn’t even take them out to look at them!” The science teacher noted that one of her students recognized the change in her practice and said, “Hey, have you been talking to Mitch, because this looks like something he would do.” In this example, the teacher was able to benefit from a several minute collaborative effort, the science teacher learned new neuroeducation-based strategies (i.e., stories and pictures) to implement into the lesson, and resulted in a positive impact in learning for both the science teacher and her students. This science teacher, according to Mitch, eventually changed how she talked to her students, which again according to Mitch, resulted in less yelling for students to put their phones away and allowed for a more respectful environment to be established conducive to learning.

Considering Mitch’s background for having studied and implemented neuroeducation-based practices with K-12 learners, adult learners serving as educators, and adult learners in a university setting for a number of years, his perspective towards the potential impact of an adult learning class with a neuroeducation perspective towards learning on adult learners is valuable. Since the adult learning class with the neuroeducation perspective towards learning is offered to

non-neuroeducation track Ed.D. students, Mitch was not sure about the level of impact that class would have on adult learners without neuroeducation experience. However, Mitch went on to say that from the impacts of neuroeducation he has seen in a K-12 school setting with K-12 learners and on adult learners severing as educators, that education really needs it. Regarding adults' level of understanding for neuroeducation-based practices in education, Mitch stated:

It would be a *disservice* and I almost want to use a stronger word than that. I think it would be *awful* to not have that [neuroeducation] available to people, who are going to be in leadership or working with children. I'm like, "How do you have that [information about neuroeducation] and know that this knowledge exists, that the outcomes are what they are from what I've seen in the research and then keep that away from a bunch of people who are going to be experts in education...even one class would have been amazing...even learning about neuroeducational learning theory in one course during the thing [the Ed.D. program] that would be really good.

Mitch, later went on to say that he felt like it would be a "...moral injustice not to provide that information to people..." and that he thought educators not having access to this information would allow schools to continue to generate awful experiences for students.

Mitch then considered the potential impact of that adult learning class with the neuroeducation perspective of learning on the likelihood of adult learners changing their professional practice. Mitch noted that several of his cohort members, after haven taken the core Ed.D. adult learning class with the neuroeducation perspective of learning, said that they thought the class was informative and that the information shared seemed to be of use. Mitch stated, "I've heard from other people who were not in the neuroed track how interesting or cool or intriguing the neuroed stuff was and how much they wanted to know more about it." Mitch



further referenced the need and importance of any level of exposure to neuroeducation in the field of education and stated, “I would hate to be the person who took that opportunity away.”

### **Barb**

Barb’s implementations of neuroeducation-based practices impacted those in her professional life, including her adult learners, her K-12 learners, and her colleagues. As an instructor at a university level, Barb’s impact (based from her students’ essays in class and comments on her course reviews) on her adult learners was very positive. When she worked with the adult learners at the university (who were studying to become educators) and implemented neuroeducation-based practices (e.g., VLMs® instead of structure-based teaching), her students told her that no one else talks about or does those (e.g., VLMs®) things. In other words, according to Barb, educators are not receiving this (i.e., neuroeducation) information. Barb said, “So what’s happening is our undergrads aren’t hearing this. They’re not hearing about neuroeducation...so, I see a positive impact of exposing future teachers to this younger, so they can really go out and see a difference with kids. It’s really exciting.” When Barb considered the impacts of neuroeducation-based practices on her K-12 learners, she said that the results are the same. Barb stated, “...they [K-12 learners] gained greater social concept, so they tend to be calm and respect each other. They do very well academically.”

The impacts of the neuroeducation-based practices on Barb’s colleagues were harder to distinguish when compared to Barb’s K-12 learners and adult learners. Barb, felt as though she is in a “tricky” situation when she works in her K-12 setting having said, “...typically you can’t be the expert next door.” However, Barb mentioned, “I do have one colleague, who we work very closely together, and she has really changed her practice and gone to seminars... so that’s really exciting.” Barb noted that the colleague that seemed interested in what she was doing because

she had heard about and seen the impacts the neuroeducation-based practices had on Barb's students. On the other hand, Barb's understanding based from neuroeducation has helped her "navigate" through some situations with more difficult colleagues. Barb stated:

...understanding anti-social or authoritarian-type reactions versus authoritative and pro-social has helped me navigate some of my more difficult colleagues. I don't know if it's impacted them, but it might have impacted them because they can't draw me into anger, and name-calling, and things like that.

Barb's background and understanding of neuroeducation, her implementations of neuroeducation-based practices on her K-12 learners, adult learners and within her personal life, and her observations of the impacts that those implementations had on others around her allowed the researcher collect a valuable perspective towards the potential effectiveness or potential ineffectiveness of an adult learning class with a neuroeducation perspective of learning on adult learners' perceptions of learning (for themselves and others) and the likelihood that those same adult learners would implement a change based from that adult learning class. Provided with another "tricky" situation Barb stated, "Adults are tricky in that there has to be a readiness to deal with change; to question yourself."

After considering the effectiveness of that adult learning class on the adult learners themselves, Barb went on to say that the first step to reach the adult learners in that class would be to start with the adult learners' thinking. The adult learners need to ask the questions, "...how do I learn? ... What's my background? Am I authoritarian? Am I teaching? Am I pro-social?" To get the adult learners to think about learning as learning applies to others around them (e.g., students, colleagues), Barb went on to say that, though "it's very possible", it seems more difficult for that one class to get adults to think about how the learning process occurs for others;

Barb said, “perception of learning for others?... that’s more concrete...”; and even more difficult to get the adult learners who had taken the adult learning class to implement a change into their professional practice, “...that’s very formal, because really, to move yourself into a place where you change your practice takes a lot of layers of ideas in this area.” Barb concluded that although the adult learning class might not cause a change in the non-neuroeducation (i.e., were not Ed.D. neuroeducation track students) adult learners’ thinking towards the learning process for others or impact their professional practices, the class along with the NSLLT at least can help the adult learners realize that, “Oh yeah, other people learn differently.”