

APPLIED EDUCATIONAL NEUROSCIENCE IN ELEMENTARY CLASSROOMS:
A GROUNDED THEORY STUDY

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DEDICATION

To Sade, Lola, and Katherine, my partners throughout this dissertation sojourn. You inspire me with your steadfast commitment and understanding as I retreated into far away worlds of reflection and generativity. Truly, I could not have triumphed through the adversity of this protracted life experience without being wrapped in your tender love. Sade, may traveling this journey with your mother, during your most formative years, empower you to transcend limiting narratives so that the world may know your creative, trailblazing spirit.

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APPLIED EDUCATIONAL NEUROSCIENCE IN ELEMENTARY CLASSROOMS:
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Educational neuroscience (EN) is a transdisciplinary convergence of neurosciences, education, and psychology that has gained international momentum. Its purpose is to advance the application of neurosciences in P-12 education as a way to improve the design of instructional environments and practices that support the multidimensional social, affective, and cognitive learning needs of students. The potential integration of EN practices into school settings affects educators and school social workers who promote positive school climates and address barriers to learning. Despite the ascension of scholarly discourse proposing the integration of neuroscience knowledge with education practices, a shared conceptual framework remains elusive for the emergent discipline, and the translation of EN into education practices is unexamined. A constructivist grounded theory study was conducted to investigate the emerging conceptualization of EN practices and implications for promoting a positive classroom climate.

Data collection included semi-structured interviews with two administrators, three teachers, and 48 students as well as four classroom observations from three different fourth and fifth grade classrooms in a US Midwest city. The data analyses generated a conceptual model that revealed how EN practices unfolded in the classroom to facilitate the co-creation of a positive classroom climate. The data indicated that a humanistic organizational structure facilitated the EN practice implementation, and the teacher's regulatory state was central to the application process. Five themes emerged that

characterized EN practices: teaching neuroanatomy, reflecting on emotions, self-regulating, adapting classroom boundaries, and honoring the whole student. Interactions resulting from these practices aligned with four established climate dimensions: teaching and learning, structure of the learning environment, safety, and relationships. The resulting classroom climate contributed to students' resiliency, as observed by reduced office referrals, readiness to learn, empowered decision-making, greater empathy, and enhanced social connectedness.

Findings from this study support a conceptual model for the application of EN practices in elementary classrooms and align with existing research that suggests positive climates promote healthy development, social-emotional learning, and academic success. The results of this study will inform future translational EN inquiry as well as educators and school social workers who seek to co-create positive classroom climates using transdisciplinary EN practices.

Kathy Lay, Ph.D., Chair

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Chapter 1: Introduction

Since the 1990s, technological advances have accelerated our knowledge of the brain's functioning, and there has been a burgeoning pursuit to provide a neurobiological explanation to our human quandaries. Schools are no exception, and this interest in neuroscience has spawned the creation of educational neuroscience, a transdisciplinary convergence of education, neurosciences, and psychology. Applied educational neuroscience in its early iterations has potential to assist educators and school social workers with cultivating instructional environments that support the multidimensional social, affective, and cognitive learning needs of students. Despite the fervor around the ascension of educational neuroscience, there persists a lack of shared conceptualization for this emergent discipline, and the role of school social workers in applying neurosciences in school settings remains mostly unexamined (Ansari, Coch, & Smedt, 2011; Butterworth & Tolmie, 2014). To address this knowledge gap, this study appraised the current applied educational neuroscience scholarship and generated findings from a grounded theory research design that aimed to contribute to the conceptualization of applied educational neuroscience practices.

Importantly, this dissertation study sought to address the question, "What is the significance of educational neuroscience for school social work practice?" As one of the oldest fields of practice in the social work profession, school social work provides emotional and behavioral support services to students and families that are vital to the school community and the students' well-being (Constable, 2016). Educational neuroscience has the potential to elucidate how environmental and individual factors interplay with neurobiology to shape the learning process (Cozolino, 2013; Sousa, 2010;

Cantor, Osher, Berg, Steyer, & Rose, 2018). With school social workers' primary theoretical orientation in ecological theory (Crosby, 2015; Garrett, 2007; Jarolmen, 2014; Monkman, 2016; Swick, Bowen, & Allen-Meares, 2015), understanding how the intersection of the environment with one's interpersonal neurobiology may hinder or promote learning aligns with social workers' central function of addressing barriers to learning (Constable, 2016). The dissertation study provided a seminal exploration into the linkage of school social work and educational neuroscience.

This chapter introduces the reader to the educational neuroscience discipline and movement. It outlines the context and rationale for this burgeoning area of inquiry and gives a preview into the research purpose and aims that defined the research design. The significance of this study is examined with a seminal discussion on the import of applied educational neuroscience for school social work practice. Embedded throughout each section, this chapter provides an overview of definitions and terms that are central to navigating this dissertation. The subsequent four chapters in this dissertation include the following: Chapter 2: Literature Review; Chapter 3: Research Methods; Chapter 4: Research Results; and Chapter 5: Analysis, Interpretation and Synthesis of Findings.

The Neuroscience Movement

Declared "the decade of the brain," the 1990s offered advanced neuroimaging technologies that yielded unprecedented access to brain functioning (Walker, Chen, Poon, & Hale, 2017). This scientific expansion inspired a torrent of inquiries seeking to demystify this uncharted realm of human existence (Tokuhama-Espinosa, 2008) with an exponential increase in neuroscience studies since 2009 (Stelzer, Lohmann, Mueller, Buschmann, & Turner, 2014). Subsequently, there has been a sharp surge in knowledge

generation about the functioning of the human brain and attempts to translate that knowledge into practice (Cozolino, 2013; Desautels & McKnight, 2016; Fischer, Goswami, Geake, & the Task Force on the Future of Educational Neuroscience 2010; Schrag, 2011; Sousa, 2010; Varma, McCandliss & Schwartz, 2008).

The quest to integrate neuroscience into all dimensions of human functioning and provide explanatory power for life's quandaries has also captured the public imagination (Weisberg, Keil, Goodstein, Rawson, & Gray, 2008) and spurred the international proliferation of scholarly journals, undergraduate and graduate degree programs, and research centers examining the merits of applied neuroscience (Joldersma, 2016; Tokuhamma-Espinosa, 2008). The ascension of the neuroscience discourse is impacting many academic fields, and there is no sign of this trend abating (Joldersma, 2016). Included in this swell of enthusiasm and inculcation of neuroscience is the field of education (Carew & Magsamen, 2010; Goswami, 2006; Joldersma, 2016).

The brain is the central human organ involved in the learning process (Butterworth & Tolmie, 2014; Immordino-Yang & Fischer, 2016; Sousa, 2010). Consequently, understanding its function and application to learning and behavior in the classroom is a reasonable pursuit for educators, student service practitioners, and researchers. Furthermore, as scientific insight into the impact of stressors on the neurobiology of learners has emerged (Chapman, 2014; Cozolino, 2013; van der Kolk, 2014; Siegel, 2012), there is an emboldened quest to apply this emerging knowledge to the classroom as an explanatory mechanism for addressing behavior disruptions and supporting the learning needs of vulnerable students (Cole et al., 2005; Plumb, Kelly, & Sonia; Wolpow, Johnson, Hertel, & Kincaid, 2009).

Based upon the assertion that learning is a holistic, social-emotional, and cognitive process (Cozolino, 2013; 2014; Immordino-Yang, 2016; Immordino-Yang & Damasio, 2007; Sousa, 2010; Zull, 2011), this dissertation specifically examined the application of the social and affective dimensions of educational neuroscience. In that vein, the study weaved together scholarship generated from a tapestry of the transdisciplinary pioneers who have nurtured the inception of educational neuroscience and who give this emergent discipline form and responsible expansion through a collaborative fusion of reflection, research, and critique. As an incipient discipline, educational neuroscience has formed through a combustion of visionary zeal (Desautels & McKnight, 2016) and contentious debate that persists in the present (Bruer, 1997; 2013). From disregarding the discipline entirely (Bruer, 1997; Cuthbert, 2015), to maintaining an agnostic position on its potential influence (Campbell, 2011; Joldersma, 2016), to embracing it as the next frontier (Carew & Magsamen, 2010; Desautels & McKnight, 2016; Immordino-Yang, 2011; Kelly, 2011; Sousa, 2010; Tokuhamas-Espinosa, 2008; Willis, 2007), there is a spectrum of beliefs about the cogency of the neuroscience and education interface that is well-documented in the emergent literature (Geake, 2009; Joldersma, 2016; Patten & Campbell, 2011; Smeyers, 2016).

Educational Neuroscience: Historical Background and Definition

The term “neurology” was first coined in 1681 (Willis, 2007). Since that time, the pursuit to discover its mysteries and potential has persisted. Historical accounts suggest that exploration into integrating education and neuroscience occurred over a century ago. Theodoridou and Triarhou (2009) highlight that around 1895 neurologist Henry Herbert Donaldson and educator Reuben Post Halleck probed the potential

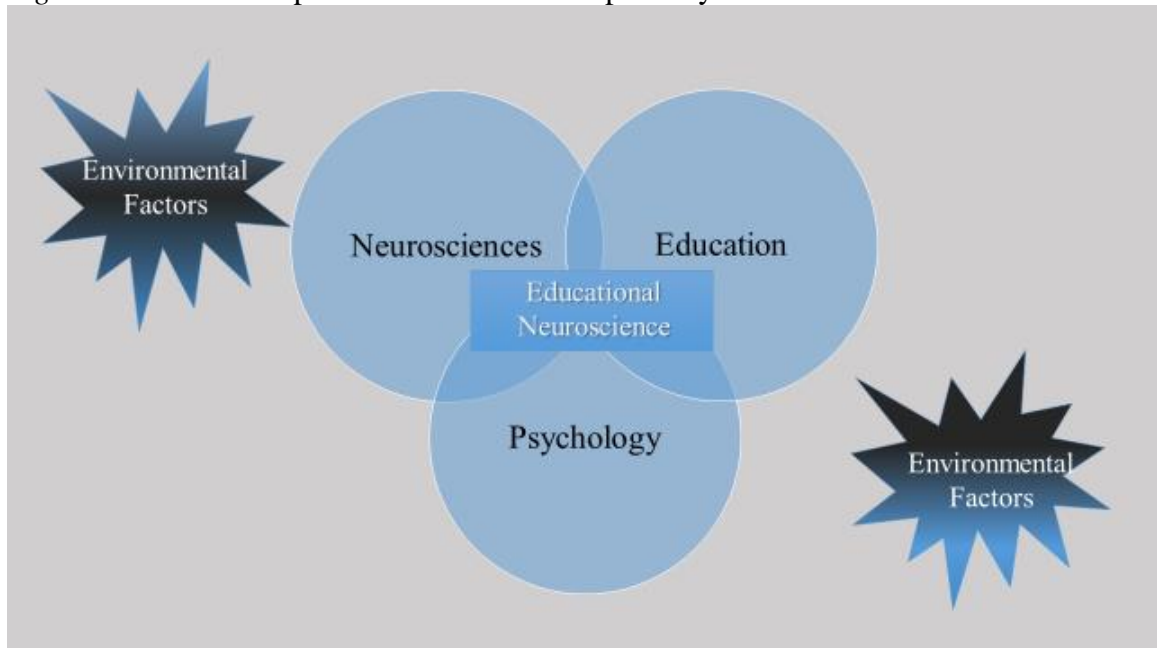
application of neurobiological research to education. Additionally, in his 1926 textbook, E. L. Thorndike, an early pioneer of educational psychology, highlighted the relevance of brain physiology for educational psychology (Mayer, 1998). By the late 1970s, emerging research established a more formidable link between the brain and learning that exceeded the boundaries of educational psychology and introduced the intersection with neurology (Chall & Mirsky, 1978). To address the growing interest in understanding the brain and its potential for learning, the field of cognitive neuroscience was established in the mid-1980s (Garner, 1987).

Within the last three decades, cognitive neuroscientists have been able to examine how brain structures facilitate mental functions, and research on learning processes is incorporating a focus on neural circuits, synapses, and neurotransmitters (Willis, 2007). Yet, by the end of the 1990s, scholars cited limitations with cognitive neuroscience arguing that cognitive neuroscience's primary focus on the science of learning neglected the science of teaching (Goswami, 2008). By the early 2000s, educational neuroscience was conceived to address the lack of inquiry into how to best teach to maximize learning potential. The birthing of educational neuroscience also sought to balance the biological determinism of cognitive neuroscience (Campbell, 2011; Siegel, 2012) with the subjective elements of teaching and learning (Tokuhama-Espinosa, 2008). The neuroscience and education nexus germinated throughout the last decade, building the momentum for a new discipline entitled educational neuroscience.

Even in its infancy, the movement to apply neurosciences in education is inspiring formidable shifts in how educators at all levels deliver instruction, promote student engagement, and support behavioral expectations (Knox, 2016). Melding education,

psychology, and neurosciences (See Figure 1), educational neuroscience is an inchoate discipline that harnesses this unique intersection by attending to the environmental, social, affective, cognitive, and neural components of learning (Butterworth & Tolmie, 2014; Cozolino, 2013; Goswami, 2004; Immordino-Yang, 2011). For some of the discipline’s early pioneers, educational neuroscience is not simply another instructional delivery program; rather, it asserts a transformation in the tapestry of relationships, norms, and values that shape our education institutions (Cozolino, 2013; 2014; Desautels & McKnight, 2016; Immordino-Yang, 2016).

Figure 1. A Visual Depiction of the Transdisciplinarity of Educational Neuroscience



Source: Sousa (2010)

Currently, a shared definition for educational neuroscience does not exist. For the purposes of this inquiry, I draw from Patten and Campbell’s (2011) definition where they describe educational neuroscience to be a “syntheses of theories, methods, and techniques of neurosciences, as applied to and informed by educational research and practice” (p. 1). Notably, Patten and Campbell qualify their averred definition as evolving rather than

definitive. The literature review section provides a more in-depth discussion of the varying definitional perspectives.

Collaborative Knowledge Building

The advent of more advanced neuroimaging technologies since the late 20th century has accelerated and expanded neuroscientific knowledge (Cozolino, 2013; Immordino-Yang, 2011; Schrag, 2011; Varma, McCandliss & Schwartz, 2008; Watanabe, 2013). To synthesize this burgeoning knowledge base, scholars have sought to create a collaborative platform for this evolving area of inquiry. In 2004, leaders in educational research formed the International Mind, Brain, and Education Society (IMBES) through Harvard University to facilitate cross-cultural collaboration in biology, education, and the cognitive and developmental sciences (Tokuhama-Espinosa, 2008). IMBES's purpose is to provide a transdisciplinary lens for creating research directions, dispensing resources to stakeholders, and fortifying the knowledge base for this movement (<http://www.imbes.org>). To support this mission, IMBES launched the *Mind, Brain, and Education* journal in 2007 to create a scholarly space for the research and discourse on the brain and behavioral considerations in education. Consequently, *Mind, Brain, and Education* was embraced by its proponents in the scholarly realm and recognized as the “best new journal” in the social sciences and humanities that same year (Schrag, 2011).

Since that time, other research centers formed throughout the world, including the Centre for Neuroscience in Education at the University of Cambridge; Centre for Educational Neuroscience at the Institute of Education, University College, London; Centre for Neuroscience and Learning at the University of Ulm (Germany); and the

Neurocognitive Development Unit at the University of Western Australia. (See Appendix A for a more extensive list of educational neuroscience research centers.) Contributing to the international recognition of the emergent discipline, the Organisation for Economic Co-operation and Development (OECD), an intergovernmental economic organization with 34 member countries (See Appendix B), has hosted international conferences and investigated the potential policy implications for neuroscience research. Their 2007 report, *Understanding the Brain: The Birth of a Learning Science: New Insights on Learning through Cognitive and Brain Science*, synthesized analyses from 2000-2007 (OECD, 2007). Building upon this historical purview, the next section describes educational neuroscience as a transdisciplinary science.

A Transdisciplinary Science

Anthropologist Clifford Geertz (1983) stretched scholarly paradigms by suggesting that social sciences were becoming and using “blurred genres” in practice and scholarship. Educational neuroscience offers a contemporary reflection of Geertz’s classic assertions from nearly four decades ago. For practitioners, philosophers, and researchers who support the development of educational neuroscience as a discipline, there is a swelling consensus that educational neuroscience is a transdisciplinary endeavor (Campbell, 2011; Knox, 2016).

Leavy (2011) defines transdisciplinarity to be “an approach to conducting social research that involves synergistic collaboration between two or more disciplines with high levels of integration between the disciplinary sets of knowledge” (p. 9). Unlike multidisciplinary and interdisciplinary pursuits that entail various disciplines maintaining their unique philosophical and methodological identities in the problem-solving, solution-

creating process (Leavy, 2011), transdisciplinary educational neuroscience engenders the melding of new philosophical considerations, theoretical frameworks, and research methodologies (Butterworth & Tolmie, 2014; Campbell, 2011; Knox, 2016). It threads together the biological, behavioral, and social contexts to inform a more texturized understanding of teaching, learning, and development (Knox, 2016) and draws from pluralistic perspectives for explanatory frameworks (Ansari & Coch, 2006; Ansari, Coch, & de Smedt, 2011). Figure 2 provides insight into principles and aligning practices that characterize transdisciplinary work. Using this framework, transdisciplinary approaches inspire conceptual, methodological, and theoretical pathways that address real-world problems through the cross-fertilization of an array of disciplines. Consequently, the transdisciplinary nature of educational neuroscience establishes a unique and logical scholarly association for school social work research.

Figure 2. Six Key Principles and Aligning Practices of Transdisciplinarity

Principles of Transdisciplinarity	
Principle	Practice
Problem-Centered	Issue-driven research determines disciplinary insight and instructs methodology
Holistic & Synergistic Inquiry	Issue is assessed holistically and iteratively, generating integrated knowledge
Transcendence	Conceptual frameworks transcend disciplinary parameters to provide real-world solutions
Emergence	New conceptual and methodological frameworks
Innovation	Researchers collaborative to construct new conceptual, methodological, and theoretical frameworks
Flexibility	Openness to unique ideas and willingness to adapt

Source: Leavy (2011, p. 30)

Transdisciplinary educational neuroscience provides a fresh, potentially revolutionary paradigmatic lens to pioneer unexplored pathways for education theory

(Immordin-Yang, 2011), practice, and research, which includes the nature of consciousness as well as the explanatory gap between the science of human neurobiology and the art of facilitating learning amid an enlivened social, cultural, and political context (Campbell, 2011). Some scholars have referred to this epistemological merging as creating the science of teaching (OECD, 2007; Tokuhamma-Espinosa, 2008). Still, transcending boundaries for a holistic examination of the interplay of mind, brain, and education remains steeped with questions and uncharted territory for researchers, administrators, and practitioners. Drawing on this discussion of the emergence of educational neuroscience, the next section transitions into the research problem, purpose, questions, and significance.

Research Problem

School climate is a multidimensional term that encompasses an array of internal and external factors that contribute to feelings of safety, belonging, engagement, and respect. Perkins (2006) defines school climate as “the learning environment created through the interactions of human relationships, physical setting and psychological atmosphere” (p. 1). Research has shown that a positive school climate is consistently linked to improving student outcomes (Cohen et al., 2009; Gerlach & Hopson, 2013; National School Climate Center, 2007; Thapa et al., 2013). Many students present with various stressors that occlude their ability to learn and fully potentiate, and educators look to neurobiological explanations to interpret behavior and design supportive learning environments that comprise school climate.

As established members of multidisciplinary student services teams in schools across the US, school social workers are central to formulating multisystem strategies

that create a positive school climate and address barriers to learning (Gerlach & Hopson, 2013; Kelly, 2013). Consequently, elucidating the affective and social dimensions of applied educational neuroscience at a school-wide and classroom level has implications for school social workers as they seek to provide consultation and support services. Despite the expectancy of applied educational neuroscience as a potential scientific pathway to inform practice in schools, a unifying conceptualization to guide responsible practice and further research inquiries remains primarily unformed.

Research Purpose and Questions

This dissertation presents a grounded theory study that examined data from three different fourth and fifth grade general education elementary classrooms in a Midwestern US city where teachers espoused the social and affective dimensions of educational neuroscience principles. The purpose of this grounded theory study was to describe how practices based on educational neuroscience principles unfolded in classrooms taught by teachers who espoused these principles. The research questions were as follows:

- (1) How do teachers, school administrators, and students describe educational neuroscience?
- (2) What practices do teachers use in the classroom to apply educational neuroscience principles?
- (3) How do students respond to their practices?
- (4) What classroom interactions are associated with these practices?

The next section outlines the significance of conducting the study at this time.

Rationale and Significance

Education is a primary mechanism for advancing social development and individual opportunities (Butterworth & Tolmie, 2014). Consequently, ensuring students' access to quality learning opportunities has social justice implications for

individuals, families, and communities (Brake & Livingston, 2016). This section highlights three key arguments for the rationale and significance of this area of inquiry: (1) the prevalence of students who experience extensive stressors while trying to learn; (2) implications for furthering evidenced-informed school social work practice; and (3) bridging epistemological chasms of neuroscience and applications to practice.

Creating Evidence-Informed Interventions for Learning Environments

Since the 1950s, the US government has passed a sequence of federal educational reforms that have sought to ensure American students' access to public education. It has also incrementally legislated supportive mechanisms to promote students' opportunities for learning (Kelly, 2013). The landmark Elementary and Secondary Education Act of 1965 and Individuals with Disabilities Act of 1975 and their subsequent reauthorizations have amplified American education's commitment to a Free and Appropriate Public Education (FAPE) (Kopels, Rich, & Massat, 2016). Despite the legislative and moral mandate to educate all students, many students present with perplexing stressors that impede their ability to learn. The increasing scholarly insight into the occurrence of students experiencing extensive stressors underscores the need for evidence-informed strategies for designing supportive learning environments. The next section highlights the impact of trauma and adversity on learning and the need for evidence-informed school-wide prevention and supports.

The Prevalence of Childhood Trauma and Adversity: Implications for Learning

Applying educational neuroscience at a school-wide level has implications for all students. Yet, there are students for whom the task of learning is especially disrupted by challenging circumstances that cause impairing distress. Gitterman and Shulman (2005)

define stress as “an imbalance between a perceived demand and perceived capability to meet the demand through the use of available internal and external resources” (p. 5). Stressors include critical life issues that exceed one’s interpersonal and environmental resources for managing them (Swick, Bowen, & Allen-Meares, 2015). Life stressors may include difficult social transitions, traumatic life events, and/or adverse experiences (Gitterman & Shulman, 2005).

Trauma can be a particularly pernicious stressor for students. The occurrence of trauma is pervasive as approximately two-thirds of Americans experience some level of childhood trauma (Centers for Disease Control, 2016). Perfect, Turley, Carlson, Yohanna, and Gilles (2016) conducted a systematic review of the literature to investigate school-related outcomes of trauma in school-aged youth. Their review of 83 empirical studies revealed the formidable impact of trauma exposure on the cognitive, academic, and teacher-reported social-emotional and behavioral outcomes of students.

A landmark study that currently shapes much of the contemporary discourse around trauma and adversity is the Adverse Childhood Experiences Study (ACES). Felitti et al. (1998) conducted the original ACES study, which uncovered excessively high rates of trauma among a participant group of over 17,000 people. The occurrence of childhood trauma was positively correlated with negative physical health, mental health, and workforce outcomes. The study highlighted a pervasive, silent epidemic that has lifespan implications. Focusing on the impact of the exposure to family adversity, Porche, Costello, and Reynoso (2016) conducted a secondary data analysis on a sample of 65,680 youth, ages 6-17, focusing on the impact of family adversity on educational outcomes. Their analysis found that the occurrence of adverse family experiences was

positively associated with the rate of mental health diagnoses, which aligned with a decrease in school engagement and an increase in the likelihood of grade retention and having an Individualized Education Plan (IEP).

Supporting Students with Exceptional Life Stressors

Understanding how stressors impact the architecture of the brain and learning is a perplexing question for those in the education community. Despite the heightened attention to trauma-informed practices and adverse childhood experiences, teachers, school psychologists, counselors, and school social workers typically receive neither formal training about the impact of trauma and adversity on students nor strategies for helping these students navigate their environmental stressors while trying to learn (Ko et al., 2008). Conversely, students experiencing life adversities and trauma are more likely to convey the need for emotional scaffolding through behaviors that elicit negative responses from educators (Cozolino, 2013). Indeed, classroom behaviors emanating from significant life stressors can be disruptive and result in punishment and isolation rather than a therapeutic response of support (Cole et al., 2005). School social work services are consistently marshaled to address the challenging situations that confound student learning. The next section explicates in more detail the roles and function of school social workers in American schools that are implemented through the prevailing Multi-Tiered System of Supports (MTSS) framework.

How is Educational Neuroscience Significant for Social Work Practice?

Educating youth is a multidisciplinary endeavor. Entering its second century of existence, school social work remains an enduring component of education teams and is one of the social work profession's oldest fields of practice (Kelly, 2008). Despite the

social and political forces that consistently influence the roles and functions of this specialized field of practice, school social workers continue to be viable members of the multidisciplinary educational team with the primary purpose of addressing the social, emotional, and behavioral health needs of youth in a school context (Constable, 2016). Through a multi-tiered framework (See Figure 6), school social workers intervene at three primary levels within the school setting: Tier 1 – the whole school and classroom context; Tier 2 – small group levels; Tier 3 – individual students and families (Kelly, 2013). The following sections further delineate school social workers’ roles and functions within the prevailing MTSS framework.

Educational Neuroscience: The Role of the School Social Worker

The infusion of applied educational neuroscience into school settings is not only relevant for teachers, administrators, students, and families, it also impacts the delivery of student support services. Formally identified as part of the specialized instructional support personnel (SISP) constellation as well as “school mental health providers” in the Every Student Succeeds Act of 2015 (the reauthorization of No Child Left Behind Act), school social workers are recognized in comprehensive federal education policy as vital members of educational teams serving students’ social and behavioral needs in school settings (National Alliance of Specialized Instructional Support Personnel, n.d.). School social work services, referred to as “related services” can also be incorporated into individualized education plans (IEPs) as legislated by the federal special education law, Individuals with Disabilities and Education Improvement Act (IDEIA) (Kelly, 2013). Consequently, any shifts in education theory, philosophy and delivery occurring in the school context have implications for school social workers. The following section

outlines the longstanding history of school social work as a specialized field of practice and demonstrates the potential implications of the emergent educational neuroscience for the guiding theories and philosophies that inform school social work practice.

Historical Features of School Social Work

School social workers' primary mission is to promote an educational process that is effective for all students, especially for those whose full engagement in education is compromised (Constable, 2016). Established over a century ago in the US education system, school social workers have maintained this specialized function in the social work profession. Beginning concurrently in the 1906-07 school year, New York, Boston, Hartford (Costin, 1969), and Chicago (McCullagh, 2000) introduced the first school social workers, initially referred to as "visiting teachers," to facilitate communication and understanding between the schools and communities of incoming immigrants (Lide, 1959). As compulsory attendance laws passed throughout the United States between 1895 and 1918, the need to address barriers to students' attendance became increasingly emboldened, as access to education was more than a privilege reserved for the elite; it was now central to preparation for modern life (Constable, 2016).

Increasingly, social workers were enlisted to liaise between the community, family, and school, addressing environmental obstructions to a student's pathway to learning. By the 1916 National Conference of Charities and Corrections, Jane Culbert, an early pioneer of school social work, presented a definition of school social work practice that entailed inclusion, respect for individual differences, education as a relational process, and a focus on the contextual environment encompassing the child (Constable,

2016). These prescient moorings of the specialized field of school social work remain relevant today.

Roles and Functions of School Social Workers

The role of school social workers in school settings is multifaceted and entails a distinctly different value-based focus within a host setting that is primarily comprised of education professionals (Franklin, Harris, & Montgomery, 2015). As change agents, social workers in school settings are situated within and intervene at multiple levels, including individual, family, group, classroom, school organization, community as well as state and national policy levels (Franklin, Harris, & Montgomery, 2015; Shayman & Massat, 2016). For nearly five decades, scholars committed to advancing the school social work field have systematically investigated and critiqued the school social work role (Allen-Meares, 1994; Chavkin, 1985; Costin, 1969; Kelly, Berzin, Frey, Alvarez, & O'Brien, 2010; Peckover et al., 2012; Staudt, 1991). Costin (1973) conducted a landmark study that outlined seven broad groups of functions in the school social worker's role. Two that are most relevant to this study include interdisciplinary team coordination and consultation (Franklin et al., 2015).

Consultation is an intervention method that entails a shared problem-solving process between a professional and a consultee who is tasked with providing direct service to another person or group (Dinkmeyer & Carlson, 2006). School social workers provide information and education to support consultees at the individual, family, classroom, or school-wide levels (Franklin et al., 2015). One study found that 85% of school social workers' work with clients involved teacher consultation and collaboration (Johnson-Reid, Kontak, Citerman, Essma, & Fezzi, 2004) and additional research

suggests that consultation services are effective at multiple system levels (Sabatino, 2009).

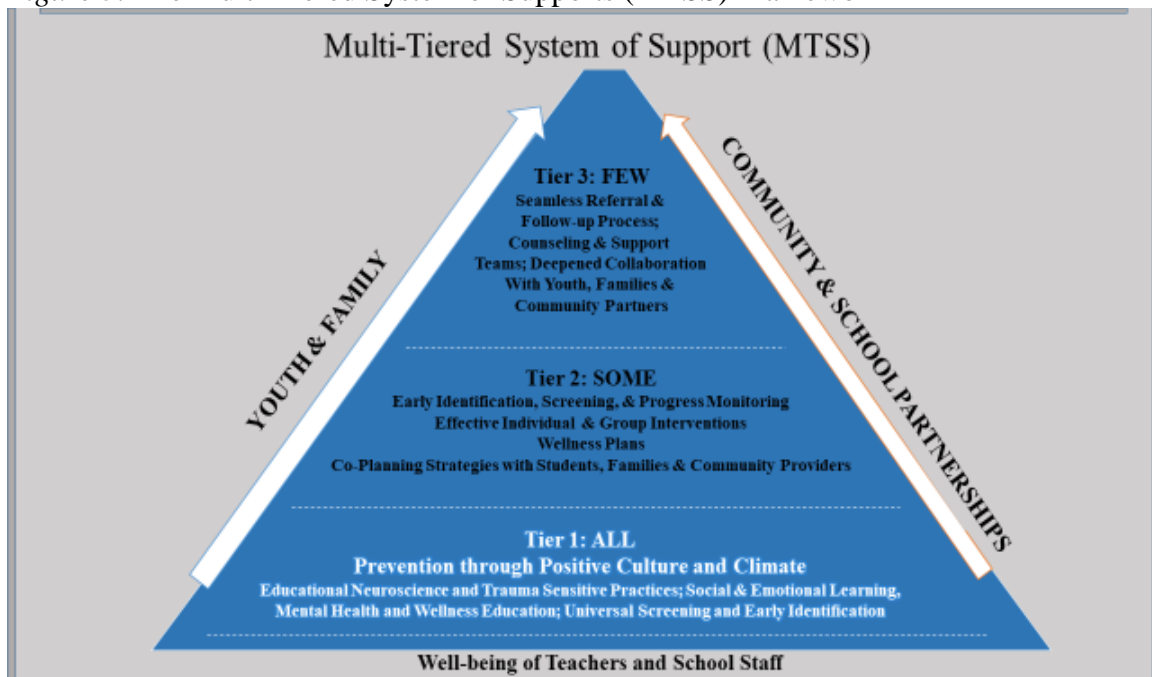
Over the past decade, school-based literature has revealed an increased focus on multi-tiered service provision that spotlights the imperative of attending to the overall school and classroom climates (Kelly, 2013). Furthermore, recent education policy supports a multi-dimensional approach to whole school community prevention and intervention that closely aligns with hallmark features of an ecologically-based school social work practice (Kelly et al., 2010).

Even with the consonant key functions of school social work, education policy perpetually fuels evolving roles and functions for school social work. Since its inception, school social work scholars have recognized that to remain efficacious in the interdisciplinary team, school social workers must be continually responsive to changes in the education system as well as national and state policies that govern education delivery (Constable, 2016; Peckover et al., 2012). The passage of No Child Left Behind, the reauthorization of the landmark Elementary and Secondary Education Act of 1965, pivoted behavioral support services toward prevention and a focus on the least restrictive environment for students. It also called for interventions to be scientifically-informed (Constable, 2016). This legislative shift precipitated the formulation of the Multi-Tiered Systems of Support (MTSS) Prevention and Intervention framework (Clark & Tilly, 2010) as a collaborative assessment mechanism to identify students' needs early and provide a collaborative, evidence-informed intervention response (Constable, 2016). The next section outlines the main features of the MTSS framework and the potential linkage of school social work to applied educational neuroscience.

The Multi-Tiered Systems of Support Framework

This area of inquiry is relevant to social work practice in schools from direct practice, organizational, and public policy vantage points. Applied educational neuroscience provides an interdisciplinary opportunity for school social workers to collaborate with school administrators, faculty, and staff to shape the teaching and learning enterprise and transform schools' organizational cultures using the emerging science. A central feature of the school social worker role is to address barriers to students' learning, which includes providing a continuum of behavioral health supports through MTSS, the prevailing prevention and intervention framework for Preschool -12th grade school environments (Clark & Tilly, 2010; Kelly, 2013). Figure 3 provides a diagram of the MTSS framework and how the three tiers provide a guide for prevention and intervention.

Figure 3. The Multi-Tiered System of Supports (MTSS) Framework



Source: Adapted from Wisconsin Department of Public Instruction (2016)

Clark and Tilly (2010) outline school social workers' roles within the MTSS framework. Tier 1 supports are universal and preventative; they are designed to impact all students by addressing learning environments and targeting school climate and culture. Tier 2 supports include interventions for students who experience moderate disruption in learning that may be temporary and addressed through group work. Tier 3 supports are dispensed for students experiencing severe and often chronic disruptions in their ability to function in the school environment. Students who exhibit trauma-related behaviors are likely to need intensive, individualized Tier 3 supports. By understanding the neuroscience principles for learning and behavior, school social workers will be better equipped to provide and advocate for research-informed approaches that support students' social-emotional needs from a multi-tiered perspective.

Importantly, emerging educational neuroscience potentially offers a neurobiological explanation for the interplay of learning, behavior, and the environment that could provide a scientific basis for practice. Traumatic life experiences, such as poverty, violence, and maltreatment, alter the brain's architecture (Anda et al., 2006; Luby et al, 2013; Perry, 2009), obstruct learning (Cole et al., 2005), and oftentimes manifest as maladaptive behaviors (Cole et al., 2005; Pefect, Turley, Carlson, Yohanna, & Gilles, 2016; Porche, Costello, & Rosen-Reynoso, 2016). A central function of school social workers is to address the environmental barriers that impede students' academic progress. Underpinning engagement, assessment, and intervention strategies with neuroscience knowledge could enhance school social workers' competency within the school organization and further promote the credibility of the school social worker's integral role of assisting youth whose learning is impacted by adverse social conditions.

Furthermore, applied educational neuroscience could offer over time empirically-based evidence to support macro interventions, including policies that advance school climates by promoting social inclusion and supportive relationships. Applying educational neuroscience, school social workers could influence educational policy that addresses school discipline as well as strategies to ensure school safety and student success. Neuroscience findings are illuminating the efficacy of supporting social-emotional needs as being paramount to student learning (Cozolino, 2013; Immordino-Yang, 2016; Immordino-Yang & Damasio, 2007). The social component of educational neuroscience underscores the presence of safety, attachment, and relationships as precursors to student learning (Cantor et al., 2018; Cozolino, 2013; Sousa, 2010; Sousa & Tomlinson, 2011), further legitimizing for key decision-makers the importance of the school social workers' role in the school community. Knowledge generated through the transdisciplinary study of the social and affective dimensions of educational neuroscience could add scientific rigor to social work's biopsychosocial conception of human behavior and offers new insights for ways in which school social workers can enhance students' capacity for affect regulation and connected relationships within the school and classroom environments.

Tier 1 Research Implications for School Social Workers

This research study explored the conceptualization of perceived educational neuroscience practices at a Tier 1 level, specifically examining classroom climate. Generating insight into ways applied educational neuroscience is conceived of at the Tier 1 classroom climate level could assist school social workers with providing consultation to teachers, students, and administrators who interface with the unique classroom

environments. Tier 1 is the primary prevention level that intends to support all students through universal supports that comprehensively address students' relational needs. This research study conceptualized educational neuroscience practices as comprehensive practices that influence classroom climate and support the learning needs of all students.

Building a Bridge of Evidence for Applied Educational Neuroscience

Despite the international fervor around the nexus of neuroscience and education, there persists a chasm between neuroscience research and the realities of education practices (Walker et al., 2017). In a quest to anchor educational neuroscience principles into an enduring knowledge base, education research must envision new epistemological and methodological pathways that engender a transdisciplinary approach (Butterworth & Tolmie, 2014; Knox, 2016). Since there are multiple ways of knowing, synthesizing a range of methodologies will assist in gathering the data necessary to bridge the gaps between scientific inquiry and applied practice. Research in the educational neurosciences will ultimately benefit from an integrative approach that is creative, flexible, and specific to multi-dimensional needs of the students, teachers, and the overall education system.

The bridge metaphor is also an apt description for the chasm that endures between neuroscience research and its translation into direct education and social work practice (Fischer & Heikkinen, 2010). How to ensure ecological validity—a term that describes a meaningful translational process of scientific findings for real-world settings and people—is a lingering question relevant to the pursuit to apply neuroscience to educational practice and policy (Immordino-Yang, 2016). The history of applied research reveals

patterns of challenges with translating science into the variability of dynamic practice settings (Ansari, Coch, & De Smedt, 2011).

Fischer and Heikkinen (2010) argue that practitioners oftentimes lack access to rigorous scientific knowledge that relates to the realities of practice. Direct practice educators are rarely integral in research teams and designs and, consequently, have specific questions that remain unanswered by researchers in the hard sciences (Fischer & Heikkinen, 2010). Fischer and Heikkinen contend that researchers from the hard sciences, such as the neurosciences, study questions that interest them rather than seeking feedback from direct practitioners about questions that remain unexamined in applied practice.

Translating objective science into practice entails a bi-directional partnership with the practitioners who possess the heuristic ways of knowing, thereby reducing a hierarchy in knowledge generation where educators are merely recipients of neuroscience information (Ansari, Coch, & De Smedt, 2011). Progressing the conceptualization of research-informed neuroscience practices requires an epistemological integration that embraces both the neurosciences and the art of applied practices. The intention of this inquiry aligns with building a bridge of evidence that allows for an alchemical construction of co-created lived experience realities as well as generalizable post-positivist truth.

Chapter Summary

Chapter 1 introduced the reader to educational neuroscience by outlining its definition, background, and transdisciplinary focus. This chapter also established the research problem, purpose, and questions as well as four specific ways this study offers a

significant scholarly contribution. To guide the reader, definitions of terms were interwoven into each section. For a more comprehensive glossary of terms, see Appendix C. The next chapter provides a review of the educational neuroscience literature relevant to the explicated research problem and rationale.

Chapter 2: Literature Review

The following examination of the literature illuminates the scholarship addressing three specific foci: (1) the emerging knowledge base that describes how educational neuroscience is conceptualized, with a specific focus on the social and affective dimensions of the discipline; (2) existing scholarship on the social and affective dimensions of applied educational neuroscience as well as lingering questions and critiques; and (3) school social work's positioning within the emerging applied educational neuroscience conceptualization. To conduct the literature review, multiple information sources were used, including books, dissertations, internet resources, professional journals, and periodicals. These sources were accessed through Google Scholar, ProQuest Education Database, EBSCO Education Source, EBSCO PsycArticles, and Social Work Abstracts. The goal was to synthesize literature from the last ten years, noting major themes, omissions, and important gaps.

Conceptualization of Educational Neuroscience

Throughout the nascent discipline's existence, there has been a concerted international effort to conceptualize educational neuroscience and applicable principles for practice (OECD, 2007; Sousa, 2010; Tokuhama-Espinosa, 2008; Willis, 2007; 2008; Zull, 2011). Despite this pursuit of a unifying framework, there is a consensus in the educational neuroscience literature that the emergent discipline lacks a cohesive theoretical, philosophical, methodological, and ethical structure (Butterworth & Tolmie, 2014; Joldersma, 2016) and there are calls for a collaborative effort to map out this process involving crossing disciplinary boundaries (Ansari, Coch, & DeSmedt, 2011; Goswami, 2006; Knox, 2016; Tommerdahl, 2010).

Scholars use a bridge metaphor to frame the debate as to whether neuroscience knowledge can have a harmonious marriage with education, or whether the chasm is too complex and differentiated to bridge (Bruer, 1997; 2014). Bruer, a cognitive neuroscientist, offered a critique in 1997 that bridging the disciplinary boundaries is a “bridge too far.” This critique, now a classic reference in the educational neuroscience literature, inspired a flurry of debate among the early pioneers and skeptics. That debate persists to this day (Bruer, 2014; Joldersma, 2016) and remains a balancing voice in the educational neuroscience discourse.

Some scholars call for caution with over-simplifying interpretations of neuro-radiological studies and neurobiological descriptions (Bruer, 2014; Geake, 2008). While neuroimaging offers great potential for helping to build causal neurobiological links with learning and behavior, methodological challenges are daunting and the neuroimaging technology is difficult to master (Bruer, 2014). Even with the acceleration of technological neuroscience advances, there remain inaccuracies in neuroradiological measurement (Geake, 2008; Stelzer et al., 2014). Although there is evidence of changes in the brain, the linkage with specific behavioral correlates is yet to be established (Bishop, 2013). As educational neuroscientists attempt to explain behavioral outcomes at the neural level, it is imperative for a methodologically diverse discipline to ensure validity and reliability in their research designs, an endeavor that Bruer (2014) states is particularly difficult with high-stakes implications.

An appraisal of the literature also reveals a lack of a shared lexicon to identify the intersection of neuroscience and education (OECD, 2007). While educational neuroscience is most predominantly applied to this emergent discipline (Campbell, 2011),

other references include brain-based education (Jensen, 1998), cognitive neuropsychology (Carmazza & Coltheart, 2006), cognitive neuroscience (Ansari, Coch, & De Smedt, 2011; Kelly, 2011), neuroeducation (Howard-Jones, 2011), and Mind, Brain, and Education (Tokuhamma-Espinosa, 2008).

In addition to the lack of shared language, definitional perspectives of educational neuroscience differ. Some emerging definitions provide a narrow interpretation of the emerging discipline. Geake (2009) defined educational neuroscience as “cognitive neuroscience which investigates educationally-inspired research questions” (p. 42). Emerging from a grounded theory meta-analysis and Delphi survey, Tokuhamma-Espinosa (2008) proposed the following description: “Mind, Brain, and Education...is a new academic discipline, which has grown out of the intersection of education, psychology, and the neurosciences....the scientifically substantiated art of teaching” (p. 337). Szucs and Goswami (2007) aver that it is “the combination of cognitive neuroscience and behavioral methods to investigate the development of mental presentations” (p. 114). Patten and Campbell (2011) offer a more comprehensive definition describing educational neuroscience to be a “syntheses of theories, methods, and techniques of neurosciences, as applied to and informed by educational research and practice” (p. 1). The collection of definitions suggests that there is an intersection with neurosciences and education, but a consonant definition to capture the scope of that merger is missing from the literature.

To explore the scholarship surrounding the education and neuroscience interface, Catherine Beauchamp, an educator, and Miriam H. Beauchamp, a neuroscientist, conducted two systematic reviews. Beauchamp and Beauchamp’s (2012) first review

aimed to identify literature between 1970-2011 that conveyed a linkage between neuroscience and education and prevalent themes in the literature that pertained to this connection. They conducted their second review in 2013 and examined literature from a discipline boundary perspective to investigate themes in the literature around boundary principles impacting the emergence of educational neuroscience.

Beauchamp and Beauchamp's (2012) initial literature review yielded 482 works that surveyed the neuroscience and education domains. They narrowed the sample to 86 works when they applied the specific criterion of the education and neuroscience integration. The analysis rendered seven salient themes-*Misapplication, Multiple Disciplines, Language, Knowledge Development, Collaboration, Research Design* and *Value*. According to the authors, *Misapplication* was a theme that addressed the problem and *Multiple Disciplines, Language, and Knowledge Development, Collaboration* and *Research Design* offer ways to surmount the identified problem. All the themes lead to the overarching theme of the *Value* authors collectively conveyed in continuing to pursue the integration of neuroscience and education. From this insight, Beauchamp and Beauchamp conducted a second systematic review that looked more closely at boundary issues with the emerging educational neuroscience discipline.

A consistent theme in the educational neuroscience literature is the debate about the complexity involved with trying to converge multiple disciplines (Bruer, 1997; Samuels, 2009) and the impact this disciplinary merging may have on the formation of the integrative educational neuroscience discipline. Building upon findings from their first literature review, Beauchamp and Beauchamp (2013) sought to answer the following questions: "Can the theoretical framework of disciplinary boundaries provide a useful

perspective for understanding the tensions and possibilities inherent in the merging of neuroscience and education?” (p. 49). By applying boundary perspective as an analytic lens to their initial literature review iteration, Beauchamp and Beauchamp (2013) discovered themes for common challenges and hopeful insights. They concluded that defining boundaries through four unique processes could produce a bridge that creates the vehicle for a transfer of knowledge between the convergent disciplines. The four processes Beauchamp and Beachamp identified were the following: (1) specific language; (2) objects (e.g., frameworks and models); (3) fresh research directions; and (4) new types of professionals. Instead of the discipline boundaries being a separating feature, their review of the literature suggests that these paradigmatic bridges could become the mechanisms through which the emerging field is defined.

To advance a shared conceptual understanding for Educational Neuroscience, the Organisation for Economic Co-Operation and Development (OECD) published a report in 2007, *Understanding the Brain: The Birth of a Learning Science: New Insights on Learning through Cognitive and Brain Science*. This report, produced through OECD’s Centre for Educational Research and Innovation, synthesized seven years of international analyses on the application of neuroscience in education from which nine central conclusions emerged. Four of the nine themes are pertinent to this literature review. The relevant themes from the synthesized report include the following: (1) educational neuroscience is generating useful knowledge to inform educational policy and practice; (2) there is a need for holistic learning approaches that honor the interdependence of body, mind, emotions, and cognitive aspects of learning; (3) the concept of “emotional regulation” is a key skill of being an effective learner; and (4) the emergence of a

learning science is transdisciplinary and needs a bi-directional flow of knowledge to support evidence-based practice. The OECD 2007 report also underscored the need for further research into the neurobiological mechanisms that correspond with the impact of stress on learning and memory as well as translating research from objective laboratory conditions to dynamic learning environments.

One attempt to solidify a shared conceptualization for educational neuroscience includes a dissertation study by Tokuhamas-Espinosa (2008). Tokuhamas-Espinosa sought to determine standards in the Mind, Brain, and Education field. She conducted a grounded theory study that entailed the meta-analysis of the last 30 years of literature (n=2,200 documents) to determine the parameters of the emerging Mind, Brain, and Education field and a Delphi survey of 20 international experts from six different countries that refined the emerging model. The findings outlined primary research, practice, and policy goals for the emerging field. The research goals included focus on the emotional, psychosocial, and contextual features of learning. The practice and policy goals underscored reciprocity in connecting theory and research with practice, identifying successful classroom experiences for continued research in the neurosciences, and persistently pursuing policies that include consideration of vulnerable youth in the design and evaluation of education practices.

Findings from Tokuhamas-Espinosa's (2008) extensive study also recognized a basic framework that included twenty-two principles, twelve tenets, and ten instructional guidelines. A primary focus that threaded through the principles, tenets, and instructional guidelines was the experientially dependent-brain; the plasticity of the brain; the role of emotions to decision-making and learning; the inhibiting impact of stress; anxiety, and

depression on learning; learning as a social process; and learning as an embodied process. Instructional guidelines that addressed the social and affective dimensions of learning included a focus on the social nature of learning, the mind-body connection, and intentionally constructing positive learning environments.

Aligning with the need to focus on the structure of the learning environment, Hohnen and Murphy (2016) introduced a model that fuses together an array of neuroscience principles and outlines the contextual features that most effectively facilitate student learning. Their model, entitled the *Optimum Context for Learning: A Neuroscientific Model* (p. 85), has six levels and incorporates attention to educational neuroscience concepts, including brain development; epigenetics; neuroplasticity; learning at the cellular level; students' mindset; avoiding social pain; and understanding social sensitivities. The six levels of the model occur in a hierarchical fashion (See Figure 4). Similar to Maslow's hierarchy of needs (Maslow, 1943 as cited in Hohnen & Murphy, 2016), the model assumes that reaching optimal learning, where students are engaged and eager to learn, requires building a firm contextual foundation. Hohnen and Murphy's (2016) proposed model includes six levels (See Figure 4):

Level 1: This level includes ensuring a child feels safe, minimizing stressors in the environment, and promoting connection to an adult. Hohnan and Murphy (2016) contend that this classroom climate promotes higher cortex activation and minimizes overactivity in the limbic region.

Level 2: This level provides achievable challenges that engage without overwhelming students. The underpinning neuroscience is based upon the assumption that being bored or overwhelmed could cause the midbrain to function in a way that it reduces communication to the thinking region of the brain and the larger associated network.

Level 3: After meeting the foundational tasks of levels one and two, level three results in students engaging in a pattern of positive learning. This assumption is based upon the notion that activity connects neurons and

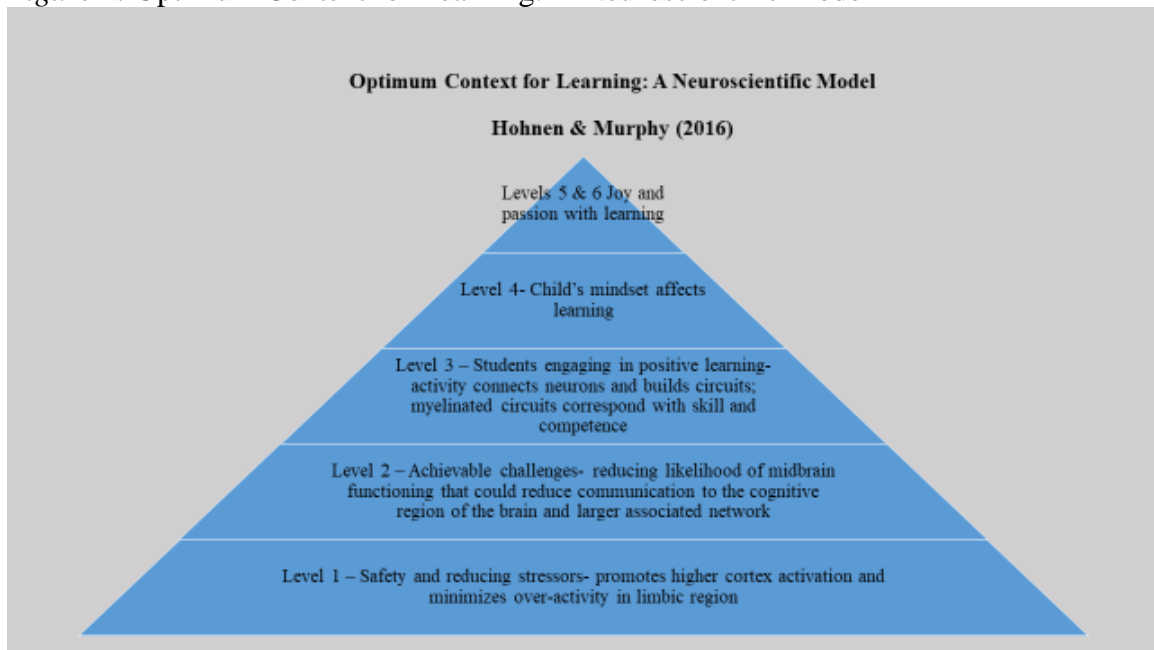
builds circuits. The myelinated circuits correspond with skill and competence.

Level 4: After feeling safe and connected; appropriately challenged; and competent in a learning activity, level four asserts that the child's mindset - their beliefs about themselves as learners - affects their learning behaviors.

Levels 5: As students' security in competency emerges, they begin to feel playful and liberated. The students' positive connections and experiences lead them to feel ownership with learning, increasing the likelihood of mastery.

Level 6: With the five previous levels established, this level presents a culminating experience of joy and passion in the learning environment.

Figure 4. Optimum Context for Learning: A Neuroscientific Model



Source: Adapted from Hohnen & Murphy (2016, p. 85)

While Hohnan and Murphy's (2016) model offers a convergent mechanism for conceptualizing educational neuroscience in a classroom setting, there is no empirical evidence to support its efficacy, and the scholarship that underlies its assertions are emergent and need more systematic investigation. Hohnan and Murphy state that implementing the model would be challenging because of the required collaborations of multidisciplinary partners and the necessary professional development to educate

teachers on its application. Finally, evaluation includes multiple variables to assess, including social-emotional behavior, neuroanatomical change, and academic performance. Still, the model introduces to the body of scholarship a conceptualization of educational neuroscience principles that could be applied to a classroom context.

Conceptualization Themes

An analysis of the current knowledge base indicates a concerted international effort to identify tensions as well as potentialities for forging a unified conceptual framework. Themes that crystallized in the review process included the need for more transdisciplinary collaboration for reciprocal research structures and practice modalities as well as creative approaches to methodological plurality. Discipline boundaries are of particular concern with educational neuroscience. Future possibilities require attending to the various traditions and cultures that shape disciplinary perspectives that contribute to the transdisciplinary process. There is a growing focus on investigating learning from a holistic perspective that incorporates attention to the interpersonal aspects of learning, including social contexts, emotional regulation, and the overall role of emotions in the learning process. Despite the transdisciplinary momentum that is brewing around educational neuroscience, clear direction around identity, scope, and methods remain opaque (Knox, 2016) and debate about its efficacy persists (Joldersma, 2016). The next focus of the literature review will be the social and affective dimensions of learning.

The Social and Affective Neuroscience of Learning

For many of the prominent scholars, educational neuroscience is not just an extension of cognitive psychology or neuroscience; it also incorporates the social (Campbell, 2011; Cozolino, 2013; 2014; Desautels & McKnight, 2016; Siegel, 2012) and

affective neurosciences (Immordino-Yang, 2011; Immordino-Yang & Damasio, 2007) that provide a more interconnected and complete interpretation of the teaching and learning enterprise. Additionally, integrating a focus on emotional regulation is seen as an important progression of educational neuroscience by some scholars (Immordino-Yang, 2011; Immordino-Yang & Damasio, 2007; OECD, 2007; Patten, 2011; Woltering & Shi, 2016); however, others perceive these conceptual claims as excessively imaginative (Smeyers, 2016). This section will spotlight the literature that addresses the social and affective dimensions of educational neuroscience.

There is a consensus in the literature that the brain is the central organ for learning (Cozolino, 2013; Immordino-Yang & Fischer, 2016; Geake, 2009; Sousa, 2010; Zull, 2011); it is also a social organ of adaptation that is constantly shaped by experience (Cozolino, 2013; Geake, 2009; Schore & Schore, 2008; Siegel, 2012). Overall, the human brain's genetic expression is guided by interactions with the environment and relationships with other people, a phenomenon referred to as epigenetics (Cozolino, 2013; Siegel, 2012). Consequently, the social context of learning exerts considerable influence on the experientially-dependent nature of the brain's development and the neural processes involved in learning.

Students learn within a matrix of relationships, and learning is not merely an individual endeavor; it is a socially, intersubjectively defined pursuit (Geake, 2009). Contemporary biology reveals the deeply entwined nature of emotions and learning (Geake, 2009; Immordino-Yang & Damasio, 2007). Learning can be facilitated or hindered by the social-emotional aspects of the learning endeavor (Durlak, Weissberg, Dymncki, Taylor, & Schellinger, 2011). Despite the expanding neuro-scientific

knowledge base that elucidates the centrality of social context and processes (Cozolino, 2013; 2014; Dikker et al., 2017; Siegel, 2012), US education leaders and policymakers continue to focus primarily on curricular content and testing outcomes rather than the active social connections that comprise learning phenomena (Cozolino, 2013).

A growing chorus of scholars contend that the prevailing investment in a mass production, outcome-based education model is misaligned with the social and emotional features of enlivened classroom ecologies (Gitterman, 2004) and the science that points to how our social brains have evolved to learn (Cozolino, 2013; Desautels & McKnight, 2016; Rushton & Juola-Rushton, 2008). Western education conceptualizes the learner as a solitary figure rather than being interwoven in a human community (Cozolino, 2013). This belief has perpetuated the focus on technical, scientific approaches to learning as a solely rational activity rather than perceiving the learning enterprise as a dynamic web of lived experiences and human interactions (Cozolino, 2006; Gitterman, 2004).

Central to the social neuroscience of learning is the neurobiological attachment patterns that inform our individual and cooperative survival functions (Cozolino, 2013; Schore & Schore, 2008). Siegel (2012) underscores that attachment is based on collaborative communications. Schore and Cozolino build upon and provide neurobiological considerations for the seminal research conducted by Bowlby (1969) and Ainsworth (1978) that established attachment as an evolutionary theory of human development. According to Schore (2003b), early attachment experiences shape the developing organization of the right hemisphere of the brain, the neurobiological base of the human unconscious. Students display these unconscious functions in classroom experiences, co-creating an attachment experience with a teacher and classmates

(Cozolino, 2013; 2014; Schore & Schore, 2008). Students whose early experiences of separation, fear, distress, and chaos may present with disorganized, insecure attachment histories that are affectively branded into their right hemisphere, leaving indelible deficits in internal working models of the self and the environment (Schore 2001; 2003a). Based upon evidence from psychotherapeutic settings, relationally-oriented contexts that support intersubjective communication and co-regulation inspire the repair of the deficits in these encoded unconscious working models in students (Bowlby, 1988; Chapman, 2014; Cozolino, 2013; Schore & Schore, 2008).

While the left hemisphere is more involved in the conscious, analytic processing of information, the right hemisphere provides implicit communication that is non-verbal and includes expressions such as subtle variations of facial expressions, body postures, and tone of voice, that originated with infant-parent bonding and persists between persons (Orlinsky & Howard, 1986). The interactive regulation process mediates shared conscious and unconscious affective and somatic states of being (Schore, 1994). This affective-embodied communication is the intersubjectivity principle that connects right hemispheres of people within relational contexts (Schore & Schore, 2008).

Understanding attachment-based, nonconscious exchanges occurring through the bi-directional right hemisphere transactions of educators and students inspires critical scientific questions about how we conceive of relationships within our instructional environments. Relating to the attachment processes occurring in the learning context, the next section outlines how emotions are a critical force in the learning process.

The Role of Emotions in Learning

Immordino-Yang (2016), a leading expert in affective neuroscience and former junior high science teacher, argues that “learning is dynamic, social, and context-dependent because emotions are, and emotions form a critical piece of how, what, and why people think, remember, and learn” (p. 17). Zull (2011), a Professor of Biology, Biochemistry, and Cognitive Science, has sought to interpret brain functioning for education. He avers that “the brain is an organ of emotion” and that “all thought is emotional” (p. 17). Emotions are inextricably linked to the motivation and self-esteem of learners (Geake, 2009). They provide a steering mechanism for direct decision-making and motivation that consequently differentially impacts brain systems that process rewards and threats (Geake, 2009; Immordino-Yang & Damasio, 2007; Zull, 2011).

The processing of emotions induces synaptic plasticity that is associated with learning (Cozolino, 2013; Geake, 2009). Learning entails a neural process that emerges from the repeated engagement with synaptic functioning (Geake, 2009). Furthermore, deep learning depends on making emotional connections between concepts that inspire a forging of meaning for the learner. This connection with learning highlights that a seemingly rationale academic subject, such as math or science, requires a motivational, meaning-making system that is entwined with the neurobiological functions associated with emotional processing (Immordino-Yang, 2016; Immordino-Yang & Damasio, 2007). Emotions essentially provide a compass to focus reasoning into the area of knowledge that pertains to a current situation or problem (Immordino-Yang & Damasio, 2007). Emotions are also central to navigating the learning environment.

The same neural systems that manage our sociocultural and intellectual experiences also help us to biologically survive (Immordino-Yang, 2016). Indeed, the brain's primary evolutionary purpose is to ensure survival (Cozolino, 2013; Immordino-Yang & Damasio, 2007), and emotions are the subjective reactions that organize our mind and body responses to external stimuli and overall help humans negotiate social and physical life (Immordino-Yang, 2016). The brain is designed to identify and reflexively respond to a real or perceived threat (Hohnen & Murphy, 2016). Emotions are part of the neural systems that ensure safety and survival through the interpretation of sensory input (Geake, 2009; Immordino-Yang, 2016). The notion of surviving for a student is interpreted within a sociocultural framework, including that of a classroom (Immordino-Yang & Damasio, 2007). A student's perception of safety and security creates neurobiological responses guiding the student to learning academic-related tasks rather than shifting into a protective mode of functioning.

Mind and Brain: An Embodied Perspective

Building upon the notion of the brain's proclivity toward survival, learning is not a disembodied experience; rather, learning, memory, decision-making, creativity, and rational thinking include a reciprocal mind and body interplay (Immordino-Yang & Damasio, 2007). Campbell (2011), the Director of the Educational Neuroscientist Laboratory at Simon Fraser University, argues that cognition is positioned within individuals and classroom contexts, and brain mechanisms that underpin cognitive processes must be interpreted from a contextual perspective that fuses the social and cognitive neurosciences. Campbell asserts that the conceptualization of educational neuroscience "seeks to bridge the gap between minds and bodies, with particular

emphases on brains as our principal organs of thought, and thereby render the nature and various effects of educational experience more comprehensible and meaningful” (p. 10). Essentially, learning is not merely a cognitive, rational process; it is part of an embodied system that includes interactions with one’s emotions and body.

Limitations and Lingerings Questions

This section outlined several important implications for further inquiry that incorporate new directions for understanding the nexus of biology, learning, and socio-cultural contexts. While there is consensus in the educational neuroscience literature that learning is a social-emotional process, the aforementioned insights about the social and affective neuroscientific dimensions of learning have not yet been empirically tested (Immordino-Yang & Damasio, 2007). The knowledge created up to this point has largely been based upon research on neurological patients who have sustained damage to certain parts of the brain and studies conducted on animals with neural mechanisms that correspond with humans (Cozolino, 2013; Immordino-Yang, 2007). More empirical evidence is needed that promotes the ecological validity of these emerging insights about the social and affective dimensions of learning within the classroom context.

Research on Applied Educational Neuroscience

Willis (2008), a renowned neurologist and middle school teacher, characterizes educational neuroscience research from the following two perspectives: function of the brain and interpretation for application to practice. There are proponents in the literature that contend that educational neuroscience is ripe for expanding its translational reach from function to applied practice (Butterworth & Tolmie, 2014; Carew & Magsamen, 2010). The literature also reveals that brain research has rendered numerous discoveries

about brain functioning that relate to learning; however, there has been scant translation into educational practice and policies because of the lack of consensus on the potential applications (OECD, 2007; Walker et al., 2017). At this time, scant research exists on how neuroscience translates into educational delivery (Butterworth & Tolmie, 2014; Goswami, 2004; Willis, 2008; Walker et al., 2017) and the role that culture plays (Hinton, Miyamoto, & Della-Chiesa, 2008). Furthermore, progress for a shared system of application remains mostly unformed (Butterworth & Tolmie, 2014; Goswami, 2006).

Throughout the educational neuroscience scholarship, there is a shared view that advancing educational neuroscience requires a reciprocal engagement between the scientific research community and direct practice professionals (Fischer, 2009). Pickering and Howard-Jones (2007) sought to ascertain educators' views on the role of the brain in education. Using a mixed-method approach comprised of surveys (n=189) and interviews (n=11), findings revealed that educators in the UK and in other international locations embrace the role of neuroscience in education, but there is a difference in the knowledge, language, and roles of educational practitioners and scientific researchers that perpetuate challenges in translating science to the education setting. Conversely, brain-based initiatives in applied education settings might benefit from additional scientific examination. The following scholarship elucidates attempts to translate educational neuroscience to the classroom context.

An emerging area of inquiry in the mind, brain, and education movement is the exploration of the teaching system as a physiological phenomenon of brain activity (Yano, 2013). A new concept emerging is the teaching brain (Rodriguez, 2012; 2013). This concept reconstitutes the teaching system and illuminates the complex, dynamic,

and context-dependent nature of the teacher's brain responses within the learning dyad (Rodriguez, 2013). This perspective spotlights the teacher's nervous system as central to the sensing pathways that facilitate a teacher's responses to the external and internal stimuli within teaching encounters. To better understand the teacher brain concept, Rodriguez and Solis (2013) investigated the cognitive processes of 23 master teachers from New York and Massachusetts using a qualitative interview design applying microgenetic and grounded theory techniques. Participants represented an equal distribution of P-12 grade settings. The aim of the study was to identify cognitive processes of the teaching mind-brain and situate them within the complex teaching encounter. From the data analysis, four themes emerged that characterized interaction: (1) relationships/deep connection with students (2) collaboration, (3) mutual effects, and (4) synergy.

Rodriguez and Solis (2013) found that the relational/deep connections entailed exchanges that exceeded interactions surrounding academic content. Teachers reported an awareness of relational bonds with students that were central to successful learning. This theme highlighted the teachers' authenticity and the empowerment of students to express genuine feelings. Collaboration emerged based upon teaching experiences that included the teacher and learner's shared responsibility, insight, and effort. Collaboration was exemplified by the teacher and learner systems actively and reciprocally agreeing upon the purpose and processes. The third theme, mutual effects, was characterized by reciprocal effects between the teacher and learner systems. When one system changed, the other system responded. The final theme, synergy, referred to the energy that emerged from a "deep human interaction of teaching and learning" (p. 166). Rodriguez

and Solis argue that these four categories provide insight for potential constructs for additional investigation related to the dynamic interaction of teacher and learner neurobehavioral connections.

Two studies incorporate emerging technology offering insight into potential technological mechanisms to measure brain activity associated with social engagement in learning settings. A recent study conducted by Dikker et al. (2017) introduced a new method to investigate the neuroscience of group interactions in ecologically natural settings. Using a portable electroencephalogram (EEG), the research team simultaneously and systematically recorded brain activity from a class of twelve high school students throughout the course of a semester (eleven classes). Their findings show that the extent to which brain activity is synchronized across students predicts both student engagement and social dynamics, suggesting a potential neural marker for dynamic social interactions. This study's finding progresses the idea that brain-to-brain synchrony is a sensitive neural marker that can predict classroom interactions.

Similarly, Yano (2013) sought to address the existing gap in educational neuroscience between understanding the relationship between brain activity and complex social phenomena, such as teaching. This study was comprised of continuous longitudinal measurements of human behavior and human interactions occurring in the everyday reality of participants (n=12), ages 24-51. Using sensitive monitoring techniques to map human interactions, findings revealed human interactions are central to creating a synchronistic energetic flow, increasing the collective productivity necessary for growth and performance. The outcomes of this study correspond to Rodriguez and Solis's (2013) finding of synergy and provide beginning groundwork for further

neurobehavioral studies that examine the science of physiological human interaction to explain complex and cooperative social phenomena that occur in the learning environment.

Summary of Applied Educational Neuroscience

The review of literature that examined research of applied educational neuroscience revealed that teachers are compelled to integrate practice based on neuroscience evidence; yet there is a translational lacuna between neuroscience research and direct practice that creates challenges with applying new knowledge in educational settings. Early attempts to investigate applied educational research indicate a focus on the dynamic physiological and social phenomenon of teaching, and that the neurobiological connections involved in the teaching and learning process are fertile for further investigation.

Neurosciences and School Social Work Practice

The call for social work to pivot to a new conceptual framework that attends to interpersonal neurobiological concepts is not new. Applegate and Shapiro (2005) outline in great detail how multidisciplinary research in affect regulation and experience-dependent neurobiological development is essential to the knowledge base of clinical social work practice. Over a decade ago, they underscored the urgency and timeliness of infusing neuroscience into social work education and practice. However, how school social work, as a distinct field of practice, integrates this emerging knowledge remains unexamined in the literature.

Multiple searches using various search strategies and keyword combinations yielded no scholarly research that specifically addressed school social workers' role and

functions related to educational neuroscience practices. Searches included a global search using the terms “school social work” and “educational neuroscience, neuroeducation, cognitive neuroscience, and neuroscience.” A second search was conducted within the *Mind, Brain, and Education* publication, a premier journal for educational neuroscience. Appraising the two journals specifically published for the field of school social work, *Children and Schools* and *School Social Work Journal*, produced no scholarly work that connected school social work practice with educational neuroscience, cognitive neuroscience, or neuroscience in general. While school social workers may be seeking neurobiological explanations for practice, attention to this new area of inquiry does not include reference to the role of school social workers at this time. The scholarly community that examines school social work practice has not yet incorporated this area of inquiry into its body of knowledge. Additionally, the literature review indicates that the transdisciplinary discourse on educational neuroscience does not include a social work perspective. School social work’s unique perspective of understanding the biopsychosocial individual within the socio-political context could make a meaningful contribution to the transdisciplinary research structure.

Literature Review Summary

A review of the literature revealed key features of the knowledge base that are relevant to the impetus for the proposed study, which is a quest for a shared conceptual framework for the social and affective dimensions of applied educational neuroscience to promote a positive classroom and school climate. In summary, there is international momentum to create a transdisciplinary convergence of education, psychology, and neurosciences; however, these disciplines come with deeply entrenched epistemological

traditions that make building a bridge between the disciplinary boundaries a complex endeavor. The need for a shared language, identity, and theoretical framework persists. Teachers are eager to incorporate practices based on neuroscience principles, but more progress needs to be made in translating research into practice. Finally, there is a consensus among the scholars that the social-emotional and cognitive aspects of learning are inextricably entwined and shaped by the socio-cultural context. Still, this line of inquiry is in its infancy and needs further investigation. The next section synthesizes these salient themes from the literature to inform a conceptual framework for the proposed dissertation study.

Conceptual Framework

The review and critique of the literature, combined with the researcher's unique standpoint (See Appendix D) informed the conceptual framework for the design and implementation of this study. The conceptual framework developed for the study focused and shaped the research process and guided the methodological design and data collection strategies that were used. The framework also offered an organizing structure for informing the data analysis process as well as to reporting the study's findings.

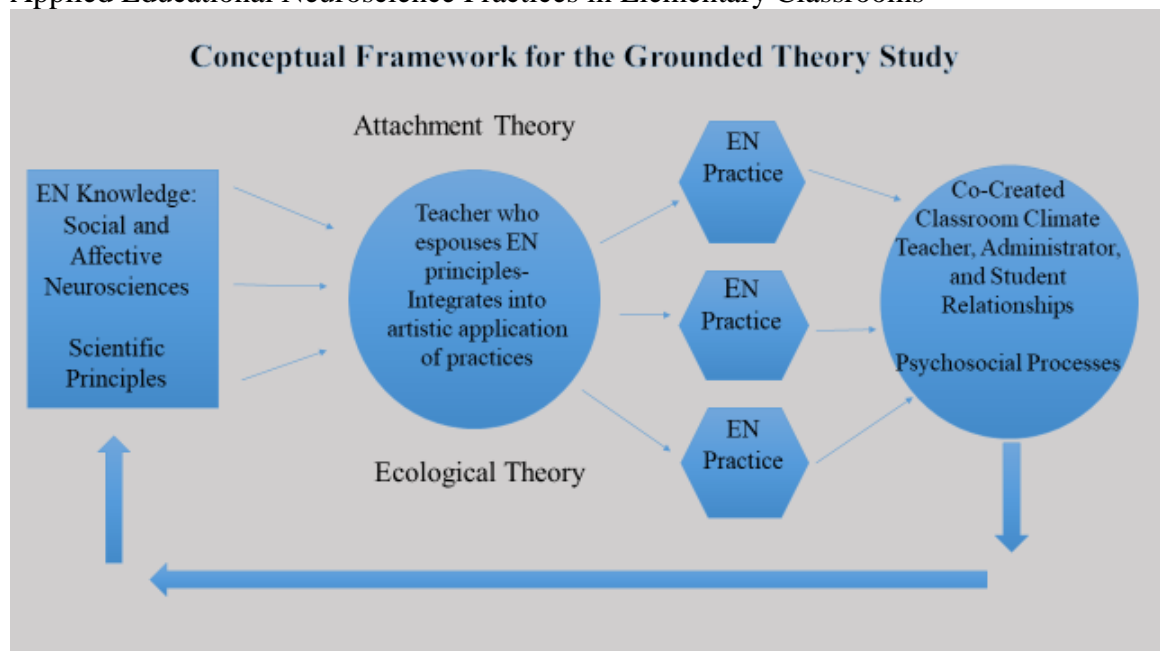
The study was oriented in a social constructivism ontology that assumes that reality is co-created and defined in pluralistic ways. Vygotsky (1978), a classic educational theorist, postulated nearly a century ago that social and cultural functioning is shaped through interaction with context and underpins cognitive decision-making and reasoning. As a foundation for constructivism, Vygotsky's assumptions embedded in social development theory are supported in the emerging scholarship on social and affective neuroscience and provide an epistemological lens for the proposed study.

Building upon a social constructivist philosophical orientation, two theories influenced this inquiry - ecological and attachment theories. Ecological theory provides an essential lens for understanding the interplay of classroom environment and interpersonal functioning. Drawing from Bronfenbrenner's (1977; 1979) seminal work, individual behavior emerges from the reciprocal interaction between one's unique neurobiological attributes and the environment. Ecological theory provides an explanatory tool for understanding the functioning of students within the concentrically encompassing classroom context, school system, and broader context.

A complementary theory to ecological theory is attachment theory. Originating with Bowlby (1969), attachment theory is a middle-level evolutionary theory of human social behavior and illuminates attachment patterns across the lifespan. Bowlby (1969) averred that attachment schemas are the culmination of myriad experiences with caregivers that become embedded in one's unconsciousness, creating automated behavior responses to specific relational stimuli in social contexts. Applying attachment theory to education settings, the teaching-learning enterprise is a "social, interpersonal, and attachment-based endeavor" (Cozolino, 2013, p. xxi). Each classroom is comprised of a teacher and students with varying attachment styles and challenges. With an amalgamation of each student and teacher's unique evolutionary patterns of coping and survival, they are constantly negotiating their social environment with a continuum of conscious and unconscious relationship dynamics. This theoretical framework is based upon the assumption that a student's capacity to learn is profoundly impacted by the quality of the relationship patterns and her/his attachment to teachers and peers in the classroom context.

The study examined practices of teachers who espouse educational neuroscience principles. Practices for this study are defined as an amalgamation of factors, including places where the incident occurs, people involved in the practice incident, individual and group interactions that comprise the practice, objects used, sequence of the practice incident over time, intentions for the practice activity, and emotions expressed during the practice incident. The conceptual framework also reflects the reciprocal bi-directional flow of knowledge between objective science and heuristic ways of knowing in the classroom and shows how insight from this type of research design provides further questions for subsequent inquiry. Figure 5 provides a visual depiction of the conceptual framework for the study that investigated the educational neuroscience practices and the ensuing psychosocial processes.

Figure 5. A Conceptual Framework for the Grounded Theory Study Investigating Applied Educational Neuroscience Practices in Elementary Classrooms



Chapter Summary

This chapter provided an appraisal of the literature, specifically examining three specific foci: (1) the emerging knowledge base that describes how educational neuroscience is conceptualized; (2) existing scholarship on the social and affective dimensions of applied educational neuroscience; and (3) school social work's positioning within the emerging applied educational neuroscience discipline. This chapter also provided a conceptual framework for the research design, shaped by the literature as well as the theoretical and philosophical orientations guiding the dissertation research. Informed by the literature review and conceptual framework, Chapter 3 will describe the research methods that were used for the study.

Chapter 3: Research Methods

To examine the conceptualization of educational neuroscience practices in the classroom setting, this study used a grounded theory approach. The following section outlines the rationale for this methodological approach and describes the research design. This section also delineates the strategy that was used for collecting and analyzing data, establishing rigor, and considering ethics relevant to education settings.

Research Design: Rationale and Description

According to Campbell (2011), qualitative inquiry plays an integral role in educational research by understanding phenomenon as it is socio-politically-situated, deepening insight into a given condition impacting education. This research design also ascribed to a transdisciplinary definition of educational neuroscience by attending to a public need that has at its root a social justice underpinning (Leavy, 2011). Butterworth and Tolmie (2014), affiliated with the Centre for Educational Neuroscience in London, highlight the common social dilemma of how to promote better learning and argue for a transdisciplinary research pathway to examine how educational neuroscience is applied.

Techniques drawn from grounded theory methods (Glaser & Strauss, 1967) were used to guide the study process and analyze the observational and narrative data. The grounded theory procedures used correspond with those outlined by Charmaz (2014) who proposes a constructivist approach to interpreting conceptual themes that emerge from the narrative data. Charmaz, Thornberg, and Keane (2018) assert that grounded theory is also an integral method for social justice inquiry. By illuminating how institutionalized inequality occurs in individuals' meanings and actions, grounded theory methods reveal connections to oppressive forces embedded in macro structures. The constructivist

version of grounded theory emphasizes reflexivity and recognizes how both the studied phenomenon and research process are co-constructed and are historically, socially, and politically situated. This ontological and epistemological orientation were central to this study.

Drawing from symbolic interactionism (Blumer, 1969; Mead, 1967), grounded theory is a method of inductive inquiry for constructing theory that emerges from data that are systematically gathered and analyzed. Grounded theory is predicated upon the assumption that social life consists of dynamic processes among people influenced by a sociocultural context through which people generate interpretive meanings. The method focuses on 1) the complexities of people undergoing change; 2) the influence of social interactions on outcomes; 3) critical junctures that impact adaptive processes; and 4) how the social environment influences human experiences (Benoliel, 1996).

Applying practices based on educational neuroscience principles, the researcher anticipated that members of the school community, including teachers, students, and administrators, would adapt to the shift in social processes and co-create new interpretive meanings to the unfolding practices used in the classroom environment. Since these collective features are best understood as a series of complex, evolving psychosocial interactions that are shaped by the sociocultural context, qualitative inquiry using grounded theory techniques was a methodological approach suitable for investigating these processes.

Research Participants and Data Collection Strategies

Participants are selected in grounded theory because of their intimate knowledge of the domain being studied. Consequently, a purposive sampling strategy (Padgett,

2008) was used for the grounded theory study. Data collection entailed a convergence of several data collection methods, including two teacher interviews for each classroom (n=6), four classroom observations, fourth and fifth grade student interviews (n=46), and an administrator interview for each school (n=2). Data collection also incorporated classroom artifacts, including pictures of the classroom structure and de-identified student assignments. While highly inferential data (Hatch, 2002), artifacts are unobtrusive to collect, provide “residues of human activity, and give alternative insights into ways in which people perceive and fashion their lives” (Hodder, 1994, p. 304).

Two school corporations committed to incorporating an educational neuroscience orientation in the classroom settings were sought for the study. In consultation with administrators from the respective school corporations, specific fourth and fifth grade classrooms were identified for the study. For each of the three identified classrooms, 1-3 classroom observations were conducted and the teachers were interviewed two different times. Interviews occurred with students in each respective class, including 29 fifth grade students and 17 fourth grade students. One school administrator was interviewed at each of the two schools.

To be eligible to participate in the study, participants met at least one of the following criteria:

- A teacher in a P-6 grade school setting who intentionally ascribes to an educational neuroscience orientation.
- A current student in the class identified by the school administrators for the study.
- A school administrator at the elementary school where the identified classroom for the study is located.

Data collection occurred in four phases for each of the three identified classrooms. Phase one of the data collection phase entailed the first of two interviews with the classroom teacher. The aim was to understand from the teacher's lens how s/he/they conceives of educational neuroscience. The classroom observations occurred during phase two of the data collection process. Four classroom observations were conducted to identify specific practice incidents that demonstrated the educational neuroscience principles.

Phase three of the data collection process included interviewing students in the classroom. A theoretical sampling strategy was used to solicit storied responses from the classroom participants who were involved in the specific incidents identified in the classroom observations. The incidents identified exemplified in some manner the fusion of environmental, cognitive, social, and neural foci inherent in the educational neuroscience principles.

Phase four of data collection included an interview with the school administrator and a second interview with the teacher. Semi-structured interviews were used to collect data. Interviews with the students and school administrators occurred on one occasion. The teacher was interviewed on two occasions, at the beginning of the study and following the classroom observations. The interview questions were open-ended to encourage participants to freely describe their experiences. There was an interview guide with sample questions; however, the interviews were guided by emerging data, aligning with grounded theory principles. The following section outlines each phase in more detail. The same multi-phased structure was applied to each of the three classrooms.

Phase 1. Interview with the Teacher

The teacher of the classroom selected by the school corporation officials was interviewed. The teacher was contacted directly via email to request her/his/their participation. A Study Information Sheet was provided and the study was explained, including the risks and benefits. Teacher interviews occurred at the school setting.

The first teacher interview began with the following statement:

I am interested in understanding how an educational neuroscience approach shapes your professional knowledge and practices. As the teacher of the classroom, I am curious to know what educational neuroscience means to you. You may answer only the questions you feel comfortable with, and, since your participation is voluntary, you may stop at any time.

Sample questions included the following:

1. How would you describe your understanding of educational neuroscience?
2. First, tell me how you became interested in educational neuroscience?
3. How has this shift influenced your approach to teaching?
4. Tell me about a specific time you intentionally applied educational neuroscience to your professional work with your classroom?
5. What are some examples of educational neuroscience practices in the classroom?
6. Tell me about a time when you assessed this approach to make a change in the classroom/students that was beneficial.
7. Tell me about a time when the approach did not seem to be helpful to you and/or the students.
8. How does this approach impact the students in your classroom?
9. How does this approach impact you as the teacher of the classroom?

10. If there was one word or phrase to capture the essence of educational neuroscience in the classroom, what would it be?
11. In what ways does educational neuroscience inform school social work practice?
12. Is there anything else that you would like to share?

Phase 2. Classroom Observations

A total of four classroom observations were conducted that included all three classrooms. Once the classroom was identified and permission was established at the building and classroom level, a notification form was sent to parents informing them of the study and their rights to not have their children participate in the study. Students whose parents agreed to their participation were involved in the classroom observation. Part of this observational data collection process entailed identifying specific practice incidents in the classroom that captured social and learning phenomena corresponding to educational neuroscience principles. (See Appendices E and F for data collection guides to identify practice incidents). At each observation, notes were taken for approximately one hour at a time. After conducting the classroom observations, student participants were interviewed at one point in time, exploring specific scenarios that emerged.

Phase 3. Interviews with the Students

After identifying specific practice incidents during the classroom observations, student participants who were actors in those incidents in some manner were recruited for interviews. Students whose parents agreed to their participation in the study were eligible to be interviewed for the study. Students were presented the opportunity to participate, and the benefits and risks of participating in the study were explained in age-appropriate

language. Students participating in the study were interviewed at the school during a time that the teacher chose as to not interfere with the academic needs of the students.

The student interviews began with the following statement:

I am interested in understanding how knowing about the brain impacts your classroom. As a member of this classroom, you know how your classroom works. I am interested in learning what a few specific experiences were like for you. I will ask you a few questions. You may answer only the questions you feel comfortable with, and, since your participation is voluntary, you may stop at any time.

Sample questions include the following:

1. First, tell me about your experience being a student in (the teacher's) classroom.
2. I noticed you were involved with (identified specific incident). Could you tell me more about that experience?
3. What feelings did you have during that experience?
4. What thoughts did you have during that experience?
5. Is there anything else about your classroom that you would like to share with me?

Phase 4: Interview with the School Administrator and Follow-Up Interview with the Teacher

Two final interviews were conducted. One interview occurred with a school administrator from the school where the classroom was located. The identified school administrator was contacted directly by email to request her/his/their participation. At this time, a Study Information Sheet was provided and the study was explained, including the risks and benefits. The interview with the school administrator occurred at the administrator's school setting.

The interview with the school administrator began with the following statement:

I am interested in understanding how an educational neuroscience approach shapes the professional knowledge and practices applied in your school context. As the principal/assistant principal of the school, I am curious to know what educational neuroscience means to you as a school leader. You may answer only the questions you feel comfortable with, and, since your participation is voluntary, you may stop at any time.

Sample questions include the following:

1. First, tell me how you learned about educational neuroscience?
2. Tell me what educational neuroscience means to you?
3. What student behaviors would you expect to see from this shift in pedagogical orientation?
4. How do you anticipate an educational neuroscience would create a shift in the classroom functioning?
5. Tell me about a specific experience with a student, teacher, or classroom where educational neuroscience was applied.
6. If there was one word or phrase to capture the essence of educational neuroscience in the classroom, what would it be?
7. In what ways does educational neuroscience inform school social work practice?
8. Is there anything else that you would like to share?

A follow-up interview was conducted with the classroom teacher. The follow-up teacher interview began with the statement below:

After observing the classroom, I have identified a few specific experiences that appear to capture neuroscience practices. I am interested in learning what these specific experiences were like for you. You may answer only the questions you feel comfortable with, and, since your participation is voluntary, you may stop at any time.

1. I noticed (cited a specific incident from the observation that indicated educational neuroscience approaches). What informed your approach to that particular situation?
2. How was your approach with that specific encounter connected to educational neuroscience?
3. What parts of that approach did not convey educational neuroscience practices?
4. (Continued with additional incidents in same manner.)
5. Is there anything else that you would like to share?

Interviews with all participants were audiotaped with permission and transcribed.

Teachers and school administrator(s) were asked if they were willing to review the findings upon completion of the interviews. Those interested were sent a summary of the findings, and they were contacted via phone or email for feedback. The teachers and school administrators were offered the option to only receive the summary of findings without being contacted for additional feedback.

Data Collection and Analysis with Grounded Theory Coding

Data collection and analysis occurred simultaneously according to grounded theory coding processes outlined by Charmaz (2014). ©Quirkos data analysis software was used for the systematic levels of coding and analysis. Drawing from Charmaz's initial and focused levels of coding, the analysis included data from both the transcribed interviews and the observational data. In the early stage of the analysis, process coding (or action coding) was used to analyze observable activities and conceptual actions that, through an interpretive process, unveiled manifest and latent themes (Saldaña, 2013).

Through constant comparison methods (Glaser & Strauss, 1967) and consistent reflection, data were compared at each analytic stage in order to mine patterns at various analytic levels. From the systematic analysis, organization of codes, and integration of memos and diagrams, categories were defined and repeatedly refined until theoretical links revealed higher order patterns. This iterative process of distilling the abstract data into substantively converging categories persisted until the conceptual density revealed a core explanatory variable that weaved the categories into a descriptive empirical framework (Glaser, 1978). The following section outlines how data collection and analysis occurred in four unique and intertwined phases (See Figure 6).

Phase 1

Phase one began with the first interview with the aim of seeking understand how the teacher conceptualized educational neuroscience. After the first interview with the teacher, this process of initial coding, as defined by Charmaz (2014), began, a relational position was assumed with the data and with the study participants (Star, 2007). Initial coding was grounded in the data and provided a preliminary opening for ongoing analytic possibilities. It is from this iterative and interactive engagement with the data, that implicit meanings were acquired into educational neuroscience concepts and practices, directions to explore were discovered, and potential links between processes in the data were revealed.

Phase 2

Phase two introduced the classroom observations into the data analysis. This phase entailed a focus on specific incidents that exemplified educational neuroscience principles. Using a data display table (see Appendix F), observations of classroom

participants were documents and initial coding began through analysis of the observational data. From this early phase of analysis of the classroom observations, five incidents were identified that exemplified educational neuroscience practices.

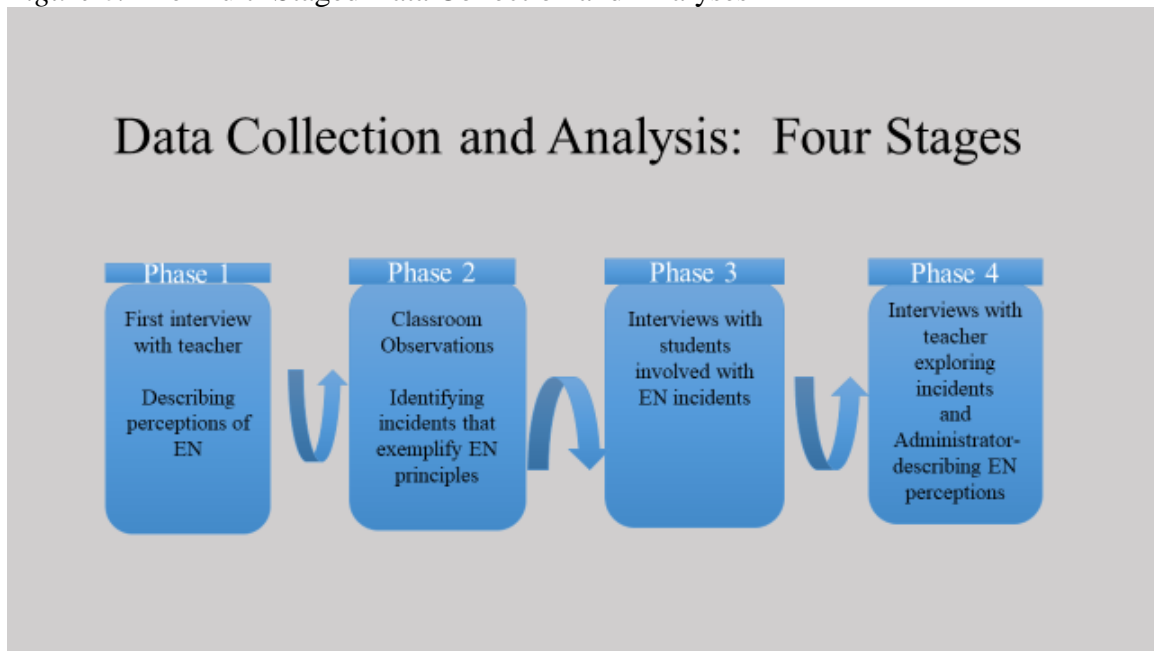
Phase 3

Phase three entailed interviews with students who were actors in the educational neuroscience incidents outlined in phase two. Theoretical sampling was used to identify students who were participants in incidents revealing educational neuroscience principles. Building upon the study's emerging theoretical perspectives, this stage of the analysis took into account the interplay between data gathering and data analysis in grounded theory (Okta, 2012). The data from these interviews generated inquiry and comparisons with the observational data.

Phase 4

Interviews with a school administrator and the classroom teacher occurred in phase four. Data from the school administrator further outlined the guiding conceptualization of educational neuroscience practices. The follow-up interview with the teacher generated additional data on the identified incidents, providing an analytic intersection with the previous phases that contributed to the genesis of theoretical categories. See Figure 6 for a visual depiction of the four phases of data collection and analyses.

Figure 6. The Multi-Staged Data Collection and Analyses



From the multi-phased data collection and analyses process, the doctoral student substantively coded the transcripts of the observational and interview data (Oktay, 2012) and sought to describe how perceptions of educational neuroscience unfolded in the classroom setting. Through close examination of descriptors for empirical indicators, initial coding generated an analytic guide that allowed for the mining of emerging data ideas. By studying and naming data units including, words, lines, segments, and incidents, data were categorized and summarized, creating an inclusive account from the data fragments. The doctoral student did the initial coding while consulting with qualitative experts on the research team.

Focused coding was the next stage of the coding process. At this stage, initial codes were engaged with and examined to determine the presence of conceptual significance of initial coding by revealing patterns among the interviews and observed incidents. From this examination, a distillation of codes emerged that best represented the essence of the data. Drawing from the multi-phase convergence of the initial coding,

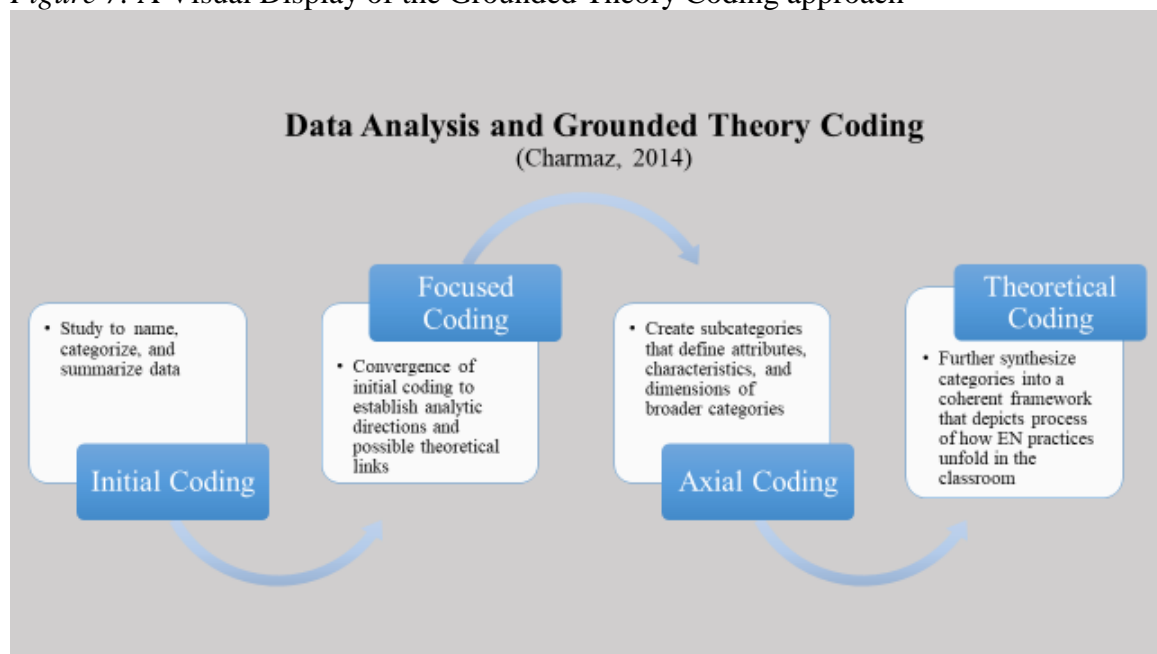
analytic directions were established by synthesizing, analyzing, and conceptualizing segments of data and also comparing possible theoretical links between codes. From this process, theoretical categories emerged. Focused coding revealed gaps in the data that were a part of the theoretical significance of the educational neuroscience perceptual phenomenon. Like the initial coding process, focused coding entailed an iterative process that prompted the emergence of theoretically significant categories related to descriptions of how participants experienced educational neuroscience practices in the classroom setting.

Axial coding was the third stage of the coding process. Applying axial coding from Charmaz's (2014) methodological orientation, categories were refined and sharpened to illuminate the theoretical centrality emerging from the data. During this coding stage, subcategories were created that defined the attributes, characteristics, and dimensions of the broader categories, which essentially reflected how sense was made of the data surrounding participants' perceptions of educational neuroscience practices in the elementary classroom setting. From this process, the next step involved reconstructing a newly devised cohesive structure from the fractures and intersections of coded and categorized data (Creswell, 2013).

Theoretical coding, the final coding stage, was used to order and further synthesize the categories developed during focused and axial coding in a coherent framework that depicted how the described perceptions of educational neuroscience unfolded in the classroom setting. Due to the highly interpretive nature of axial and theoretical coding, this coding level involved a team of qualitative researchers, including other doctoral students as well as faculty on the doctoral student's dissertation committee

who possessed grounded theory expertise. Categories related to discerning perceptual features of educational neuroscience in the classroom were integrated to develop a theoretical framework that explained how perceptions of educational neuroscience influenced practices that occurred in the context of the fourth and fifth grade classroom settings. Figure 7 provides a diagram that outlines the constant comparative processual flow of these four levels of coding.

Figure 7. A Visual Display of the Grounded Theory Coding approach



Ensuring Quality

The purpose of the research was to describe how an educational neuroscience orientation unfolds in the classroom through student, teacher, and administrator engagement and psychosocial interactions. Ensuring quality of the research outcomes entails conceiving fresh and implicit meanings of the studied phenomenon based upon lucid reflections and cogent convictions culminating in a relevant scholarly contribution (Charmaz, 2014). Four criteria outlined by Charmaz were used to ensure trustworthiness

of methods, data, and the final product. The criteria were credibility, originality, resonance, and usefulness.

According to Charmaz (2014), credibility is comprised of three primary components including 1) how closely the categories encompass the breadth of the data; 2) the occurrence of systematic comparison between data and categories; and 3) how well the data align with the emerging grounded theory. Originality refers to the relevance of categories and the presentation of unique insights, conceptualization and/or social/theoretical implications (Charmaz, 2014).

The research team used several strategies to promote credibility and originality. Credibility was enhanced in the design through the triangulation of data and the inclusion of a second person for data collection with classroom interviews and observations. Peer debriefing occurred through regular data reviews by the qualitative research team. Regular memos were kept that promoted development of the categories and the theoretical framework. Finally, a systematic audit trail provided a written record of each methodological and analytical decision, and the research team regularly reviewed the audit trail.

As instructed by Charmaz, resonance and usefulness are the next two strategies used to ensure quality. Resonance occurs when the emerging theory is relevant and aligns with the people experiencing the investigated phenomenon. Usefulness refers to the analytic impact of the emerging theory and how it may have value for actual educational and social work practices. Resonance and usefulness were advanced by two primary procedures. As categories were developed during the data analysis, emerging categories were assessed for resonance with subsequent participants. Once the

preliminary theory was developed, it was presented to the teachers, administrators, and the guiding community stakeholder who has introduced this educational neuroscience conceptual framework to the two school corporations that participated in the study. Feedback was obtained from classroom teachers who do and also who do not ascribe to the educational neuroscience practices about the potential usefulness of the theoretical framework in their pedagogical approaches.

Ethical Considerations: Human Subjects Review

Researching human participants comes with three ethical charges that are universal to the research community: (1) respect for the person, (2) beneficence, and (3) justice (US Department of Health and Human Services, 1979). Investigators must respect at all times a participant's self-determination, ensuring that anyone with diminished autonomy is afforded protections in the research process. Hatch (2002) posits that conducting qualitative research in educational settings comes with unique ethical responsibilities as there are inherent power differentials to consider. A researcher must be sensitive to the vulnerability of students given their age and containment as mandated members of a classroom. Teachers typically have minimal power in educational settings and may feel coercion to participate in research based upon an administrator's request or that their denial is indicating that they are not being transparent. With both of these participant groups, Hatch advises researchers to ensure genuine informed consent is given and to clearly communicate the voluntary nature of their participation in any proposed study. These considerations were adhered to during the institutional review board proposal and throughout the implementation of all phases of the study.

This study also included data collection from minors that required additional ethical attention. Prior to conducting the classroom observations, the parents were provided a parental notification form that informed them of the proposed research and their rights. Included in the parental notification was the opportunity to opt their student out of the classroom observations. This form was provided in both English and Spanish versions. Parent/guardian consent was required for student interviews, and in cases determined appropriate by the Institutional Review Board, students assented to the research process.

To ensure there was no sense of coercion to participate in the study, members of the school community were informed that their choice whether to participate in any aspect of the research would not negatively impact their position or educational standing in the school organization. The classroom teacher and school building administrator were informed that the purpose of this research did not involve in any way an evaluation or critique of the teacher, student, or school performance. At all stages of recruitment and data collection, study participants were reminded that their involvement in the study was voluntary and that the study complied with the Family Educational Rights and Privacy Act (FERPA) and school policies on confidentiality and privacy.

Limitations

There were limitations to consider with the study design. Since the study design was subjective in nature, the study was vulnerable to researcher bias. Even with attempts to promote reflexivity in the research process, findings were generated and situated through the researcher's cultural and socio-political lens. (See Appendix D for the researcher role and assumptions). There were also limitations to the trustworthiness of

the findings, since there was no comparison group for this research design, and the study occurred in one geographic area where participants had received the same professional development.

Chapter Summary

This chapter described the constructivist grounded theory research design for this dissertation study that examined the application of educational neuroscience practices in three elementary classrooms. It described the data collection strategies and the multi-phased research design for data collection and analysis. The chapter also explained the constant comparison analysis process used with the four stages of coding, according to Charmaz (2014). Strategies to ensure quality were delineated as well as ethical considerations that guided the study design and process. The next chapter outlines the study's research findings.

Chapter 4: Research Findings

The purpose of this grounded theory study was to describe how practices based on educational neuroscience principles unfold in classrooms taught by teachers who espouse these principles. The impetus for the dissertation study was to contribute to a shared conceptual framework for the social and affective dimensions of applied educational neuroscience. The researcher believed that a more in-depth understanding of applied educational neuroscience and the corresponding psychosocial processes would inform school administrators, educators, and student support personnel in terms of designing instructional environments and delivering practices that promote positive classroom climates for optimal learning.

This chapter presents key findings obtained from four classroom observations, six in-depth teacher interviews, two in-depth school administrator interviews, 48 student interviews, and artifacts from three different fourth and fifth grade general education classrooms in a Midwestern US city. The 48 student interviews were comprised of fourth and fifth grade students. It is important to highlight that data retrieved from the student interviews contributed to the emerging themes interwoven among the findings; however, there were qualitative differences in the responses from these two different age and developmental positions. With that consideration noted, this study generated five major categorical findings presented in Table 1.

Table 1. Summary of Research Findings

Categorical Findings	Description of Findings
Conceptualizing Applied Educational Neuroscience	Participants described educational neuroscience as being a science-driven shift in classroom processes that fostered a holistic alignment with the teacher and students' unique social and biological needs to promote learning and connected relationships.
Humanizing the Supportive Structures	Participants indicated that the school's organizational culture - characterized by its commitment to human potential, flexible boundaries, holistic perspectives, and autonomous decision-making - was central to the teachers' ability to incorporate applied educational neuroscience practices in their respective classrooms.
Infusing Educational Neuroscience Practices	Through the convergence of data from interviews, observations, and artifacts, the teachers applied five categories of educational neuroscience practices in the three respective classrooms: (1) Teaching Neuroanatomy; (2) Taming the Mind and Body; (3) Letting Classroom Boundaries Breathe; (4) Honoring the Whole Student; and (5) Giving Voice to Emotions.
Co-creating the Classroom Climate	Through the interviews and observations, the data revealed four categories of applied educational neuroscience practices that produced interactions aligning with four classroom and school climate variables, (1) Safety; (2) Relationships; (3) Teaching and Learning; and (4) Structure of the Learning Environment.
Building Students' Resiliency	Participants reported the following five co-created student and relational outcomes that they perceived precipitated from the ways educational neuroscience practices influenced the classroom: (1) Reduced Office Referrals; (2) Readiness to Learn; (3) Empowered Decision-Making; (4) Empathy, and (5) Social Connectedness.

Following is a discussion of the findings with details that support and explain each finding. "Thick descriptions" (Denzin, 2001) were used to document the scope of storied experiences, creating an opportunity for the reader to enter into this dissertation study and deepen insight into the research participants' reality. The emphasis is on capturing the participants' voices. Illustrative quotations taken from interview transcripts are used to portray an array of participant perspectives and also depict the richness and complexity of the psychosocial phenomena that was investigated. Where appropriate, critical incident and observation data are synthesized with the interview data to augment

and solidify the discussion. Pictures of classroom artifacts are incorporated to provide visual insight into the findings outlined in this chapter. This chapter culminates with a conceptual model that integrates the categorical findings and illustrates how these educational neuroscience practices unfold in the elementary classroom.

Finding One: Conceptualizing Applied Educational Neuroscience

Participants described educational neuroscience as being a science-driven shift in classroom processes that fostered a holistic alignment with the teacher and students' unique social and biological needs to promote learning and connected relationships.

A primary finding from this study was how the participants conceived of applied educational neuroscience. Participants saw educational neuroscience as a paradigm shift, rather than a program, and defined it as an alignment with relational ways of being in the classroom. Notably, they perceived this shift as being an illumination of science that offered an explanatory mechanism for what was inherently natural.

A school administrator offered the following explanation of applied educational neuroscience being a paradigm shift in education practices:

You can't just open up a package and implement this. It's more of a deeper understanding of how we develop....It is a paradigm shift, so I think you're gonna see a lot of data in both academic and behavior data with teachers that are using this effectively.

Participants consistently emphasized the centrality of relationships, as one of the fourth grade teachers stressed, "...I think it's all relationship-driven," and a school administrator added to this notion of relationships being a hallmark characteristic in her assertion that the approach is rooted in "strong, strong relationships with kids."

Participants looked to educational neuroscience as an explanatory vehicle for supporting what seemed intuitive to them, as indicated by one of the fourth grade teachers who

responded, “I think intuitively we’ve always known that relationships support brain development, but just didn’t have the science to back it up.” Another fourth grade teacher added, “It’s good practice for teaching, but now here’s the why.” Participants framed additional perceptions of the relational and explanatory features of educational neuroscience in the following ways:

...the holistic approach to teaching in which you’re making the students more aware of how their brain develops, how different situations and different reactions and emotions affect us and connecting some of the way that they’re feeling and some of the way that they learn to real science. This is not a packaged program; this is just implementing what we know about science and the brain into education. (School Administrator)

I think educational neuroscience really simply is kind of within all of us. It’s something that naturally good teachers do but don’t have a name for it or you don’t know why you do it. It’s natural because it’s our biology; it’s our neuroanatomy so things that naturally occur within us. The relationships we build should be natural and genuine and easy to do. The flow of Room 18 is a natural flow. Consequences? There are consequences, but they’re natural consequences. It’s a natural way of being in a classroom with your students. (Fifth Grade Teacher)

The participants also saw this explanatory feature as legitimizing this shift toward integrating neuroscience knowledge with education.

I mean, learning how we develop and how we approach things and how that affects our brain and having the science to back it up, you know. It’s easier to buy into when you can prove that this is real, this is science. (School Administrator)

Participants conceptualized educational neuroscience as a way to improve teaching practices by integrating an accurate understanding of students’ neurobiology and development into education. One of the fourth grade teachers stated it was “tying the brain’s activity and how children learn together, so that we can teach them even better.” A school administrator reported, “...when a teacher understands how the brain develops, it’s not just behavior; it helps them teach; it helps them understand how to better deliver

effective instruction too.” Another school administrator described this integrative process in the following way:

...it’s just all educators needing to have an awareness of the brain and how it develops and when we understand that, we can understand learning and student behavior in a deeper way. So I would say, it’s just the understanding of how neuroscience relates and impacts education.

This deeper understanding of students’ unique neurobiological development and the centrality of relational connections was viewed as a feature that supported all students. Participants also conceptualized educational neuroscience as a mechanism for engaging students when stressors impeded their ability to engage and learn.

Educational Neuroscience and Student Stressors

The participants viewed educational neuroscience as an important shift for all members of the classroom. The fifth grade teacher indicated, “I think sometimes we look at these interventions, or these processes, this way of being with kids, and we think of just our at-risk kids, but really it’s so beneficial for everyone, including the teacher.” While participants saw this shift as inclusive of the entire classroom community, they emphasized how it is especially elucidating for supporting students who come with extensive stressors that could impede their ability to learn. One of the fourth grade teachers described educational neuroscience as “kind of how the brain works with learning and in a school setting, especially if they come from trauma...” Another fourth grade teacher added to this notion, “I think it’s just an understanding of the brain to help my teaching. So understanding how trauma affects the brain, I think, has really changed everything for me.”

Building upon participants’ considerations of how stressors may impact brain functioning, participants conceptualized educational neuroscience as being a way to

differentiate learning supports both in teaching and the structure of the learning environment to meet students' individual developmental needs. Teachers saw educational neuroscience as being a process of partnering with students to identify strategies that worked for their unique needs. As one of the fourth grade teachers explained, "I do think that is a piece of educational neuroscience too...understanding themselves and their own brain and what's going to help in that time."

Finding One: Conceptualizing Applied Educational Neuroscience revealed how participants conceptualized applied educational neuroscience practices. Themes described in this chapter include a science-driven paradigm shift that entailed viewing neurosciences as an explanatory mechanism to support relational ways of being in the classroom. Conceptualizations also included educational neuroscience practices as serving the needs of all students and especially those with extensive life stressors.

Finding Two: Humanizing Supportive Structures will present how the organizational and classroom structures helped to facilitate this conceptualization of educational neuroscience practices described in this first categorical finding.

Finding Two: Humanizing the Supportive Structures

Participants indicated that the school's organizational culture - characterized by its commitment to human potential, flexible boundaries, holistic perspectives, and autonomous decision-making - was central to the teachers' ability to incorporate applied educational neuroscience practices in their respective classrooms.

A theme that arose throughout the data collection and analysis processes was the organizational characteristics that supported the philosophical shift that the educational neuroscience conceptualization engendered. Participants highlighted how the

organizational cultures of their schools embraced autonomy and flexibility of teachers.

One of the fourth grade teachers claimed, “Yeah, we have a ridiculous amount of freedom here, which is wonderful. We’re like really allowed to teach.” Others described these flexible approaches in the following ways:

It’s really nice that they are flexible with us and most days walking in, if we had to re-teach that instead of starting science that day, they would be totally understanding that is a need our class has at the moment, so they are really flexible. (Fourth Grade Teacher)

I’ve taught at another school where it was more like if I walk into your classroom at 9:20 on February 22, this is what should be happening, but I think it’s a lot about the administration in the building, and if they understand why we’re doing what we’re doing, then you can definitely find times for it. (Fourth Grade Teacher)

I think you probably would see administrators who are not as comfortable with teachers you know, using flexible seating in the classroom, using fidgets. We have teachers who have ellipticals in their classroom. A lot of administrators would probably question that more or kinda say, ‘no, that’s gonna be distracting for students’ rather than kind of giving the teacher the autonomy to try out [new things]. (School Administrator)

Participants indicated that the culture of leadership was open to new ideas while also monitoring the progress of their implementation. This type of supportive openness was illustrated in the following responses:

So yes, attitude and open mind to hear new ideas and what it could look like and the ideas around that...I mean, I have created this position, and I asked for a mentor and I have that and I’m starting a club for students and a club for teachers, and there’s a willingness to do that... (Fifth Grade Teacher)

That’s a culture in X Township that I’m really pleased to be a part of. I think leadership in general, they want to try new things, so the organizational shift I saw was saying, yes, let’s try that, let’s be at the forefront even though other schools aren’t doing it, but let’s show how we’re doing it. (Fifth Grade Teacher)

Yeah, I would say that we’re a very democratic leadership model here in general and, like there’s a lot of trust. I really trust every staff member here. And I think you have to because like with this being new, if you

don't have the freedom to try things out, or if they think there's only one way of doing it, you know. They're not going to be creative and will never try things and fail and learn from those failures. (School Administrator)

Additionally, participants shared how they modeled educational neuroscience principles in their ways of providing support, which included differentiated support to teachers at various stages of development. The following responses demonstrate these perspectives:

...I try to be a model to what I would hope teachers would be able to do so I think that's really important and I think being a learner alongside of teachers and being vulnerable through the process. (School Administrator)

So I think it relies heavily upon the teacher, and there are teachers that can manage that at a level, a very highly effective level, and in that case, from an administrative standpoint, we give them complete autonomy to do that. At the same time, that takes practice and training and skills that the teachers need in order to be able to manage that [applying educational neuroscience practices] at a highly effective level, so it's not something that all teachers can just implement right away....If there's a teacher that was not managing it effectively, then, we're probably gonna have to say, 'ok, let's take a step back, we need to, you know, figure out a system that works for you and the kids, so I think it's support, I think it's differentiated support from the administration. (School Administrator)

The observational and interview data showed that the conceptualization and process of applying educational neuroscience practices placed the teacher at the core of the classroom structure. The teacher's state of regulation and wellness was inextricably linked to how the practices occurred in the classroom settings. Illustrating this finding was the fifth grade teacher who stated, "Teacher brain state impacts all the brains in the classroom, and so if I'm not mentally prepared or healthy or happy, then neither will the 30 kids be in my classroom." A school administrator explained how the organizational

culture promotes teachers' ability to regulate and how that structure models strategies for the students.

I've noticed that it's a very real environment. The teacher is able to say, you know, I'm not in a place right now, like my amygdala's firing. I'm not in my prefrontal cortex-like, I'm not where I need to be right now. I need a moment. We have a lot of teachers who are really good about modeling these strategies....and kind of shows the students that it really does work. Teachers are human too, so they get frustrated; we get frustrated and when we take a moment to ourselves and just take a deep breath, it works....I think it's a very real environment for kids and it's a calming environment and overall a much more positive learning environment in the classroom. (School Administrator)

Another school administrator emphasized how the organizational culture not only encourages teachers to participate in self-regulation as needed but that her leadership style aims to support teacher wellness amid the stressors they encounter.

I would say speaking about teacher health, like I hope that I am the type of leader that encourages people to take care of themselves, because it's such a hard field to work in, and there's so much stress. (School Administrator)

This school administrator's sensitivity to the stressors that teachers encounter further highlighted the organizational and classroom structures that were conduits for the application of educational neuroscience in the classrooms. Overall, the data for this categorical finding indicated that application of educational neuroscience practices were facilitated through a democratized leadership style that supported autonomy and individual potential.

Finding Three: Infusing Educational Neuroscience Practices

Through the convergence of data from interviews, observations, and artifacts, the teachers applied five categories of educational neuroscience practices in the three respective classrooms: (1) Teaching Neuroanatomy; (2) Taming the Mind and Body;

**(3) Letting Classroom Boundaries Breathe; (4) Honoring the Whole Student; and
(5) Giving Voice to Emotions.**

A blending of the data sources yielded five distinct practice themes that the school administrators, teachers, and students framed as educational neuroscience practices in their classrooms. These five practice themes are delineated in the following section. Along with the participant voices, pictures of classroom artifacts are included as features of the classroom that help to exemplify these practices.

Teaching Neuroanatomy

The data revealed that one of the educational neuroscience practices applied in the classrooms includes incorporating neuroanatomy into the curriculum. Specifically, teaching neuroanatomy in the classroom focused on the neurobiological processes related to one's social and emotional states. The data indicated that this focus was on increasing students' brain literacy to promote reflection on their unique regulatory functioning. One fourth grade student indicated, "Well, we learned about neurons and how they pass messages through your brain, and there's a ton of them." Other participants described teaching and learning processes surrounding neuroanatomy in the following ways:

The neuroscience is really strong in the first quarter, because we spend a lot of time building that classroom culture and teaching the anatomy of the brain and what happens, and they're so interested! They're inquisitive; they have questions. It makes sense. It's like, oh, I do that! That's happened to me before. (Fifth Grade Teacher)

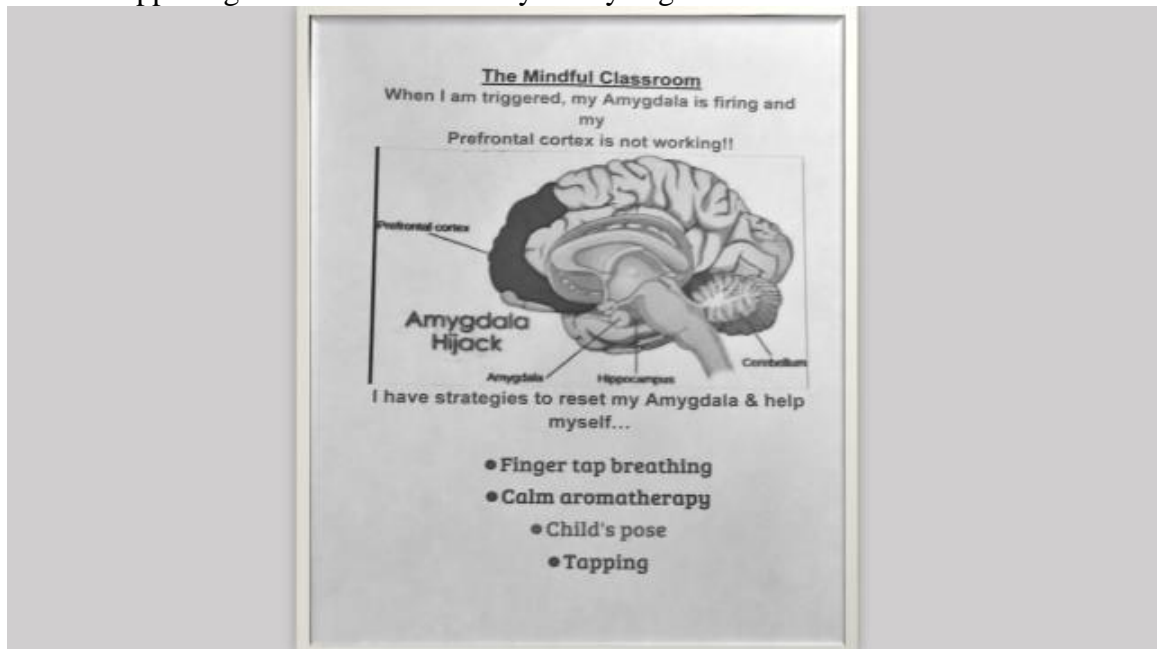
I think it's part of what we teach them in the beginning of the school year, is that your brain is not the same as somebody else's and doing these coping strategies is helping your brain find new pathways to success and all that. So we do explicitly teach that. (Fourth Grade Teacher)

Well, last year, we weren't good students. This year we came to X's room, and we were just wild and just like wildcats, and she said, 'No, we're not gonna do this; we're gonna need some attention breaks.' But it's like we

have a blank slate in our mind, like what is an attention break, like what? And so she started to teach us about neuroscience and the importance of it, and we've learned so much because we were really rough and (pause) we figured that out cuz we are feelers who think....we've learned how to calm our bodies. (Fifth Grade Student)

Classroom artifacts reinforced the observational and interview data. There were student projects and neuroanatomical structures in the classroom to reference what students were learning about their brains. Figure 8 depicts an artifact in one of the fourth grade classrooms, reminding students about brain structures employed in learning and emotions.

Figure 8. A guide that hung on the wall of one of the classrooms, instructing students on what is happening in the brain when they are dysregulated



Taming the Mind and Body

A predominant finding was the array of strategies that were used in the classroom to promote self-regulation of students and the teacher. A variety of terms and exercises comprised this practice, which coalesced as a way to create calmness and focus in their mind and bodies. Students described this calmness as getting them prepared to learn and

engage with peers. One strategy included students taking time at a station within the classroom reserved for what they referred to as “resetting.” A fourth grade student explained that students used this space “when they need to reset their body and make sure that they’re at their best self, like making sure they’re like fully ready to be able to be with their classmates.” Additional participant responses framing this practice theme included the following:

When I got mad, I would just shut myself down, and then I would take it home, but now I take deep breaths, or I take a lap around the school and before I get angry and transfer that into my group work and stuff. (Fifth Grade Student)

We talk about brains need to be reset, need to become calm, and we have each child practice, and you know, it’s like you need a refresher and time to get back to your best self is how we try to frame it. (Fourth Grade Teacher)

Just the way my kids see their emotions, like when they feel really angry, I see them like-just like how they deal with it is different. Instead of being angry, they’re like what can I do to calm myself down? (Fourth Grade Teacher)

The kids really didn’t have an understanding of how to regulate, how to cope. So [now] their classrooms are totally peaceful. There are still issues, but I feel like we’re able to work through them and make changes a little bit quicker than when that foundation hasn’t been laid. (School Administrator)

We know the two ways that our brains can calm down are breathing and movement, so with him, like he would get too angry just sitting in the corner breathing, so that strategy works for most kids, but not him. He would literally sit there and punch himself, so now our deal is when he’s escalated like that, he takes three laps around the inside of the building, and like I trust him to do that, and he does and he comes back most of the time de-escalated from that extreme situation, and then he’s willing to talk and take deep breaths. (Fourth Grade Teacher)

Well, last year when I went for math, she didn’t do like brain intervals and focus attention practices, but this year, I feel so much more calmer because I know like I can do this to help calm my brain. I have this to help my brain calm down after recess. (Fourth Grade Student)

The following pictures present classroom artifacts that illustrate classroom features that supported the application of self-regulation strategies in the classrooms.

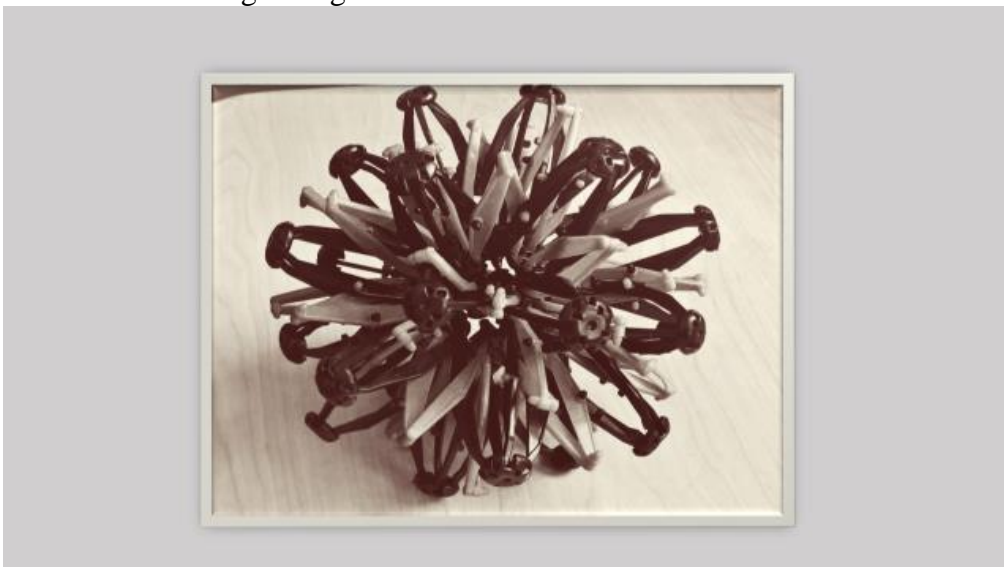
Figure 9 is a picture of the amygdala reset station from one of the three classrooms.

Figure 10 depicts a breathing ball that students could use as part of their strategy of resetting.

Figure 9. Picture of the amygdala reset station in the classroom where students could visit as needed to engage in their choice of self-regulation strategies



Figure 10. Picture of a breathing ball that students used to guide breathing with the intention of self-regulating



Students shared that the self-regulation strategies helped them listen, focus, and subsequently have a more positive learning experience. One fourth grade student emphasized, “Everyone is way more focused and can think straight....because when you can think straight, you can learn easier and you’ll listen better and that’s just what I love about Ms. X’s class.” Similarly, another fourth grade student responded:

Well, it makes me feel a lot more calm – like not tired – like a bit on the tired side, but more like just calm more than I was before, and I think it really helps because then you actually listen to the teacher.

Additionally, students shared how they have transferred these practices into their lives outside of the classroom. A fifth grade student reported, “I take deep breaths when I’m at home when I get frustrated.” Similarly, another fifth grade student offered, “When things happen I just do a brain interval by myself. I go up the stairs to my room, or I go outside and ride my bike.” Students shared how they are applying their self-regulation strategies with family members, friends, and other students in the school community.

Letting Classroom Boundaries Breathe

As part of the application of educational neuroscience, classroom observations revealed students having flexibility to move around the classroom during instructional time. Participants described having choices to identify and apply regulation strategies that addressed their unique needs. They also explained in their responses how these classrooms were different than previous classrooms that restricted autonomous decision-making for regulatory needs. Examples of these differentiated approaches in the findings are outlined in the following participant responses:

Normal teachers don’t let us do this. They don’t let us take a lap if we get mad. They tell us to calm down. They don’t think about what’s going on in our brain. They don’t think about how mad we are, how mad we can get, especially if you’re like our age, going through puberty and stuff.

You get really mad; you get really scared. Everything happens. Your amygdala goes off; you get alarmed and crazy and stuff. Ms. X lets us take a lap, go get a drink of water, when it's convenient for us. (Fifth Grade Student)

I like having a choice, because that helps me like think what's best for me....We always have a variety. We come back to our favorites, but there's always a variety, and I think it's really just helped me with my learning experience this year. (Fourth Grade Student)

...everyone has their own needs. And just being really flexible, I think it's also to build community that they understand. Like one time a girl had things happening at home and she was literally laying in the library with a lavender eye pillow, and no one asked any questions. One kid had the lizard on his shoulder during the lesson, and that one was a little distracting, but for the most part, they know, oh, ok, everyone needs something different. (Fourth Grade Teacher)

It's a great place. I love that we have butterflies and a pet lizard. Oh yea, holding Kendrick, it calms down people cuz like he crawls on your arm and it feels, it kinda hurts because of his nails, but it feels good to just feel him crawling around. (Fourth Grade Student)

Below are two visual examples from observational data of flexible classroom structures that gave students freedom to engage in self-regulation strategies throughout the day. One example was the classroom pet located in the classroom reset area (Figure 11). Another classroom feature that offered opportunities for movement was an area with exercise equipment (Figure 12).

Figure 11. The classroom lizard, named Kendrick, that students could engage with as a self-regulation strategy



Figure 12. Exercise bikes in the classroom that students used as needed throughout the day as a self-regulation strategy



Honoring the Whole Student

Participants expressed how educational neuroscience practices entailed seeing students from a perspective that honors the interplay of their neurobiology with the layered systems affecting their lives. Teachers intentionally set out to know more about the students beyond their roles as students. Three quotes exemplify this perspective:

A lot of these kids want to just be heard and so they want someone to listen to them, and there's time for that in the first quarter, and we do a lot of that. And, I see it pay off in a lot of ways. (Fifth Grade Teacher)

A lot of it is relationship-building and just, like getting to know the kid. So each morning, we have a morning meeting... We have a share component of it where they can share anything... so that kinda helps me get to know what's going on in their home lives. (Fourth Grade Teacher)

Even just a couple of weeks ago, right before the first (name of state's standardized test), I was hanging up a bulletin board in the hallway, and there are many ways of being smart, and I spent the weekend contacting parents, finding ways that kids – cool things kids did outside of school because I knew some, but I wanted it to be a surprise, and so I came in and I was hanging them up, and it's out in the hallway.... (Fifth Grade Teacher)

Viewing students from a holistic perspective, teachers interpreted behaviors as being a reaction to life stressors. One fourth grade teacher demonstrated this finding by saying, “Instead of thinking, you know, they're just having a bad day, they're a bad kid, which I never did, thankfully, but like what's going on that's making them act like this?” Related to this perspective, another fourth grade teacher responded, “Yeah, it's making me think deeper about why are these behaviors (pause), what are they communicating?”

The classrooms included images of students' family members supporting how classroom members perceived of students as being members of family systems that impacted their classroom experiences. Below is an entryway into one of the classrooms

that featured a wall of students' various family pictures that they chose to include in the classroom environment (Figure 13).

Figure 13. Picture of the entryway of one of the classrooms, displaying pictures of students' family members



Giving Voice to Emotions

Another practice theme that participants identified was the centrality of identifying and validating emotions. Participants viewed emotions as preceding their ability to think and learn, and they made space in the curriculum and in the learning environment for emotional expression. In the following ways, two teachers described their approaches to emphasizing the importance of emotions in the learning process:

I always start my first week, I hit it really hard, that we are feeling creatures who think from Dr. Jill Bolte Taylor, and I do lessons on that the whole first week of school. We talk about what that means and why feelings come before thinking, so the kids get a really strong understanding of how we feel first. And, we talk about all of those emotions that we do feel before we start talking about the prefrontal cortex and all of those things. We make it very clear that we feel first, and it's OK, whatever way we feel. (Fifth Grade Teacher)

In the morning, we hold a meeting where they greet each other. They read my morning message to them, and then they have a time of sharing....Or, I might ask them to share a worry and something they're excited for, just give them the opportunity to share what's weighing them down even before we start talking academically. (Fourth Grade Teacher)

Creating time and space for emotional expression was an important component of educational neuroscience practice. Teachers focused on inviting students to actively identify and share feelings with the intention of helping students illuminate root causes of their behaviors.

We always say in class...if you can name it, you can tame it. So, we do a lot of again validating. Sometimes we'll do an emoji share, so I put a few emojis on the board. And, I'm like, 'how are you feeling?' Sometimes they're feeling really angry, but I think even being able to say what you're feeling is helpful, so I try to validate all of that. 'I hear you're really angry. I would be angry too....' (Fourth Grade Teacher)

One of my kiddos, he was really struggling, and he's normally a minor behavior, but not like any extreme behavior. I finally asked him, 'What's going on? This is not like you. What's going on?' I knew his parents had just gotten divorced, but he was like, 'well, my mom has a boyfriend now, and she's spending more time with him than with me,' and it was like oh! He was like, 'I didn't realize that's why I was mad, but that's why I'm mad!' And so I was like, 'yes! OK! Well, thank you for letting me know, and I hear you're really frustrated.' (Fourth Grade Teacher)

Student responses illuminated how these approaches facilitate emotional expression. A fourth grade student's response exemplifies how students felt comfortable sharing emotions:

Yeah, I think it's really special because their (pause) like our class is really cooperative, more than a lot of other classes are, and everybody really expresses their feelings, like literally we go into really deep topics like I can't even say how deep, far we go into them. People really share what they think about it.

Threaded together, the participant responses reveal how *Giving Voice to Emotions* was an educational neuroscience practice theme that emerged from the data. The data showed

how participants perceived validating and reflection on emotions to be a practice theme informed by educational neuroscience principles.

Summary of practice themes

Findings from this section revealed ways participants conceptualized and experienced educational neuroscience practices in their respective classrooms. Findings indicated five categorical practice themes that included increasing students' literacy into their neuroanatomy; facilitating students' reflections on emotions; fostering self-regulation of mind and body; viewing students from a holistic perspective, and finally supporting differentiated approaches to support students' unique self-regulatory needs through flexibility in the learning environment. The next section presents findings on how student and teacher interactions associated with the educational neuroscience practices generated four specific classroom climate features.

Finding Four: Co-Creating the Classroom Climate

Through the interviews and observations, the data revealed four categories of applied educational neuroscience practices that produced interactions aligning with four specific classroom and school climate variables, (1) Safety; (2) Relationships; (3) Teaching and Learning; and (4) Structure of the Learning Environment.

This section describes how interactions resulting from the five practice themes outlined in *Finding Three: Infusing Educational Neuroscience Practices* yielded classroom interactions that corresponded to four established dimensions of classroom climate – *Safety, Relationships, Teaching and Learning, and Structure of the Learning Environment* (Cohen et al., 2009; Hopson & Lawson, 2011; Thapa, Cohen, Guffey, & Higgins-D'Alessandro, 2013). Participants indicated that they had positive interactions

associated with these climate themes, a perception that is captured in a fourth grade student's response, "...I think it just is a great environment to learn in..." The following section delineates the four climate variables revealed in the data.

Safety

Participants articulated how the interactions resulting from the applied educational neuroscience practices contributed to a sense of safety in the classroom. Consistently throughout the data, participants referenced how the students' life stressors were factors in the learning environment, but the climate helped them to feel safe in their classroom space. The following participant responses illustrate how a sense of safety through trust and belonging were fostered:

They definitely see this as a safe place. When one student lost his cat, he wasn't there for the morning. But, he told his mom, 'I wanna be at school.' A couple of his friends came over to comfort him. He reset for a bit, and then he was, you know, OK and ready to learn. Had he not felt that way, had he felt like this room was chaotic or something like that, he probably wouldn't wanna come to school. (Fourth Grade Teacher)

Yeah, it really helped me because I just talked to Ms X about like my issues cuz she's very trustworthy, and she's very, you know, dependable, cuz if I tell her stuff, she will not tell a soul, she will not tell anybody....She says she keeps our issues in her mind, and she tries to help us. (Fifth Grade Student)

I just trust them off the get-go, and I say that often, you know. 'I trust you.' And so I think, again, that language you use with them, they have that buy-in. It's a place where they want to be. (Fifth Grade Teacher)

The fifth grade teacher shared the following about a student who was moved to the class toward the end of the year because of struggles in another class:

(Student's name) who recently moved in here about five weeks ago, struggled in another class....is going through a lot of adversity at home. He's got a single mother, several children at home and poverty, just a lot going on and struggled at school and has been in and out of several other schools....But he has grown so much in just five weeks, and when I think

about this experience in this classroom where kids are accepting and it's ok to be a risk-taker, and it's ok to be wrong, and it's ok to make mistakes and it's ok to not be the smart one, he sees a place for himself, and he doesn't not want to be in here. He doesn't want to miss out.

The participants conveyed findings related to the climate theme of *Safety*. Students' interactions related to educational neuroscience practices generated a sense of safety in the classroom.

Relationships

A theme interwoven throughout the data was the focus on relationships as a core feature of educational neuroscience practices. It was also clear from the data that the relationships that emerged as a result of applying the practices were deeply connected relationships from which a trust formed. Two fifth grade students described their connections with the teacher in the following ways:

She cares! She really cares!....Last year, when I had just came, I got bullied a lot and the teacher I had, I won't say her name, but she did not care. And at the end of the year, I had an award, and I thought it was gonna be something really special. She called out my name and she said 'most annoying.' And I got really sad, but I accepted the award and thought it was just an award, and I was happy to get one. Then after that, everyone started laughing at me, and I went into summer break really with that on my mind, and I came here, and she cared about everyone. She greeted everyone. She really cared about everything, and she wanted the best for everyone. (Fifth Grade Student)

It makes me feel really good because I know that someone really cares about if I go somewhere. She really cares about where I go in life, and she will do anything to help me get to that next level. And she really – it's not just about keeping her job, she, like she visits everyone during their sixth grade year, because she wants to see how much we grow. She really loves us. (Fifth Grade Student)

A fourth grade teacher described below how having a strong relationship with the students is essential for the practices to be effective:

They're able to regulate and our relationships with them are so strong that they trust you enough to like really tell you....I know that this isn't about what is happening in our classroom or what's going on, and I think that shocks them. I know you didn't kick that chair because you're mad about what's going on. (Fourth Grade Teacher)

All three teachers emphasized how they openly displayed the bond they had with the students. Below is a message that the fifth grade teacher had on the screen to assist the students with transitioning to the next learning activity (Figure 14). Data from interviews, observations, and classroom artifacts captured how the fifth grade teacher frequently communicated to the students that she loved them both orally and in writing.

Figure 14. A sample of the communication style a teacher used to guide students through a transition



Teaching and Learning

A climate variable that emerged from the findings was *Teaching and Learning*. Applying educational neuroscience practices entailed weaving content about students' neuroanatomy and how it relates to self-regulation into the curriculum. All three teachers

appropriated space in the class curriculum for teaching about neuroanatomy, emotional expression, and self-regulation.

All of the teachers indicated that they invest time at the beginning of the academic year to teach educational neuroscience strategies. One of the fourth grade teachers imparted how they “take the time to teach the brain at the beginning of the year, since it’s really not one of our standards.” Teachers reported that investing time at the beginning of the academic year helps to anchor the practices.

That six weeks is there to set up procedures, and if we’re setting up procedures at the beginning of the year, occasionally we have to re-teach, but if I had just left it there and explained it one time, it wouldn’t go as well. (Fourth Grade Teacher)

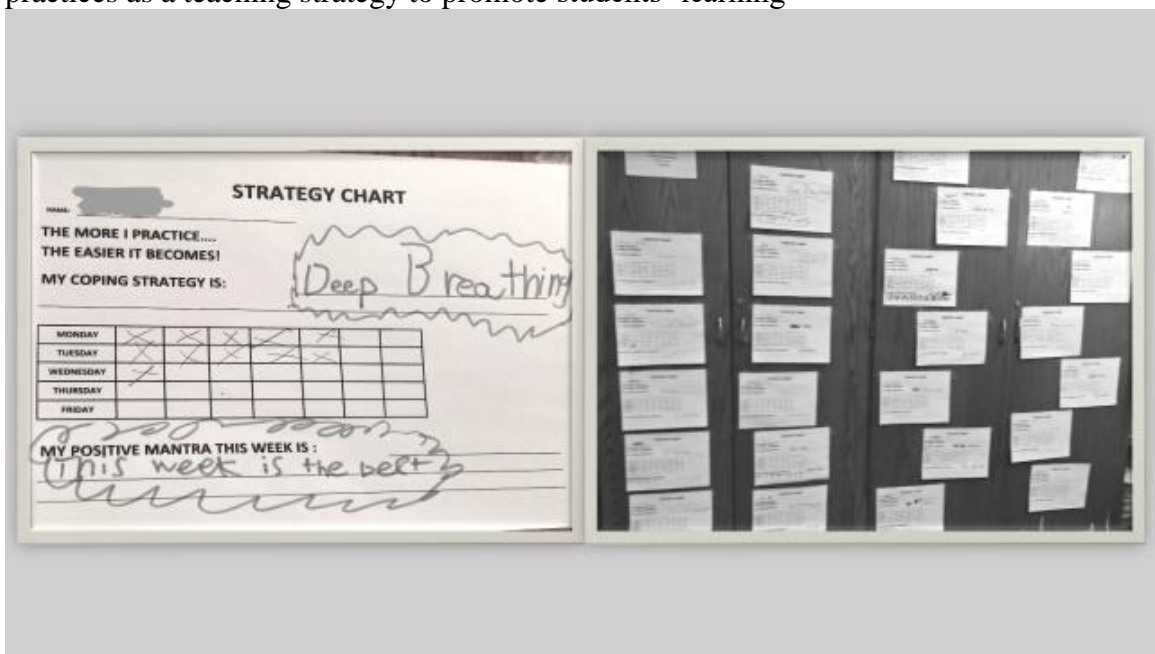
Still having the rigor and the high expectations, but, you know, at the beginning of the year, front-loading with the neuroscience, teaching them about their brains and what’s happening and the science behind it so that they know that throughout the year. (Fifth Grade Teacher)

Students reported through their interviews how they saw their classrooms as learning spaces that were unique from other classes. A fifth grade student’s response typified this finding: “Well, it’s a neuroscience class, and so of course, it’s not like an ordinary fifth grade class- I mean, you do like neuroscience, like you study neuroscience, you do practices.” A fourth grade student shared, “I just feel like it’s a different perspective, because last year we didn’t do this stuff, and this year we’re doing this stuff, which I think is so inspiring!”

Data from participant interviews, observations, and classroom artifacts demonstrated how teachers sought to actively teach self-regulation strategies as part of what they conceived to be educational neuroscience practices. As one school administrator stated, “We are teaching coping strategies....it is truly to regulate and get

back on track.” Additionally, the classrooms displayed tools for teaching about self-regulation strategies and emotional expression. One classroom had strategy charts where each student documented how they used a specific self-regulation strategy throughout the week. Figure 15 is a picture of one student’s strategy chart aside a picture that showed how the strategy charts were displayed to help students monitor their use of a chosen strategy.

Figure 15. A visual display of how a teacher incorporated educational neuroscience practices as a teaching strategy to promote students’ learning



Structure of the Learning Environment

A climate variable that was present throughout the data was the *Structure of the Learning Environment*. As part of the application of educational neuroscience practices, school administrators and teachers allowed for flexibility and adaptation to meet student’s unique regulatory needs. They also stressed the importance of students’ choices in deciding what strategy worked best for them. Relating to the practice themes outlined

in *Finding Three: Infusing Educational Neuroscience Practices*, participants described the unique structure of the learning environment in the following ways:

So I think even walking into other fifth grade classrooms in our building, this year the space looks different. So the lighting-I have all the lights on now, but the lighting throughout the day looks different. We have exercise bikes; we have a lot of space, so I do flexible seating so that we have space to work on the floor, or we have some different options so that we're comfortable. I give the students a lot of choice on where they wanna sit or how they complete activities or who they work with. (Fifth Grade Teacher)

I feel like with the – like the way that the classroom is set up, I think that it helps with other people's needs and (pause) it's able to get them re-focused and them paying attention so then they don't distract the other students. (Fifth Grade Student)

What's different about it is that Ms. X – we have the opportunity to free roam when we like, and at my other school, like we had to sit at desks, like rows of people that you don't want to sit by and like the only times you really get to talk to your friends are at recess or at specials. It was like really strict.... (Fifth Grade Student)

Visual examples of the learning environment are included in the two pictures below (See Figures 16 and 17). All three classrooms included an area where students could gather and sit on the floor. The classrooms also included flexibility and choice with seating throughout the instructional time, as illustrated below with the flexible seating options.

Figure 16. A picture showing part of the room where students could freely go to be comfortable and work. It was also where students participated in class-wide mindfulness exercises. The picture includes the daily message that the teacher and students posted to provide encouragement to each other



Figure 17. A picture of the flexible seating options available to students in one of the classrooms



Summary of Co-Creating the Classroom Climate Themes

This section outlined four climate variables that were present in the findings, including *Safety, Relationships, Teaching and Learning, and Structure of the Learning Environment*. The student and classroom interactions associated with the educational neuroscience practices were reflected in the four climate themes that emerged throughout the data. The final categorical finding, *Building Students' Resiliency*, will address students' responses to applied educational neuroscience practices in the classroom setting.

Finding Five: Building Students' Resiliency

Participants reported the five co-created student and relational outcomes that they perceived precipitated from the ways educational neuroscience practices influenced the classroom: (1) Reduced Office Referrals; (2) Readiness to Learn; (3) Empowered Decision-Making; (4) Empathy, and (5) Social Connectedness.

The convergence of these relational themes point to the presence of students' resiliency that the co-created, relational climate generated. The resulting interactions that emerged - including (1) *Reduced Office Referrals*, (2) *Readiness to Learn*, (3) *Empowered Decision-Making*, (4) *Empathy* and (5) *Social Connectedness* – suggest that protective factors were present to facilitate the change in social and behavioral outcomes. Protective factors are individual or environmental features that lessen the impact of stressful life events and align with the term “resilience” (Fraser, Kirby, & Smokowski, 2004). Resilience is generally referred to as a process where individuals positively adapt to life events, especially those that pose exceptional stress (Luther, 2003). Further aligning with the resulting resilience were participants' perspectives about the enduring

impact the engagement with the co-created climate had on their lives, as articulated in the follow participants' responses:

What she teaches us, it will help us later on in life is what we don't realize, but later on in life, we're gonna look back at that and think, 'wow, I thank her so much for all years that she helped me!' (Fifth Grade Student)

Every single one of them knew a lot about the brain, how it works, how it develops and even the students who struggle academically with content knew a lot about their brain and how they develop and how their emotions are going to be changing and how their brain's gonna be changing. I think that at a fifth grade age, getting ready to enter middle school, how much more important that is than knowing certain random fifth grade standards that our state deems is what they need to know. So yeah, she did a great job of transforming them into young, going to be young adults, that are getting ready to enter the next stage of their life and knowing how to effectively navigate the world. (School Administrator)

It helped me out because I had some really, really bad issues in X's class, and now that I'm in X's class, it just makes me feel like (pause) one of the best students I've ever been in my life. (Fifth Grade Student)

From the participant responses and observations, the following five themes emerged to frame resiliency outcomes in students associated with interactions that occurred through the application of educational neuroscience practices.

Reduced Office Referrals

The participants reported that applying educational neuroscience practices in the classroom resulted in a reduction of office referrals. According to the participants' perceptions, the practices provided teachers additional skills and strategies to support students' regulatory needs, reducing disruptive behaviors in the classroom. Responses also pointed to the centrality of the teacher-student relationship and how the strength of the relationship, a climate variable previously noted in *Finding Four: Co-Creating the Classroom Climate*, influenced the discipline processes. Outlined below are the shifts

participants described in discipline approaches and results at their respective school settings:

I see teachers that are able to process things with students in the moment in the classroom rather than them just coming to the office automatically, which is a huge benefit because a lot of times the issue, the behavioral issues, arise when a teacher and a student are not on the same page or there's not a relationship built or trust enough and so then that student has to then come to the office because that behavior persists and is not resolved. (School Administrator)

And I try as much as possible to keep them in the classroom – even like X's room to me feels like a very last resort because if I'm 'kicking them out of the classroom' or if like they're not welcome here, like that sends a big message and they're missing out on instructions. I think the more you can show them like through the behaviors you still care about them and you still love them, I think that's important, so I think the shift is keeping them in the classroom. (Fourth Grade Teacher)

I've definitely seen more self-regulation from my kids. Again, the little guy I use the validating things with – since I had him last year like when he got upset, it would ruin the whole day. I mean no matter what, his whole day was shot, and he typically ended up with our assistant principal for the rest of the day, because he was just so escalated, he couldn't cool off. And now with doing the laps thing, he's able to be back in like five minutes, so it's five minutes of instructional time lost versus like a whole day. (Fourth Grade Teacher)

I think really empowered teachers too-they feel like they have a lot of strategies, a lot of tools to work through hard issues. I think when we think about discipline and office referrals just like in the general setting in school, I notice a pattern of, it's a lot of times a lack of confidence with the teacher, you know. It's something that doesn't necessarily have to go to an administrator, but if the teacher is not quite sure how to de-escalate or what the appropriate response to the behavior could be, then out of that lack of confidence, they call in more support....Then, we start sending kids out and not necessarily getting to the root of the behavior. (School Administrator)

One of the school administrators described how office referrals diminished throughout the year in classrooms where teachers ascribed to educational neuroscience principles, stating:

From the beginning of the year to the end of the year, it was a significant decrease. There were certain students that were getting office referrals really frequently, that by the end of the year I was never having a conversation with....As opposed to a classroom that's not using those [educational neuroscience practices], you know, I'm gonna see a lot more students that have escalated and the teacher's not sure how to manage that and de-escalate it as well.

A fourth grade teacher shared a similar perspective relating to her class, stating "I mean, it's a different class, but I still have some of the same kids that were super heavy hitters in the past years, and they haven't had any office referrals."

Classroom observations revealed one student who was consistently active during instructional time. The fifth grade teacher shared the following regarding how he has responded to being in a classroom that applies educational neuroscience practices:

So he definitely was expelled from another district. He's been very successful here. He's had no suspensions this year. He is a student when we did our survey of what works for us, movement works for him, and he likes to take laps and so he has a signal where he can take a lap or he just comes and says "lap" and I nod my head....He can lay on the floor; he rests on the floor with a yoga mat because that's where he's most comfortable....and it's ok with me because he is more successful when you allow him to move and have that space.

Participants described how educational neuroscience practices created student and teacher engagement that yielded a reduction in office referrals for behavior challenges. From their collective perspectives, educational neuroscience practices were providing strategies for de-escalation and self-regulation that prevented disruptive behaviors.

Readiness to Learn

Participants shared how applying educational neuroscience practices resulted in interpersonal responses that promoted student engagement in the learning process. Multiple students from all three classrooms reported feeling calmer and more focused upon engaging with the practices. Data from classroom observations reinforced

perceptions of calmness and focus that were sustained as students transitioned through learning activities. The school administrators and teachers noted that the practices and resulting classroom interactions produced an instructional environment conducive to learning and students' behaviors were regulated in ways that kept them more anchored in instruction. Participants believed that these environmental and relational shifts translated into opportunities for academic growth. Participant responses exemplified how they perceived shifts in attitudes that would lead to student engagement and, ultimately, academic growth.

The way we are in class together, during math time, this student who is new in the last two weeks, he's learning how to be in Room 18, and in Room 18, like everyone's engaged during math. That's what we do; it's not an option. And he's learning that, and he's seeing that, and there are examples of that. They all participate. They have their materials ready, because it's just what we do. It's the expectation that we will all be successful, and we're all prepared, and we all care about this. But just the way we're in the classroom looks so different. (Fifth Grade Teacher)

If they're in the classroom more, they're obviously going to improve academically, so especially that little guy now, his emotions are in check. He's able to learn. (Fourth Grade Teacher)

The fifth grade teacher shared how one student was transferred late in the academic year to her class due to challenges in another classroom. The teacher reported that the student demonstrated a shift in his attitude toward attending school.

But his mom, just in the two weeks I've spoken with her four times, and every time it's just like, 'I can't believe the quick turnaround,' and it's not perfect and it's not there yet, but she's like, 'he's excited to come to school every day. He has his backpack. He's never had his backpack with him.'

The fifth grade teacher also described how academic growth has occurred among students who have struggled to engage in the classroom in previous years.

They do grow. It's not huge growth, but in my experience with these kids, a lot of these kids, this is their first year really doing school or being present in the classroom, so that's a success....so in all ways, I could say academics are greatly affected and I see huge benefits from the educational neuroscience implementation.

The fifth grade teacher emphasized the following:

Everyone made growth. My high readers made high growth. Some of my low readers made low growth, but everyone made growth....my kids grow, and I also observe them growing in sooo many more ways than just academics, but they absolutely grow.

Participant perceptions unveiled how students responded to educational neuroscience practices with a *Readiness to Learn*. Data supported how students reacted to the practices with increased focus and engagement within the learning environment, generating positive academic outcomes.

Empowered Decision-Making

Participants stated that the regulation that resulted from their engagement with the educational neuroscience practices increased students' sense of efficacy with making choices and being successful. Participants reported that they experienced an increase in confidence in their ability to make positive decisions, especially as they considered the future. Their responses revealed that they had hope for the future. One fifth grade student declared, "I always thought that I wasn't gonna be successful in my life, but now I just realize that I'm gonna be successful for once in my life." Another 5th grade student shared this positive outlook, stating "My behavior is really improving, and I really think that next year will be a piece of cake for me." (5th Grade Student). A fourth grade teacher highlighted "I think it's empowering to have them have the ability to say like I'm mad, I need to go cool off." Throughout the data, participants reinforced students' enhanced

sense of regulated decision-making that increased their sense of agency. The following quotes illustrate this theme in the data:

Well, now that I have all of this knowledge about the brain, I can really think about my actions in sixth grade, because I'm not really the type to go off on a teacher or anything, but it's still a possibility, because there are really – because my brother's in sixth grade, and he's told me about a lot of things in sixth grade and just hearing about it kinda scares me, that seeing as though that people are being talked about, fights break out about each and every time and I could just take a deep breath each time someone does something mean or wrong to me, and I can like calm myself during sixth grade. (Fifth Grade Student)

Learning about the brain, you know if somebody accidentally knocks past you in the hall, you can think, oh this is such a big school, they said sorry. It's fine-instead of taking that so offensively. (Fifth Grade Student)

So I find it to be very empowering to them....I see it pay off in a lot of ways, like they take action in so many ways throughout the year. They're doing a clothes drive right now; they're doing exhibition, and they're volunteering at several different places and raising money and writing grants, and they feel empowered to make a difference in their building, in X Township, so just empowerment. (Fifth Grade Teacher)

The fifth grade teacher also described how students had grown, noting one particular student who had spent significant time out of the classroom for behavior disruptions. By the end of the academic year having engaged with the educational neuroscience practices, the teacher described the student as “such a success story for this year.” The teacher went on to describe the student's progress in the following way:

She has **changed (emphasized)** her neuroanatomy; she is a different person; she's making different choices, and it's hard and she has really hard days, and she's easily triggered and aggravated, and she has a lot of things at home that she's struggling with. But, she has grown so much, **profoundly (emphasized)** this year.

The fifth grade teacher provided a follow-up story for this student to convey how this student is using what she has learned and incorporating it into a project to help others feel

calm and regulated. The teacher shared the following ways this student is now using what she has learned to inform other students:

She's got a presentation on how to take deep breaths. She's gonna teach kids what that looks like. So, she has changed the way she co-regulates, but now she's encouraged and empowered to help other students at X School do that.

The fifth grade teacher also shared how being with students feeling empowered affected her morale. She claimed, "I love working and I love coming here, and it's a great space to be with 30 kids who are feeling empowered and who are making change, and who are working really hard." The data revealed how applying educational neuroscience practices shaped students' sense of self-efficacy, creating among them positive approaches to engaging with themselves and others.

Empathy

A finding that emerged from the participant responses was the occurrence of empathy. Teachers and students gained insight into how each person has a unique neurobiological structure and different responses to stressors, precipitating a shift in how behaviors were interpreted. Teachers and students reported being more attuned with how stress can interfere with students' decision-making. The following participant responses provide insight into this finding:

We have a morning meeting structure in a circle, and we just talked about our brains and how everybody's different, and just because someone's making a difficult choice doesn't mean that they're a bad person, and what are some ways that we can support that person and support our teacher....
(School Administrator)

It's taught them a lot of empathy....You can understand Ok, this person did this not because they don't like me or not because they hate me. Those are things they were thinking before. They didn't mean to hurt me. Their amygdala was just in control instead of their pre-frontal cortex, and

that's how they word it with each other sometimes. (Fourth Grade Teacher)

Through the connections and relationships that students built with each other through the interactions, students demonstrated they cared for each other. Classroom artifacts included students writing encouraging messages to each other, particularly after taking an intensive standardized test. One fourth grade student described how the classroom was special “because like everybody listens to everybody else and they, (pause) and they're always nice to each other.” Aligned with this fourth grade student, participants indicated how interactions corresponding with educational neuroscience practices shifted how students engaged and ways they interpreted the causes of behaviors.

Social Connectedness

Participants described how applying educational neuroscience practices engendered a sense of belonging with the teacher and other students in the classroom. Data indicated that throughout the year, the sense of social connectedness grew among classroom members.

Some kids were actually pretty troubled....Now they have really (pause) like every time Ms X gives us a talk about something that we're not supposed to do, they fix up their act, and it makes me feel like (pause) it makes people feel like they belong in the classroom. (Fifth Grade Student)

Participants described the sense of belonging as being unique from other classroom settings. They also indicated that the classroom interactions challenged their assumptions about their expectations regarding social connections. They describe their interactions and the effects of these engagement approaches in the following ways:

The way we talk to each other feels different than other classrooms. We take pride in our things, because we care about each other and we talk about caring about our space. So when I say it feels different, when you

walk in, it's quieter. Students look engaged; students are working together or talking nicely to each other, and that's not something that if you were to walk even in classrooms in this same grade level and this same building, it would look different. (Fifth Grade Teacher)

Yeah, when I first came from Ms. X's class, I thought I was gonna be getting in trouble. That didn't happen...As soon as I got to Ms X's class, everything changed, and it made my life better. I have a lot of new friends. (Fifth Grade Student)

The students shared how they had become more connected throughout the year and talked about missing each other and the teacher as they considered transitions to new classes. The sense of a connected community was further supported by fifth grade students who shared, "We're a great class," and "We're all a neuroscience family...."

Classroom observations and artifacts reinforced the findings of this sub-category of social connectedness. Observational data included students collaborating on projects and fostering inclusion for students with differences. Particularly in the fifth grade classroom, students wrote notes of encouragement to each other on the daily announcement boards. The room number had become a symbolic representation of their sense of belonging. The room number was displayed throughout the room, outside of the room and even on miscellaneous items, such as an apron that hung on an easel. The teacher and administrators collectively addressed classroom members by this symbol of belonging. Below is the banner that hung above the entrance to the classroom (See Figure 18).

Figure 18. A picture of a sign outside the classroom that featured a symbol of the classroom unity



Five Categories of Findings: A Summary

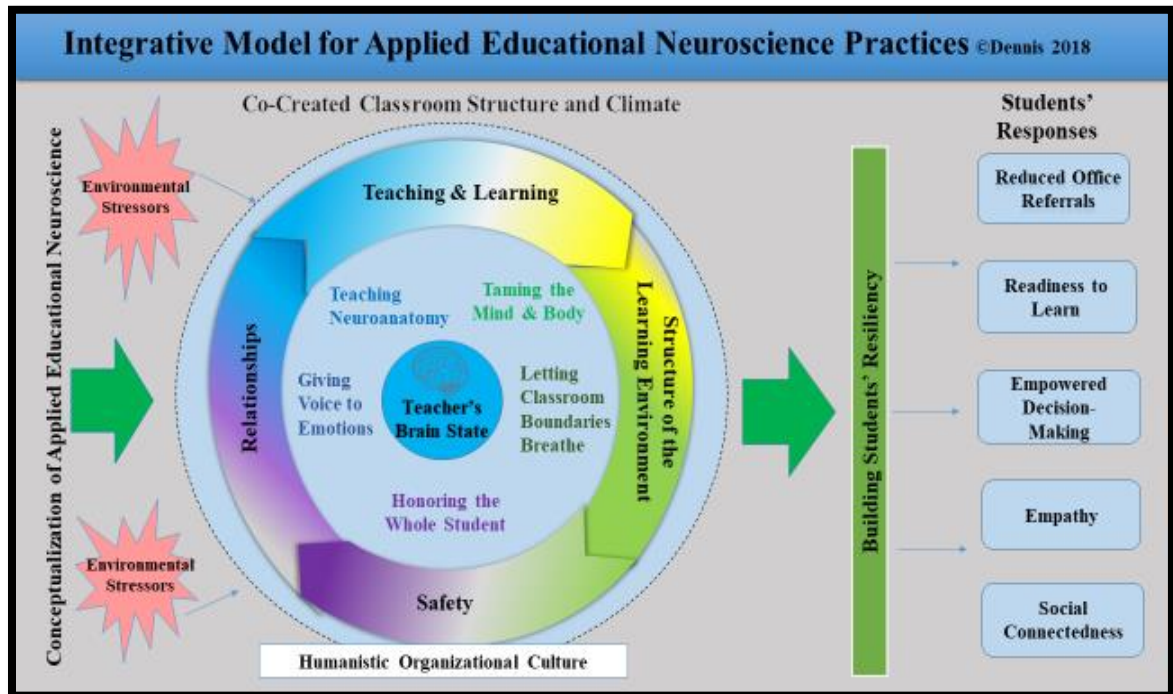
This section has documented findings on the participants' conceptualization of applied educational neuroscience and also the psychosocial ways students responded to the implementation of educational neuroscience practices in the elementary classroom setting. Through engagement with the co-created climate, students displayed characteristics of protective factors, indicating the presence of resilience. These five categories of findings coalesced to yield a conceptual model, which is presented in the final section of this chapter.

Conceptual Model for Applied Educational Neuroscience Practices

The fusion of the five categories outlined throughout this chapter yield a processual model that illustrates how educational neuroscience practices were applied and integrated into the classroom setting and the psychosocial interactions that emerged as a result of the intrapersonal and interpersonal engagement facilitated through these

practices. Figure 19 is conceptual model elucidating how applied educational practices are conceptualized and subsequently occur in the classroom setting.

Figure 19. Conceptual Model for Applied Educational Neuroscience Practices in Three Elementary Classrooms



The visual display of the conceptual model shows how educational neuroscience practices unfold in the classroom to facilitate the co-creation of a positive classroom climate. Participants reported the occurrence of stressors that students brought with them to the classroom experience. Next, the data uncovered administrative characteristics indicative of a humanistic organizational structure that facilitated the educational neuroscience practice implementation and how the teacher's regulatory state was central to the application process. Five themes emerged that characterized educational neuroscience practices: (1) Teaching Neuroanatomy; (2) Taming the Mind and Body; (3) Letting Classroom Boundaries Breathe; (4) Honoring the Whole Student; and (5) Giving Voice to Emotions. Interactions resulting from these practices aligned with four climate

variables: teaching and learning, structure of the learning environment, safety, and relationships. The resulting classroom climate contributed to students' resiliency, as observed by reduced office referrals, readiness to learn, empowered decision-making, greater empathy, and enhanced social bonding. The next chapter will provide a more in-depth discussion and layered analysis of the five categories delineated in the conceptual model.

Chapter Summary

This chapter presented five categories of findings revealed by this study. Findings were organized according to the research questions. Data from individual interviews, classroom observations, and classroom artifacts unveiled research participants' perceptions surrounding the conceptualization and application of educational neuroscience practices in the elementary classroom setting. As is typical of grounded theory research, extensive samples of quotations from participants were included in the presentation of the findings. By incorporating participants' voices and visual depictions of classroom artifacts, the doctoral student intended to accurately represent the reality of the persons and social phenomena studied. Chapter 5 will provide an analysis of these findings that situates them with relevant scholarship. The resulting discussion will culminate with recommendations for further research.

Chapter 5: Analysis, Synthesis of Findings, and Conclusions

The purpose of this grounded theory study was to explore how applied educational neuroscience principles were translated into practices and the ways these practices affected psychosocial processes in the classroom setting. It was expected that understanding perceptions of classroom participants' experiences with applied educational neuroscience practices would inform attempts to create a shared conceptualization of the processes involved with translating neuroscience into educational settings. This culminating chapter explains the analysis and synthesizes the findings, leading to conclusions and recommendations for future research relevant to building transdisciplinary theoretical and practice pathways for educational neuroscience.

Constructivist grounded theory methods were used to gather qualitative data by conducting semi-structured, in-depth interviews and collecting supportive data through classroom observations and artifacts. Participants in the study included three teachers, two school administrators, and 48 students from three different fourth and fifth grade general education classrooms at two different school systems in a US Midwest city. The data were coded, analyzed, and organized first by the research questions and then by categories and subcategories instructed by the conceptual framework, as depicted in Chapter 2. The dissertation study was based on the following four research questions:

- (1) How do teachers, school administrators, and students describe educational neuroscience?
- (2) What practices do teachers use in the classroom to apply educational neuroscience principles?
- (3) How do students respond to their practices? and

(4) What classroom interactions are associated with these practices?

Analytic categories are directly aligned with each of this study's research questions. In the analysis, the doctoral student searched for connecting patterns within the analytic categories, as well as linkages or themes that emerged among the various categories. A second layer of the analysis compares and contrasts these themes with relevant theory and research occurring throughout the literature.

Chapter 4 presented the study's findings by threading the data from the various sources into categories to generate a narrative account of the phenomenon. The purpose of this chapter is to provide interpretive insights into these findings by constructing a more holistic picture from the layered synthesis. The discussion takes into consideration the scholarship emanating from the following areas of inquiry: (1) educational neuroscience; (2) attachment and ecological theories; (3) social and affective neuroscience; (4) self- and emotional regulation; (5) school climate; and (5) resilience. The implications of these findings contribute to the ongoing efforts to crystallize a shared conceptualization of applied educational neuroscience practices and how they occur in the classroom setting.

Analytic Category 1: Conceptualizing Applied Educational Neuroscience

The first research question sought to examine how participants conceptualized applied educational neuroscience. Participants described educational neuroscience as being a science-driven shift in classroom processes that fostered a holistic alignment with the teacher and students' unique social and biological needs to promote learning and connected relationships. Participants perceived this approach as an explanatory vehicle

for the shift, which corresponded with what was inherently natural to student development.

The participants' perspectives reinforce the literature. Scholars call for the creation of pathways to translate the expanding scientific knowledge on neurobiological development into educational practice as a way to evolve outmoded systems (Center on the Developing Child at Harvard University, 2016). A dissonance persists between the ways education systems function and the robust scientific knowledge on the non-linearity of child development and students' learning processes (Stafford-Brizard et al., 2017). Currently, education systems are designed to facilitate academic development but oftentimes lack the necessary resources and structures to adequately support the other interrelated cognitive, social-emotional, and physical developmental domains involved with the learning process (Durlak et al., 2011). According to the literature, educational neuroscience provides a paradigmatic vehicle for integrating scientific knowledge, providing a more complete and rigorous scope of students' developmental domains that support learning processes (Canter et al., 2018; Osher et al., 2018).

A predominant focus in the educational neuroscience literature is the possibilities of and challenges with creating a transdisciplinary model that synthesizes neuroscience with education practice and theory (Blakemore & Bunge, 2012; Butterworth & Tolmie, 2014; Fischer, 2009; Goswami, 2006; Knox, 2016; Sousa, 2010; Sousa & Tomlinson, 2011; Tommerdahl, 2010; Willis, 2008). The literature documents the need for an expansion of educational theory that synthesizes the social and affective neurosciences (Cozolino, 2013; Immordino-Yang, 2011; Immordino-Yang & Fischer, 2016); holistic processes of learning; the impact of adversity; and critical meta-cognitive skills; e.g.,

self-regulation (Cantor et al., 2018). Yet, how this integration occurs in a way that transforms complex education systems amid the backdrop of an accountability-based political landscape remains a perplexing proposition.

Social Connection and Relationships

Participants emphasized the centrality of connected relationships as part of the pivot toward educational neuroscience principles. This perspective corresponds with scientific knowledge grounded in interpersonal neurobiology, a field that fuses biological and social sciences, and modern attachment theory (Siegel, 2012). Interpersonal neurobiology provides insight into how the developing child relies on collaborative communication and relationships for the regulatory functions that are critical to attention, cognition, and memory (Cozolino, 2013; Siegel, 2012). It also draws from the deepening human development knowledge that spotlights the manner in which the brain develops through reciprocal exchanges between the individuals and their culturally-situated contexts, with relationships driving the developmental processes (Osher et al., 2018).

Patterns of development are enduringly responsive to relationships. Relational connections characterized by nurturance, attunement, trustworthiness, cognitive engagement, and scaffolding facilitate attachments that progressively inspire more expansive development (Center on the Developing Child, 2016; Fischer & Bidell, 2006; Osher et al., 2018). For a school context, relationships that are essential for student development are interwoven within the classroom setting (Osher et al. 2018).

Summarizing a compendium of research on attachment and epigenetic expression, Cozolino (2013) avers, "...all this suggests that the developing brain is woven into a

matrix of interpersonal and environmental experiences that determine how the brain is built....” (p. 49).

Addressing Stress and Trauma

Participants shared how the educational neuroscience approach illuminated ways to support students who experience stressors and trauma. Espousing educational neuroscience principles provided a lens for interpreting behavior based upon causes rooted in pain and dysregulation versus the predominant focus of behaviorism, which assumes a system of mandated and managed behaviors (Siegel & Payne-Bryson, 2014). Students present with varying physical, cognitive, and social-emotional needs that must be addressed to ensure their ability to learn successfully (Cole et al., 2005; Blair & Raver, 2012; Osher et al., 2018). A trauma-responsive approach includes attention to the neurobiological effects of chronic stress that affect brain architecture and diminish neural connections involved in the learning process (Blair & Raver, 2016; Center on the Developing Child, 2016; Osher et al., 2018).

Chronic stress through the release of stress hormones, such as cortisol, impacts the learning centers of the brain including, the amygdala, hippocampus, and prefrontal cortex, undermining the development of self-regulation and executive functioning skills that are predictive of academic success (Blair & Raver, 2016). The hippocampus, a highly plastic structure in the brain that plays a crucial role in learning and memory, is especially susceptible to stress hormones that are activated through exchanges with environmental conditions (Hasselvoort, Khan, Hillman, & Cohen, 2016; McEwen, 1999; Wenger & Lövdén, 2016). Chronic stress in childhood can produce neural changes in the hippocampus that can exacerbate risk factors for mental health and learning impairments

that have lifespan implications (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008; Lupien, McEwen, Gunnar, & Heim, 2009).

Most often, teachers are not prepared with knowledge pertaining to how stress impedes development and learning nor are they equipped with strategies to address these needs in students (Stafford-Brizard, 2017). Moreover, a unified vision for incorporating knowledge on stress and trauma into educational neuroscience is in a formative state. Looking forward, scholars underscore the necessity to develop strategies for social-emotional scaffolding and opportunities for developing buffering relationships for co-regulation to address triggers and dysregulation (Center on the Developing Child, 2016; Cozolino, 2013). The next section discusses how applying these conceptualizations of educational neuroscience inspired new systems of co-created meaning.

Symbolic Interactionism

The data conveyed how participants intersubjectively defined and experienced educational neuroscience practices in the classroom setting. Rooted in symbolic interactionism (Blumer, 1969; Mead, 1967), grounded theory is based upon the assumptions that social life consists of dynamic processes among people influenced by sociocultural context through which people generate interpretive meanings. For this study, symbolic interactionism is relevant for interpreting how the classroom members were socialized and, subsequently, created a shared system of language, meaning, and negotiated roles for this emerging practice pathway.

Using grounded theory methods provided in-depth access into the psychosocial processes of classroom members. The exposure to the narrative data revealed how language and symbols in the classroom context emerged in the educational neuroscience

application process, forging systems of shared meaning that catalyzed interpersonal shifts in the ways of being in the classroom. Teachers and administrators articulated how they perceived educational neuroscience to be a mechanism for giving language to what seemed natural and intuitive but lacked a shared network of expression. The data analysis suggests that these practices are a potential vehicle for transmuting educational neuroscience knowledge into a new system of intersubjective meaning for the classroom climate and culture.

Analytic Category 2: Humanizing the Supportive Structures

The second finding revealed how the school's organizational culture was central to the teacher's ability to effectively incorporate educational neuroscience practices into the classroom setting. The findings highlighted key features, including flexible administrative structures, holistic perspectives, differentiated support, and autonomous decision-making. While this research did not set out to examine organizational culture, salient themes linking organizational culture to the educational neuroscience conceptualization and practice implementation were evident throughout the data.

This study sought to examine how the application of educational neuroscience practices affects classroom climate. Reviewing the climate literature, the studies illuminate the import of organizational culture in determining how relationships occur within the school setting. Researchers examining climate identify the institutional environment as a key climate variable (Thapa, et al, 2013). School climate depicts the quality of school life, which encompasses the organizational patterns that shape norms, values, and ways of being within a school community (Cohen et al., 2009). Hopson and Lawson (2011) stress that "climate is a sociopsychological feature of organizational life

in each school and district” (p. 107). Consequently, a focus on classroom climate is inextricably associated with organizational features shaping classroom functioning and the relationships that comprise the classroom. Attending to the organizational system and its interconnected influence also aligns with the ecological theoretical orientation (Bronfenbrenner, 1977; 1979) that informed the study.

Humanistic Organizational Structure: A Paradigmatic Shift

The findings indicated that the organizational structure operated from a holistic paradigm that honored the unique potential of each individual student and teacher. Boundaries were adaptive, allowed for individual expression, and accommodated relational needs of classroom members. These findings suggest that the school administrators and teachers who espoused educational neuroscience principles departed from the dominant functionalist paradigm for schools and embraced a more humanistic philosophical perspective.

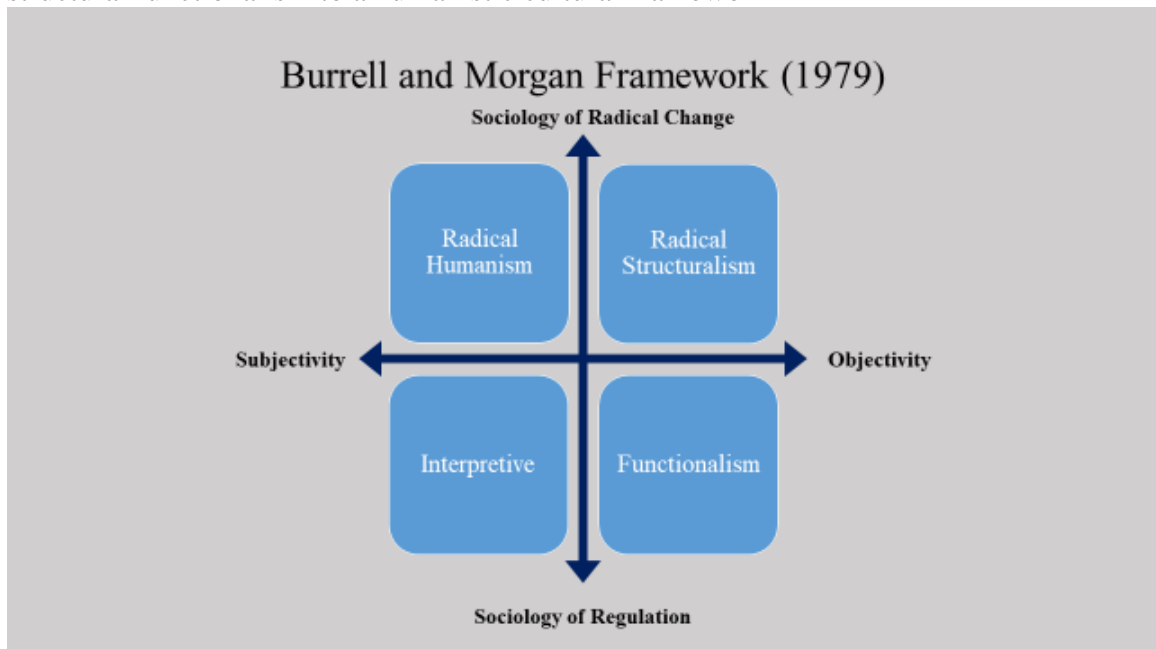
The Burrell and Morgan Framework (1979) is a classic framework applied to organizational studies (Buchanan & Bryman, 2009) and provides a useful tool for illuminating the organizational shift in culture that the findings unveiled. To analyze social phenomena in organizations, Burrell and Morgan conceptualized a four-cell matrix that defines fundamentally different perspectives along a continuum (O’Connor, Netting, & Fabelo, 2009). The intersection of a subjectivist - objectivist continuum and a sociology of regulation - radical change continuum form the boundaries for the four paradigmatic cells – (1) functionalism, (2) radical structuralism, (3) radical humanism, and (4) interpretive. Each paradigm reflects an ontological perspective of the social world with corresponding meta-theoretical assumptions.

Figure 20 illustrates an integrated display of the Burrell Morgan Framework. The framework provides a comparative paradigmatic lens for ascertaining underlying assumptions and values that shape knowledge for supporting behavior and, ultimately, how the climate occurs within a school setting. The prevailing paradigm guiding US school organizations is a functionalist perspective that ascribes to the scientific management approach to school organizational structures and curriculum (Au, 2011; Cozolino, 2013). Functionalism in school organizations assumes that there is an orderly and systematic way of school administration, and institutional behavior is characterized by formalized patterns of rules, policies, and procedures that seek to maintain social order. The curriculum is highly standardized and behavior is managed through control and systematically enforced regulations (Au, 2011). A functionalist paradigmatic view assumes technical-rational approaches to teaching, and learning is driven by external objectives that assume all students and teachers will respond in pre-determined ways to produce the desired outcomes (Cozolino, 2013).

Conversely, a radical humanist paradigm seeks to advance individual human potential and advances the belief that reality is pluralistic and subjectively defined. Applied to a school organizational culture, this paradigm assumes that the classroom reality is co-created based upon the dynamic exchanges of socio-cultural beliefs, norms, and values that continually evolve to shape ways of being in the classroom. The findings reflected the participants' humanistic paradigm, as they conceived of and applied the practices in ways that supported students' and teachers' differentiated emotional, behavioral, and cognitive needs. Teachers were allowed autonomy to interpret the needs of their students, which oftentimes entailed departure from standardized approaches that

typically characterize classroom functioning. Administrators expressed their support of teachers exercising authority in an effort to differentiate supports and to help students achieve their unique potential. Throughout the literature, there is a focus on individual variation in learning, behavior, and development (Canter et al., 2018; Fischer & Bidell, 2006; Rose, Rouhani, & Fischer, 2013), and a growing call for a shift in guiding paradigms to support the knowledge expansion of neurobiological development. Supporting this perspective, Stafford-Brizard et al. (2017) call for innovation within educational practices arguing, “The predominant model of American education directly conflicts with our growing understanding of the dynamic development of a child” (p. 155). The next section spotlights the teaching system as a supportive classroom structure.

Figure 20. The Burrell and Morgan Framework to illuminate the cultural shift from structural functionalism to a humanistic cultural framework



Source: Adapted from *Sociological Paradigms and Organisational Analysis*, by G. Burnell and G. Morgan, 1979, p. 22.

The Teacher's Brain State

Findings portrayed how the teacher's presence in the classroom was like the nucleus of a cell, whose symbiotic connection with the students generated the tenor and overall health of the classroom context. The teacher's state of mind was a key determinant for the flow and mood of the classroom. These findings support what Rodriguez (2012) terms as *the teaching brain*, which represents the myriad social, emotional, cognitive, and physiological processes activated during the teaching engagement.

Historically, research has focused on learning through the student's lens rather than evaluating teaching and learning as a social, biologic, and cognitive interaction between learner and teacher (Battro, 2010). Scholarship on the teaching and learning enterprise has primarily examined how teachers adapt planning and interventions to support the learners' needs, neglecting to incorporate the interconnection with the teacher's state of being (Rodriguez, 2012). Moving beyond traditional pedagogical methods entails educators understanding how their own brain functioning shapes thoughts and behaviors in the classroom (Kent, 2013; Walker et al., 2017). Rodriguez (2012) argues that teaching is more than a knowledge and skill set that is transmitted to educate children in a classroom setting; rather, teaching is a dynamic, context-dependent, physiological exchange that supports the synchrony of humans within a specific context.

Synchrony is a term often used in education to describe how the classroom community, through rhythmic patterns of social interactions, moves toward an experience together (Kent, 2013; Rodriguez, 2013). As teachers are living organisms, sensitive to life stressors and contextual stimuli, the ability to achieve synchronization, is dynamic

and rooted in the intricacies of implicit and explicit interactions occurring throughout the classroom ecology (Kent, 2013). The findings from this study support the assertion that the teacher's brain state is central to establishing the synchronization and flow of the classroom.

Analytic Category 3: Infusing Educational Neuroscience Practices

The findings identified five salient themes that characterized educational practices applied in the three classrooms: (1) Teaching Neuroanatomy; (2) Taming the Mind and Body; (3) Giving Voice to Emotions; (4) Letting Classroom Boundaries Breathe; and (5) Honoring the Whole Student. These educational neuroscience practices converged to create in the students core skills to regulate thoughts, actions, and emotional responses in a way that enhanced goal-oriented behavior conducive for learning. Collectively, these core skills are known as executive functions or self-regulation (Blakemore & Bunge, 2012). Zimmerman and Schunk (2011) define self-regulation as it relates to learning as the “processes whereby learners personally activate and sustain cognitions, affects, and behaviors that are systematically oriented toward the attainment of personal goals” (p. 1). Students develop social-emotional competencies in ways similar to academic skills, including instruction, modeling, scaffolding and application (Jones & Bouffard, 2012). The findings from this study depict how the educational neuroscience practices, incorporating a neurobiological perspective, merged with the academic skill development to provide an integrative approach to educating students.

Proponents of infusing neuroscience knowledge into education assert that teachers using educational neuroscience practices are creating experiences that build neural structures in students' brains that support pro-social behaviors (Dubinsky, Roehrig, &

Varma, 2013; Willis, 2009). These behaviors not only facilitate student engagement and learning, they could have effects that are more enduring for students. Research demonstrates that supporting executive functioning and self-regulation skills are robust predictors for positive outcomes both for students' immediate learning processes and throughout their life course (Blair & Raver, 2016; Moffitt et al., 2011; Razza & Blair, 2009). While the literature does not highlight specific educational neuroscience practices, it does point toward increasing teachers' brain literacy as a way to evoke changes in instructional design and interventions (Dubinsky et al., 2013; Walker et al., 2017). The following sections discuss each of the five educational neuroscience practice themes that teachers in this study incorporated into their classroom content and setting.

Teaching Neuroanatomy

The participants shared how a key focus was intentionally teaching students about their neurobiology. Students were given instruction about their neuroanatomy and how emotions interplayed with learning. Using knowledge of their neuroanatomy, students were taught a variety of self-regulation strategies to increase their attention in preparation for learning. Students then had opportunities to apply strategies to find what worked best for their unique needs.

While there is scant research on this pedagogical approach, one study found that teaching students about their brain functioning was related to increased academic functioning. Blackwell, Trzesniewski, and Dweck (2007) investigated middle school classrooms, where a treatment group of students who were taught about brain plasticity and a control group who did not receive the brain plasticity instruction. The group receiving the instructional interventions demonstrated higher scores on standardized math

exams than the control group, suggesting the teaching intervention may have contributed to the middle school students' academic outcomes. Scholars supporting this practice assert that incorporating instruction on neuroanatomy affects the ways students think about their own learning (Dubinsky, Roehrig, & Varma, 2013), giving them an enhanced sense of efficacy in their ability to influence their learning processes (Willis, 2009).

Taming the Mind and Body

The teachers reported experiences with students where challenges with self-regulation in the classroom impeded their learning or caused disruptive behavior. A salient practice theme that emerged from the findings included a repertoire of multi-sensory strategies that the teachers used to facilitate the students' self-regulation, calming them physically, socially, and emotionally. Teachers linked these strategies with students' neuroanatomy and helped them use the strategies to transition to instructional time.

To facilitate a calm classroom environment, one practice approach included mindfulness exercises. Mindfulness practices have existed for thousands of years, and the practices have gained secular attention in the last thirty years (Olson, 2014). A spectrum of definitions exists for mindfulness, including a more academic operationalization proposed by Garland and Fredrickson (2013) who frame mindfulness as, "attentive and nonjudgmental metacognitive monitoring of moment-by-moment cognition, emotion, perception, and sensation without fixation on thoughts of the past or the future" (p. 46). While there are varying expressions of mindfulness, the core features include increasing the capacity to internally focus attention and non-judgmentally

observe thoughts, feelings, and sensations with the intention of releasing them (Olson, 2014).

Currently, the mindfulness research is in its infancy with most existing research focusing on adults; few studies have examined the practices with children and adolescents in school settings (Black, Milam, & Sussman, 2009). Wisner and Jones (2010) conducted a review of the school-based mindfulness interventions and found supportive evidence for improved cognitive functioning in adolescents, increased self-esteem, enhanced emotional and self-regulation, decreased behavioral challenges, and improved school climate. More rigorous research methods are needed to establish the empirical merits of mindfulness and to better understand how it can be most efficaciously applied in school settings, particularly for promoting self-regulation.

Giving Voice to Emotions

A practice theme that emerged in the findings was the focus on attending to and validating emotions throughout the learning process. Teachers were routinely attuned to their own and students' emotional states. The teachers taught students to recognize and reflect on their emotions and emphasized how this intentional engagement with emotions was integral to the learning process. While educators and scholars are in the early stages of re-envisioning educational theory and practices that incorporate emerging neurobiological evidence related to emotions and social processing (Immordino-Yang, 2011), the teachers' perspectives aligned with the burgeoning focus in the literature examining the centrality of emotions in the learning process.

Neuroscience research in the last decade has elucidated the critical role that emotions play in cognition (Immordino-Yang & Damasio, 2007; Immordino-Yang &

Fischer, 2016). Human reasoning is not derived from abstract logic as some might assume; rather, it emerges from somatic and emotional experiences within social and physical spheres of functioning (Immordino-Yang & Damasio, 2007). Regulating emotions is essential for cultivating socioemotional competence (Durlak et al, 2011; Woltering & Shi, 2014), and there has been surge in scholarly interest in this construct (Gross, 2014). Despite the escalation in interest surrounding emotional regulation, a lack of consensus persists regarding its conceptualization and definition. Eisenberg and Spinrad (2016) define emotion-related self-regulation as:

the process of initiating, avoiding, inhibiting, maintaining, or modulating the occurrence, form, intensity, or duration of internal feeling states, and/or the behavioral concomitants of emotion in the service of accomplishing affect-related biological or social adaptation or achieving individual goals. (p. 338)

Evidence suggests that children's regulatory functioning is associated with students' academic achievement. Emotional regulation has been shown to influence students' motivation (Steinmayr & Spinath, 2009), ability to focus on academic tasks (Trentacosta & Izard, 2007), and the rate at which they actively participate in academic instruction (Valiente, Swanson, Lemery-Chalfant, & Berger, 2014).

Kwon, Hanrahan, and Kupzyk (2017) examined elementary students' emotional expressivity and emotional regulation as they related to academic functioning. Their study, which included 417 elementary students and their teachers, showed that emotional regulation was positively associated with academic motivation, engagement, and achievement. For emotional expressivity, happiness was positively associated with academic functioning, whereas anger was found to have an inverse relationship with academic functioning. Their findings align with previous scholarship that suggests

emotions serve a compass that informs individuals how to allocate cognitive energy for attention, memory, and problem-solving (Blair, 2002). For some students, this neurobiological process can become disrupted by exceptional life stressors.

Stress in the learning environment, traumatic memories, or adversity in a student's life outside of the classroom can impede the learning process by obstructing neuroplasticity (Cozolino, 2013). Consequently, when students with chronic stress and trauma are faced with new learning challenges, they may need emotional scaffolding to re-engage neuroplastic processes that have become impaired (Cozolino, 2013). Findings from this study provided narrative insight into how teachers applying educational neuroscience principles provided additional emotional scaffolding support to help students with exceptional life stressors learn to emotionally regulate over time in the classroom.

Letting Classroom Boundaries Breathe

Classroom observations and participant responses demonstrated how boundaries were adaptive to individual student needs in the classroom. Students were able to apply a variety of strategies at the times when they needed to regulate. A pervasive theme that resonates throughout the educational neuroscience literature is the focus on individual variation in learning, behavior, and development (Canter et al., 2018; Fischer & Bidell, 2006; Rose, Rouhani, & Fischer, 2013).

For both children and adults, development varies in response to context (Fischer & Bidell, 2006). While the learning environment exists at a mostly unconscious level, it permeates every aspect of the classroom functioning (Sousa & Tomlinson, 2011). The structure of the learning environment must intentionally support affective and cognitive

needs that reflect a learner-centered context. Building upon students' variability in social, affective, and cognitive development, the instructional environments should optimize the human yearning to learn and reach one's unique potential (Sousa & Tomlinson, 2011).

Adaptive learning describes an approach where classroom tasks and approaches are dynamic and flexible (Rohrkemper & Corno, 1988). Adaptive learning is based upon the belief that students are embedded in the social context of the classrooms, and learning is co-constructed through situated interactions and relationships with teachers and peers (Perry & Rahim, 2011). The social processes that support adaptive learning in classroom contexts include co-regulation and shared regulation (Perry & Rahim, 2011).

Co-regulation entails teachers and peers providing responsive scaffolding, modeling, and shared problem-solving supports to students so that they may practice and progressively build their self-regulatory skills (McCaslin & Good, 1996). The next step in the progression toward self-regulated learning is shared regulation where multiple students collectively regulate and work toward co-constructed goals (Hadwin, Miller, Gendron, Webster, & Helm, 2009). This adaptive learning lens assumes there is a reciprocal relationship between the socially-constructed instructional environment and individual cognitive and affective processes in the daily reality of classroom life (McCaslin & Good, 1996). The focus on structuring co-created, learner-centered environments that are adaptive to students' varied developmental needs aligns with the humanistic philosophy, which is further explicated in the following section that discusses the practice theme *Honoring the Whole Student*.

Honoring the Whole Student

Findings indicated that students felt listened to and trusted in their classroom interactions. Students expressed how they felt cared for by the teacher in ways that transcended their role as a student. Students juxtaposed this unconditional regard with past educational experiences where they felt disregarded and how these feelings negatively influenced their connection with the school environment. Teachers and administrators described how environmental conditions, family systems, and intrapersonal circumstances influenced students' ability to focus and learn. Emotions emerging from these situations were validated, and students responded by expressing their sense of trust with the teacher and the learning processes. Stemming from the teacher and administrators' conceptualization of educational neuroscience, a holistic perspective was applied to the classroom settings.

A holistic perspective corresponds with the humanistic philosophy that informed the embodying organizational structure. Humanistic philosophy is underpinned by the assumptive ideals that people should be treated as whole persons that are inextricably linked with sociocultural contexts that shapes their interpretive reality (Payne, 2014). Central to humanistic practice is the objective that educators and practitioners are genuinely concerned about having a relationship with those they are serving, treating them with unconditional regard (Payne, 2014). The focus is on the individual's interpretive narrative that is subjectively constructed by the cultural, spiritual, socio-political, and economic forces that shape their phenomenological worldview (Burrell & Morgan, 1979).

Acknowledging the student's embodied learning experience also aligns with honoring the whole student. Research has shown that the brain and body are inextricably

integrated by a shared system of biochemical and neural circuits (Damasio, 1994) and that a person's embodied learning experiences are in a state of constant reciprocal exchange with the socio-cultural context (Osher et al., 2018). Cozolino (2013) weaves together these paradigmatic perspectives relative to a holistic approach, averring, "Students and teachers are not uniform raw materials or assembly-line workers, but a diverse collection of living, breathing, human beings with complex evolutionary histories, cultural backgrounds, and life stories" (p. xvii).

Analytic Category 4: Co-Creating the Classroom Climate

This study aimed to answer the question: What interactions are associated with the identified educational neuroscience practices? Richman, Bowen, and Wooley (2004) assert that school climate is shaped by four primary ways of interacting in a school setting, including: (1) interactions among students, (2) interactions between school personnel and students, (3) interactions among school personnel, and (4) interactions among school, families, and the community. Emerging from these interactions, school climate is characterized by the quality of relationships in the school context and based upon patterns of people's experiences within the life of the school (Cohen et al., 2009). While the construct of school climate is an enduring feature of education research, policy, and practice, one universal definition does not exist to capture its complexity (Cohen et al., 2009).

Amid the varying views about what dimensions of school and classroom climate are most consequential, there is consensus among scholars that climate is comprised of four main dimensions: (1) safety, (2) relationships, (3) teaching and learning, (4) and structure of the learning environment (Cohen et al., 2009; Gerlach & Hopson, 2013;

Hopson & Lawson, 2011). The data from this study generated five sub-categories of educational neuroscience practices that produced classroom interactions closely aligning with these four key dimensions of climate, as outlined in Chapter 4, *Finding Four: Co-Creating the Classroom Climate*.

Researchers have acknowledged the importance of school climate for over a century (Perry, 1908) and have systematically researched school climate since the 1950s (Cohen et al., 2009). Thapa et al. (2013) aimed to synthesize the volume of school climate research by conducting a systematic review of the array of studies investigating this construct. Their review included 206 scholarly works, comprised of literature reviews as well as studies that were experimental, correlational, descriptive, and international in scope. Findings from Thapa and colleague's review indicated that school climate has a substantive impact on students' mental, emotional, and physical health. In a related vein, a theme emerging from the review emphasized a positive correlation between school climate and students' self-concept. The scholarship compendium also revealed that climate influenced students' motivation to engage in learning and mitigated the negative impact of socioeconomic context on academic achievement. Related to risk factors, Hopson and Lee (2011) underscore how research has shown that a positive school climate is especially beneficial for vulnerable students, including minority, economically disadvantaged, gender diverse, and urban youth.

Previous research also supports Thapa et al.'s (2013) review of the literature. Cohen et al. (2009) conducted a historical analysis, literature review, a national State Department of Education policy scan, and a national survey (N=40) examining school climate measurement and improvement practices at a local, district, and state levels.

Their comprehensive examination found that an increasing body of empirical research supports the connection between a positive school climate and academic achievement, school success, effective violence prevention, teacher retention, and students' healthy development. Despite the substantive evidence supporting the connection between climate and beneficial student outcomes, Cohen et al.'s investigation revealed that most states were deficient in coordinating efforts to advance school climate policy, practice, and professional preparedness.

Countering Cohen et al.'s (2009) critique of a state level commitment to address climate as a critical prevention and intervention practice pathway, there are national initiatives spotlighting the importance of school climate. The Centers for Disease Control and Prevention (2009) has identified a positive school climate as a data-driven strategy that facilitates healthy relationships, school connectedness, and dropout prevention. Furthermore, the US Department of Education (2014) has supported the Safe and Supportive Schools grant program to generate statewide efforts to study and measure school climate improvement efforts.

Findings from this study correspond with previous school and classroom climate research and practice initiatives addressing the import of climate and its connection to positive student outcomes. Importantly, through the applied educational neuroscience focus, this study adds an unexamined dimension to the climate research compendium. Following is the analysis and discussion of the four climate dimensions present in the data.

Safety

Findings indicated that students' responses to the educational neuroscience practices revealed a theme of feeling safe in the classroom context. Broadly, social, emotional, intellectual, and physical safety is a foundational human need, as theorized by Maslow (1943) several decades ago, and there is broad consensus in the literature that safety is a key dimension of a positive school climate (Cohen et al., 2009; Cozolino, 2013; Devine & Cohen, 2007; Gerlach & Hopson, 2013; Hopson & Lawson, 2011; Thapa et al., 2013). Feeling safe in the classroom is critical for fostering students' healthy development, trust, and learning (Devine & Cohen, 2007). Conversely, research demonstrates schools without safe climates are more likely to have students who experience violence, peer victimization, and punitive discipline. Academically, students from schools where safety is lacking display higher rates of absenteeism and lower academic outcomes (Astor, Guerra, & Van Acker, 2010).

Feeling safe directly affects the neurobiological functioning needed for learning. The neurobiology of learning and memory is entwined with the primitive survival circuitry that attends to stress, arousal, and fear (Hohnen & Murphy, 2016). The brain's emotional filter system evaluates the environment based on current and previous experiences. The brain's primary function is to ensure survival, so stress activates emotional processing in the limbic regions to ensure safety while reducing activity in the frontal lobes, the part of the brain that facilitates thinking and developing higher order circuits (Willis, 2009).

In addition to environmental stressors present in a student's life outside of the classroom, experiences within the classroom could cause stress as well. Hohnen and

Murphy (2016) outline classroom interactions that could reduce students' sense of safety in the classroom. They note that students' perceptions of the teacher as angry or negative could cause stress and obstruct students' engagement with learning processes. Another example they highlight includes students who present with executive functioning skills that need additional development. These students may lack the ability to focus attention, control impulses and regulate behavior and emotions. Consequently, a teacher may impose punitive measures that perpetuate states of stress for students and erode the students' sense of safety (Cozolino, 2013; Hohnen & Murphy, 2016). Providing emotional scaffolding, co-regulation, and nurturing relationships in the classroom calms students' limbic systems and contributes to their sense of safety.

Relationships

Conceptualizing applied educational neuroscience in the classroom, participants described the focus on relationships as a central feature. This aspect was demonstrated both in how the participants conceptualized applied educational neuroscience as well as through observations and participants' interactive responses to the practices. Emerging from the interview and observational data, the student and teachers' responses to the educational neuroscience practices yielded interactions that facilitated connected relationships that fostered trust. Discussion of the *relationships* as a dimension of climate builds upon the developmental implications discussed in *Analytic Category 1*:

Conceptualizing Applied Educational Neuroscience.

The teaching and learning enterprise is profoundly relational (Thapa et al., 2013). The relationship dimension of school climate is comprised of the patterns of norms, goals, values, and interactions and the level of quality connection people feel toward one

another and with themselves (Thapa et al., 2013). Research providing a focus on relationships in schools has shown that when students perceive fair discipline practices and positive student-teacher relationships, there is a reduction in subsequent behavioral challenges (Gregory & Cornell, 2009; Wang, Selman, Dishion, & Stormshak, 2010). There is evidence that early relationship patterns with teachers are indicative of ongoing relational challenges in subsequent academic years. Hamre and Pianta (2001) found that conflictual teacher-student relationships in kindergarten are predictive of behavioral and academic problems in later grades.

Attachment theorists explain how learning and development occur within a web of relationships. Cozolino (2013), a leading scholar on attachment theory and learning, contends, “Relationships are our natural habitat” (p. 13). Attachment theory offers an evolutionary lens for discerning how an individual’s neurobiological architecture is shaped through relationships. According to Cozolino (2013; 2014), our neurobiology is designed to function within tribal units that foster safety, cohesion, and belonging. It is from this place of tribal connection that we intersubjectively make and pursue systems of meaning in our learning processes (Cozolino, 2013; 2014). Developing children and adolescents depend on secure connections and relationships for co-regulation support when they are triggered in some way or dysregulated (Osher, et al., 2018; Sameroff, 2010; Siegel, 2012).

Teaching and Learning

Results from the study showed how the teaching and learning dimension of school climate was evident throughout the application of the educational neuroscience practices. An overarching theme that threaded throughout all of the practices was the focus on

teaching and implementing strategies for self-regulation. Teachers intentionally integrated curricular content on students' neurobiology and self-regulation strategies related to students' specific social, emotional, and physiological needs. This curricular approach was encouraged by administrators who embraced the philosophical shift associated with the way they conceptualized educational neuroscience practices.

According to Gerlach and Hopson (2013), the norms, goals, and values of a school community inform the pedagogical methods that are used. Teaching and learning methods that foster collaborative learning and giving students' a voice in decision-making amid the learning exchange contribute to a positive climate (Cohen et al., 2009). The climate literature emphasizes that this climate dimension entails teaching content that is not only academic but that also addresses the social, emotional, civic and ethical aspects of development (Cohen et al., 2009).

Structure of the Learning Environment

The data demonstrated how the structure of the learning environment was a central feature in applying the educational neuroscience practices in all three classrooms. The educational neuroscience conceptualization and practices focused on the individual needs of students, giving them choice and a degree of freedom to apply the practices at the times they identified the need to self-regulate. This aspect aligns with the literature that highlights the growing insight into students' individual variation in learning, behavior, and development (Canter et al., 2018 & Rose et al., 2013) that is contextually-situated (Fischer & Bidell, 2006).

The climate literature frames this dimension based upon the physical structure, including adequate and effective use of space, materials, aesthetic quality, school size,

and curricular and extra-curricular offerings (Cohen et al., 2009). Specific to this study, this climate dimension was interpreted as providing the type of physical space that met the variance of students' learning and self-regulation needs. While there is some research on personal space and its association with student achievement (Tanner, 2008), the climate literature has not extended its boundaries to align with the human development literature that underscores the variation in child development and the relevance of adaptive classroom structures.

Analytic Category 5: Building Students' Resiliency

The findings revealed that the students' reactions to the educational neuroscience practices engendered adaptive responses that contributed to their abilities to do the following: (1) reflect on their emotions, (2) identify when they needed to regulate, and (3) choose regulatory strategies that corresponded with their unique neurobiological needs. The resultant interactions contributed to the process of co-creating a positive classroom climate that yielded psychosocial outcomes related to reduced discipline, readiness to learn, empowered decision-making, empathy, and social connectedness. The findings indicate that the co-created climate emerging from the application of educational neuroscience practices aligns with the body of research that suggests positive school climate is an integral component for effectively fostering protective factors and mitigating risk factors for students (Catalano, Berglund, Ryan, Lonczak, & Hawkins, 2002; CDC, 2009; Gerlach & Hopson, 2013; & Greenberg et al., 2003). These adaptive responses suggest that educational neuroscience practices in the classrooms contributed to students' resiliency.

Currently, there is no consensus for the definition of resilience in the clinical or scientific literature (Southwick, Litz, Charney, & Friedman, 2011). Scholars examining the term resilience denote at least eight distinct meanings for the term (Layne, Warren, & Shalev, 2007), and they underscore that the term resilience may be conceptualized as an *outcome* to a stressful encounter or as a *process* that moderates the response to stress (Southwick et al., 2011). Furthermore, researchers emphasize that the term “resilient” describes pathways of adaptation and not merely an adjective to describe an individual (Luthar & Cicchetti, 2000). Since there are few direct measures of neural health, researchers have struggled to operationalize resilience at a neurobiological level, thus relying on behavioral observations and personal perceptions of an individual’s internal experiences (Feder, Charney, & Collins, 2011).

Specific to this study, the participants reported student stressors that included divorce, poverty, family conflict, previous school expulsions, history of negative school experiences, and death of a parent. Participants indicated that being in the classrooms where educational neuroscience practices were applied facilitated a learning environment that mitigated the impact of these stressors on students. As a student’s development is shaped by the bioecological context, environmental context can mediate adversity through nurturing, consistent, and attuned relationships (Osher et al., 2018).

Development of youth is embodied, socially and culturally-situated, and contextualized within a physical ecology (Osher et al., 2018). The reciprocal interactions between a youth’s biology, her/his physical and social environments, and these multi-system contexts have the ability to provide a “constructive web” through which complex skills are constructed and positive adaptation is promoted (Fischer & Bidell, 2006).

Social and organizational structures of schools that foster developmentally-rich contexts can mediate the effects of stress and trauma and foster students' resilience (Osher et al., 2018). This ecological perspective for building protective pathways aligns with the experientially-dependent nature of the brain, where the brain is constantly sculpted by the encompassing social environment (Canter et al., 2018; Dubinsky, Roehrig, & Varma, 2013; Hassevoort et al., 2016; Osher et al., 2018; Wenger & Lövdén, 2016; Walker et al., 2017). The next sections discuss how the positive co-created climate yielded five themes that portrayed the ways resiliency occurred among the students when educational neuroscience practices were applied in the classroom.

Reduced Office Referrals

Participants reported a decrease in office referrals throughout the academic year. As a response to the educational neuroscience practices, participants stated teachers and students were better equipped to de-escalate students directly in the classroom, and students sought adherence to the relational norms that motivated them to remain engaged in the learning community. Notably, school administrators highlighted that the teachers from the three classrooms did not refer students to the office by the end of the academic year.

Dupper (2010) calls for a paradigmatic shift in school discipline practices that ascribes to a relationship-based, preventive model. This model considers how behavior is complex and interactive, often shaped by an interplay of internal and external factors. Factors that are internal include physical, developmental, and emotional aspects specific to an individual student. External factors include classroom climate and the quality of relationships with peers and adults within the school community (Noguera, 2001).

According to Dupper (2010), a positive school and classroom climate is a primary school factor that influences student behavior. Climate features support the extent to which students feel a sense of school connectedness, and students are more engaged in classrooms where teachers are empathic, respectful, and consistent (Dupper, 2010). Existing evidence suggests that as students feel higher levels of attachment with the school community, rates of behavior challenges decrease (McNeely, Nonnemaker, & Blum, 2002; Stewart, 2003).

Underlying Dupper's (2010) proposed relationship-based, preventive model of discipline is a paradigmatic shift toward supporting behavioral challenges in the classroom. Educators mostly apply a behaviorist approach for social-emotional expectations, expecting adherence to pre-determined behaviors rather than building skills for differentiated support and application (Siegel, 2012). This behaviorist philosophy is entrenched in schools' discipline practices, where behaviors are expected and managed without any instruction related to the social-emotional skills a student needs to regulate her/his behavior (Siegel & Payne-Bryson, 2014). Rather than discipline practices that provide relational connections for co-regulation when a student is dysregulated and triggered, schools have traditionally turned to approaches based on shame, isolation and removal – the opposite of what a student in a dysregulated state needs (Cozolino, 2013; Dupper, 2010).

Findings from this study illuminated how educational neuroscience practices facilitated the relational connections that offered co-regulatory opportunities with teachers and peers. The results also showed how the teachers using educational neuroscience practices addressed the social-emotional developmental domain by

promoting skill development with students' social-emotional needs, increasing their competencies with regulating their emotions and behaviors. The result was a relational climate, aligning with Dupper's (2010) relationship-based, preventive model of discipline, which yielded a reduction in office referrals, inherently translating to an increase in students' engagement with instructional time.

Readiness to Learn

Classroom observations and participant perspectives indicated that students responded to the educational neuroscience practices with a readiness to learn. Participants indicated that by engaging in the practices they felt calmer, and there was evidence that academic growth occurred in a manner that was different from previous classroom experiences. A recurring theme in the literature is the profound impact that self-regulation has on a student's success in school and life. Self-regulation skills are precursors for school readiness, more complex learning, self-direction, and metacognition (Blair & Razza, 2007; Cantin et al., 2012; Zhou, Chen, & Main, 2012), leading to increased academic and social competence (Blair & Diamond, 2008).

Creating a climate that is safe, nurturing, and conducive to individual learning needs increases students' access to what Hohnen and Murphy (2016) describe as a positive cycle of learning. The positive cycle of learning is inspired when a student experiences success in a learning task. According to Hohnen and Murphy, that sense of success will activate the reward systems in the brain. Dopamine, a neurotransmitter, is released when an experience produces a reward response, reinforcing future action and increasing motivation and attention. As the student anticipates the likelihood of positive learning experiences, dopamine may be released as a student through memory and

experience anticipates a reward (Sharo, Shiner, Brown, Fan, & Dolan, 2009). Hohnen and Murphy's proposed model aligns with the positive memories of student engagement and learning that students shared from the three classrooms studied.

Empowered Decision-Making

Empowerment, from a social work perspective, entails individuals increasing their sense of power to act by increasing capacity and self-efficacy and sharing this acquisition of powers with others (Payne, 2014). Aligning with this empowerment framework, students shared how learning about their brain enhanced their sense of agency with interpersonal relationships and academic success. Teachers reinforced student responses by providing stories of transformation they witnessed in some of the students' attitudes toward school engagement and ways they saw the students using the skills to give back to their families and the larger school community.

Willis (2009), a former neurologist who later became a middle school teacher, shares her experience with teaching students about their brain and the empowering impact it has on them. According to Willis, helping students understand how the brain functions equips them with knowledge to influence their own cognitive and emotional health. Willis provides anecdotal experiences of teaching students about their neuroanatomy that mirror responses from students in this study. Specifically, she highlights students who think they are "not smart" and how the process of learning that they can change the structure of their brains is a liberating experience for them. This insight corresponds with the fifth grade student who declared, "I always thought that I wasn't gonna be successful in my life, but now I just realize that I'm gonna be successful for once in my life."

Willis (2009) contends that when students learn about their brains, they are better prepared to take charge of their learning, which enhances motivation. As the science continues to emerge around epigenetics, the experience-dependent expression of genes, (Cozolino, 2013; Siegel, 2012), educators have an opportunity to help students gain scientific insight into how the brain constantly adapts to transactions with the social and physical environment. Siegel and Payne-Bryson (2012) distill below how the brain's malleable nature has life course implications:

We aren't held captive for the rest of our lives by the way the brain works at this moment – we can actually rewire it so that we can be healthier and happier. This is not only true for children and adolescents, but also for each of us across the life span. (p. 7)

As students learned about their neuroanatomy, they also increased knowledge about the brain's role in helping them make choices to feel calmer and ready for instructional time and to navigate challenges in their social environment.

The educational neuroscience practices incorporated strategies to increase students' self- and emotional regulation skills. Executive functioning skills enhance social competence and include three core components – attention, memory, and inhibition (Cantin et al., 2012). The feature most notably expressed in the data was inhibition, which is the ability to suppress a response. Students cited how they anticipated being able to choose their responses when faced with interpersonal conflicts in the future, e.g., potential peer conflicts in middle school. Students' responses correspond with research that suggests inhibition is a feature of both academic and social competence (Razza & Blair, 2009).

Empathy

As a response to the positive classroom climate that emerged, participants described how students' empathy was enhanced. Through classroom interactions and the process of gaining insight into their own self-regulatory needs, students became more sensitive to other students' emotional conditions. Although there is variance in definitions surrounding empathy, Eisenberg, Spinrad, and Valiente (2016) define empathy as "an affective response that stems from the apprehension or comprehension of another's emotional state or condition, and which is similar to what the other person is feeling or would be expected to feel" (p. 224). Empathy entails emotionally attuning through a process of mirroring systems that are linked with parts of the forebrain that allow individuals to encode and imprint onto their own nervous systems what others experience (Rizzolatti & Sinigaglia, 2008). This mirroring system intersects with emotional networks and produces an emotional resonance that activates empathy (Cozolino, 2013).

Through the supportive emotional attunement present in the three classrooms, the emotional contagions produced a heightened display of empathy and group coherence. Students and teachers began to see disruptive student behavior as a way of communicating an emotional need rather than a student being inherently flawed or intentionally making destructive choices.

Social Connectedness

Through a convergence of the data sources, a salient theme that emerged was the presence of social connectedness among students and with the teachers in the respective classrooms. From a school climate perspective, students' sense of connectedness reflects

the extent to which students feel attached to at least one caring adult within the school setting and that adults and peers in the school not only are interested in their academic progress, but also care about them as individuals (CDC, 2009; Cohen, et al., 2009). Previous research indicates that students' connectedness is a predictor of health and academic outcomes (McNeely, Nonnemaker, & Blum, 2002; Shochet, Dadds, Ham, & Montague, 2006; Whitlock, 2006) and a potential protective factor for sexual violence and substance use (Catalano, Haggerty, Oesterie, Fleming, & Hawkins, 2004).

Conversely, the occurrence of social pain, the experience of pain because of interpersonal rejection or loss, can have neurobiological implications (Hohnen & Murphy, 2016). Research has shown that social pain, defined as perceived rejection, is linked with activation in the same brain region as physical pain (Eisenberger & Lieberman, 2004; Eisenberger, Lieberman, & Williams, 2003). There is evidence that those who report higher levels of social pain also show increased brain activation (Eisenberg et al., 2003). Creating climates that promote social cohesion and prevent the occurrence of bullying and other forms of social exclusion is of critical importance (Cozolino, 2013; Hohnen & Murphy, 2016; Thapa et al., 2013). Consequently, the occurrence of social connectedness as a protective factor not only has academic implications but also influences students from a social, emotional, and physiological standpoint.

Summary and Implications of Analyses

According to Butterworth and Tolmie (2014), education practice is shaped by two primary questions: (1) What are the sources of individual differences in learning? and (2)

What are the optimal contexts for meeting unique learning needs? The findings from this translational study address both of those questions integral to education delivery.

The findings from this study suggest that differentiating supports for self-regulatory needs fostered students' holistic growth. These differentiated approaches were evident in how teachers validated students' unique emotional expressions and gave students permission to apply individualized self-regulatory strategies based upon the student's identification of regulatory challenges. Importantly, the process of differentiating emotional supports taught students to reflect on their emotional states and to self-evaluate what strategies worked best for them to achieve the emotional equilibrium needed for learning.

This study also produced findings that addressed the contextual features supporting students' unique social-emotional learning needs. Classroom boundaries were adaptive to students, both in the internal classroom structure and with organizational features that allowed students autonomy to act upon their reflective process for self-regulation. Importantly, contextual features unveiled the critical intersection between the humanistic administrative approaches and the teachers' autonomy to try these new approaches in the classroom.

This study offered insight into how three different elementary teachers applied educational neuroscience principles into the classroom setting. Application of educational neuroscience practices promoted classroom interactions that produced a positive classroom climate. Findings from this study also contributed to the growing knowledge base that suggests supporting students' social, emotional, and physiological reactivity and self-regulation through classroom interventions and climate provides

protective features that may ameliorate the corrosive impact risk factors pose to students' development (Blair & Raver, 2016). Building upon the findings, the next section discusses how enhancing the classroom climate through applied educational neuroscience practices aligns with the school social worker role.

Tier 1 Interventions: The Role of School Social Workers

This study examined how educational neuroscience practices unfolded in the classroom and influenced the classroom climate. School and classroom climate is a feature of Tier 1 within the Multi-Tiered Systems of Support Framework (MTSS) as was discussed in Chapter 1 (See Figure 6). Tier 1 is intended to provide a preventative level of support that creates a positive learning climate for all students. As integral educational team members, school social workers play a central role in facilitating a positive climate because of their expertise in ecological systems perspectives and interdisciplinary collaboration (Franklin et al., 2015; Gerlach, & Hopson, 2013; Hopson & Lawson, 2011). Furthermore, school social workers serve as consultants at multiple system levels within the school setting (Franklin et al., 2015; Johnson-Reid et al., 2004), which positions school social workers to be the ideal professionals to assess and collaboratively integrate knowledge about the interplay between the student's neurobiology and her/his environment.

The study results also highlighted how the educational neuroscience practices included a focus on emotional attunement and de-escalation strategies in the classroom. Since the inception of this specialized area of practice, school social workers have addressed students' social-emotional developmental needs and provided multi-system level interventions for students and families vulnerable to life stressors that could impede

learning (Constable, 2016). Consequently, school social workers are uniquely qualified to provide leadership to school organizations that seek to incorporate educational neuroscience practices that more fully integrate the social-affective dimensions of students' developmental needs.

Over a decade ago, Applegate and Shapiro (2005) called for clinical social work to integrate into its knowledge base multidisciplinary research in affect regulation and experience-dependent neurobiological development. A search of the literature suggests that there has not been a coordinated effort to answer this call to action in the school social work field of practice. This study offers a transdisciplinary pathway to integrate neuroscience knowledge that is specific to school social work practice, pointing to new directions for preparing future school social workers. Since the role of school social workers and other student services personnel in the emerging educational neuroscience transdisciplinary endeavor is yet to be examined, this study and the ensuing discussion stretches the current educational neuroscience discourse into a rich territory that is fertile for discovery.

Suggestions for Future Research

Improving school climates requires advancing students' and educators' social and emotional knowledge and abilities (Cohen et al., 2009; Thapa et al., 2013). The recent establishment of the educational neuroscience discipline reflects the growing momentum that seeks to transform educational theory and practice through the integration of the social and affective neurosciences (Butterworth & Tolmie, 2014; Immordino-Yang & Fischer, 2016), opening possibilities for addressing the current knowledge gap among educators. This study offers a seminal examination into the translational endeavor to

inform educators and school social workers on possible practice pathways for applying the social and affective dimensions of educational neuroscience practices to promote positive school climates.

This area of inquiry is ripe for discovery and needs additional investigation to support the findings that emerged from this study. More research needs to be conducted to empirically test the conceptual model produced by the data. Future translational studies examining the conceptualization and practices in classrooms should consider a comparison group that does not espouse educational neuroscience principles. Other age ranges and settings, e.g., special education classrooms, would expand the reach of these findings. Furthermore, the rapid escalation of neuroscience knowledge necessitates the need for scholars to continually test findings with emerging knowledge to ensure the accuracy of practice frameworks and to allow for falsifiability, a term Stafford-Brizard et al. (2017) use to describe an openness to revealing flaws in theories in an effort to transform practice.

Research on Different Stages of Social Development

This study examined the perceptions of school administrators, teachers, and students in fourth and fifth grade classrooms as they related to applied educational neuroscience practices in the elementary classroom setting. In addition to building upon translational research for elementary school settings, additional investigation is needed for secondary education. Research on this age range would include an examination of adolescents, a developmental stage that researchers frame as a “sensitive period” (Blakemore et al., 2014; Busso, 2014; Hohnen & Murphy, 2016). Sensitive periods are considered developmental phases when the brain is particularly malleable to

environmental stimuli and especially efficient at incorporating new forms of learning (Blakemore et al., 2014; Busso, 2014). Researchers typically define adolescence as a timeframe that begins with the hormonal, physical, and neurobiological changes associated with puberty and ending with social transitions into adulthood defined by cultural expectations (Blakemore et al., 2014; Siegel, 2013).

Adolescent students present with unique challenges, including more complex peer relationships (Hohnen & Murphy, 2016; Siegel, 2013; Steinberg & Morris, 2001).

Emerging neuroscience suggests could be in part caused by the development of the social brain and specific neural correlates corresponding to social cognitive processes (Blakemore et al., 2014). Some scholars advocate for an increase in the integration of social elements into instructional design to align with the adolescents' developmental needs, which includes a heightened focus on the social sphere (Lieberman, 2012).

Differentiating practices and optimizing learning environments to support neural plasticity unique to this developmental time will be a critical area of inquiry for applied educational neuroscience.

Building Bridges for Inquiry: A Transdisciplinary Research Agenda

In recent decades, there has been a surge in knowledge that addresses neurobiology, the learning process, and how contextual effects shape the nonlinear development of youth (Cantor et al., 2018). Still, this knowledge expansion remains unintegrated and underutilized, and its relevance is not fully known in settings where children grow and learn (Cantor et al., 2018). This knowledge lacuna is also underscored in the educational neuroscience literature (Blakemore & Bunge, 2012; Butterworth & Tolmie, 2014; Goswami, 2006; Stafford-Brizard et al., 2017; Willis, 2008). Seeking to

address this gap, this study aimed to contribute to the ongoing efforts to translate neuroscience into educational practices and settings. Notably, this study captured the contextually-situated narrative of the educators and students in the translation process, a source mostly untapped in the emergent transdisciplinary discourse at this point.

Future research should continue to build upon this and similar translational studies to forge a cogent conceptualization of shared terms and to formulate a theoretical framework that guides educational stakeholders with implementing practices with fidelity. As is echoed throughout the educational neuroscience scholarship, this emergent discipline requires a transdisciplinary research approach that braids together disciplinary traditions into a non-reductionist framework (Butterworth & Tolmie, 2014; Stafford-Brizard, 2017). Importantly, creating educational neuroscience knowledge in a context-sensitive form relevant to theory and practice calls for direct, bi-directional collaboration between researchers and members of the multidisciplinary education team throughout all stages of the research process (Kent, 2013; Stafford-Brizard, 2017).

Fully realizing the potential of emerging scientific knowledge requires a reconfiguration of disciplinary structures, paradigms, and conventional research incentives (Cantor et al., 2018). In the quest for more holistic inquiries that inspire creative questions, measures, epistemes, and frameworks, transdisciplinary work entails a disruption of the status quo (Leavy, 2011). Specific to educational neuroscience, there is a need to align and synthesize knowledge from an array of disciplines, including biology, neuroscience, psychology, and social work. Transforming educational practice by infusing neuroscience and human development knowledge requires accessibility to the growing knowledge base, and it entails researchers gaining insight into the complexity of

school organizations and practice (Osher et al., 2018). Efforts to expand reward systems for publication and funding priorities will be critical for this type of innovative boundary work, outlined by Beauchamp and Beauchamp (2013), which proposes creating shared systems of meaning to bridge the various disciplinary structures. Furthermore, a bridge to connect science and practice requires a dissemination model for translated science so that it can meaningfully inform practice and further the bi-directional feedback loop between the practice and research communities (Stafford-Brizard et al., 2017).

Conclusion

This dissertation study contributes to the discourse surrounding the emergent educational neuroscience discipline. The intent of this qualitative research was to further the quest to create a system of shared conceptual constructs for this emergent transdisciplinary area of inquiry. Despite the mounting zeal for educational neuroscience, there is scant research that examines the application of educational neuroscience principles and the array of assertions that exist about the social and affective dimensions of this nascent discipline. This study aimed to address that gap.

This study yielded findings that illuminated further epistemological questions as well as insights that could inform all members of the multidisciplinary educational team, which includes school social workers. By examining the study's limitations, this inquiry also aimed to contribute to the knowledge base by elucidating future research pathways that require a creative methodological approach, engendering a transdisciplinary response. Ultimately, the impetus for this dissertation was the quest for a shared conceptual framework for the social and affective dimensions of applied educational neuroscience practices to promote a positive classroom and school climate. To that end,

this dissertation study was a vehicle to generate findings that cultivated inquiry into future possibilities for balancing the evolving educational neuroscience practices with rigorous research, building the bridge to consequential and responsible practice pathways.

Appendices

Appendix A. Educational Neuroscience Research Centers and Academic Programs

- Mind, Brain, and Education at Harvard University
- Neuro Education Initiative at John Hopkins University
- Stanford Education Neuroscience Program at Stanford University
- Centre for Neuroscience in Education at the University of Cambridge
- Centre for Educational Neuroscience at the Institute of Education, University College, London
- Neurocognitive Development Unit at the University of Western Australia
- Numerical Cognition Laboratory at the University of Western Ontario, Canada
- Center for Neuroscience and Learning at the University of Ulm, Germany
- Neuroeducational Network at University of Bristol, UK
- Educational Neuroscience Laboratory at Simon Fraser
- Brain and Creativity Institute at University of Southern California
- Southwest Center for Mind, Brain, and Education at University of Texas, Arlington

Undergraduate and Graduate Programs in Educational Neuroscience

- Butler University (Certificate Program)
- Vanderbilt University
- Teachers College, Columbia University
- Harvard University
- Stanford University
- Cambridge University
- Oxford University
- VU University of Amsterdam

Adapted from Joldersma (2016, p. 12)

Appendix B. Organisation for Economic Co-operation and Development (OECD)

Member Countries

Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States

Retrieved from: <https://www.oecdwatch.org/oecd-guidelines/oecd>

Appendix C. Glossary of Terms for Applied Educational Neuroscience

Adaptive Learning – A set of attitudes and skills by which students can learn to cope with and modify the stress caused by classroom learning tasks not of their own choosing (Rohrkemper & Corner, 1988, as cited in Perry & Rahim, 2011)

Affect – The way an internal emotional state is externally revealed (Siegel, 2012, p. 389)

Affective Neuroscience – The neuroscience of emotion (Immordino-Yang, 2016, p. 19)

Affect Regulation – The mechanism by which emotion and its expression are modulated (Siegel, 2012, p. 389)

Amygdala – Part of the centrally located limbic regions of the brain. It is an almond-shaped cluster of neurons that is involved in the appraisal of meaning, the processing of social signals, and the activation of emotion. It plays a crucial role in coordinating perceptions with memory and behavior. (Siegel, 2012, p. 389)

Attention – The cognitive process of selectively concentrating on one task while ignoring other tasks. Supported by imaging studies, there are distinct networks of neural areas areas which carry out functions of attention, including maintaining the alert state, responding to sensory information, and negotiating conflict among competing thoughts or feelings (OECD, 2007, p. 250)

Brain – The extended nervous system distributed throughout the entire body and intimately interwoven with the physiology of the body as a whole. It is the embodied neural mechanism that shapes the flow of energy and information. (Siegel, 2012, p. 390)

Cerebral hemispheres – The two specialized halves of the brain. The left hemisphere is specialized for speech, writing, language, and calculation; the right hemisphere is

specialized for spatial abilities, face recognition in vision, and some aspects of music perception and production (OECD, 2007, p. 251)

Cognition – Set of operations of the mind which includes all aspects of perceiving, thinking, leaning, and remembering (OECD, 2007, p. 251)

Cognitive Neuroscience – A scientific field that studies the biological processes that underlie cognition and the neural connections that are involved in mental processes (Goswami, 2004)

Consciousness – The subjective experience of being aware. It has two dimensions that include access to information, and the phenomenal or subjective personal quality of an experience. (Siegel, 2012, p. 391)

Co-regulation – A process by which teachers and peers provide responsive scaffolding, modeling, and shared problem-solving activities for learners to practice and learn self-regulatory strategies (McCaslin & Good, 1996)

Ecological Validity – Translating scientific findings to the real world of direct practices (Immordino-Yang, 2016)

Educational Neuroscience- A new discipline that involves a syntheses of theories, methods, and techniques of the neurosciences, as applied to and informed by educational research and practice. It is commonly defined as a transdisciplinary endeavor (Patten & Campbell, 2011, p. 1)

Electroencephalograph (EEG) – An instrument that charts fluctuations in the brains electrical activity via electrodes attached to the scalp (Sousa, 2010, p. 286)

Emotions – Whole-body phenomena that involve loosely coupled changes in the domains of subjective experience, behavior, and central and peripheral physiology (Maus, Levenson, McCarter, Wilhelm, & Gross, 2005 as cited in Gross, 2014, p. 4)

Emotional Regulation – An ability to manage emotions appropriately and to flexibly adjust internal goals and responses to the changing demands of a situation (Woltering & Shi, 2016, p. 1085)

Empathy – An affective response that stems from the apprehension or comprehension of another’s emotional state or condition, and which is similar to what the other person is feeling or would be expected to feel (Eisenberg, Spinrad, & Valiente, 2006, p. 224)

Epigenesis- The process in which experience alters the regulation of gene expression by way of changing the various molecules on the chromosome (Siegel, 2012, p. 392)

Executive Functioning – An umbrella term used to describe the processes that allows individuals to manage and focus their attention, thoughts, and actions to meet adaptive goals (Blair & Raver, 2012; Cantin et al., 2012)

Experience-dependent – A property of a functional neural system in which variations in experience lead to variations in function, a property that might persist throughout the lifespan (OECD, 2007, p. 254)

Explicit Memory. Memories that can be retrieved by a conscious act, as in recall, and can be verbalized, in contrast to implicit or procedural memories, which are less verbally explicit (OECD, 2007, p. 254)

Hippocampus – A seahorse-shaped structure located within the brain and considered an important part of the limbic system. It functions in learning, memory, and emotions. (OECD, 2007, p. 255)

Hypothalamus – A complex brain structure composed of many nuclei with various functions. These include regulating the activities of internal organs, monitoring information from the autonomic nervous system and controlling the pituitary gland (OECD, 2007, p. 255)

Implicit Memory/Learning – Memories that cannot be retrieved consciously but are activated as part of particular skills or action, and reflect learning a procedure of a pattern, upon which might be difficult to reflect or to explicitly verbalize (OECD, 2007, p. 255)

Inhibition – The ability to suppress a response as an adaptive behavior toward a social goal (Raza & Blair, 2009)

Interpersonal Neurobiology (IPNB) – A consilient field that embraces all branches of science, as it seeks common, universal findings across independent ways of knowing in order to expand our understanding of the mind and well-being (Siegel, 2012, p. 394)

Limbic System – Also known as the “emotional brain,” this part of the brain borders the thalamus and hypothalamus and is made up of many of the deep brain structures – including the amygdala, hippocampus, septum, and basal ganglia – that work to help regulate emotion, memory, and certain aspects of movement (OECD, 2007, p. 256)

Memory – The way past events affect future function, meaning the brain experiences the world and encodes an interaction in a manner that alters future ways of responding (Siegel, 2012, p. 46)

Mind – An embodied and relational process that regulates the flow of energy and information (Siegel, 2012, p. 3)

Multi-Tiered System of Supports (MTSS) - A whole-school, data-driven, prevention-based framework for improving learning outcomes for every student through a multi-level continuum of collaborative practices and systems (Constable, 2016)

Mirror Neurons – A neuron which fires both when a human performs an action and when a human observes the same action performed by another (OECD, 2007, p. 257)

Motivation – States in which the organism is prepared to act physically and mentally in a focused manner, characterized by raised levels of arousal. Motivation is intimately related to emotions as emotions constitute the brain’s way of evaluating whether things should be acted upon. (OECD, 2007, p. 257)

Neocortex – The outer layer of the cerebral hemispheres that mediates information-processing functions, including perception, thinking, and reasoning (Siegel, 2012, p. 396)

Neurobiology – The study of how neurons work and how the nervous system functions (Siegel, 2012, p. 396)

Neuromythologies – Popular accounts of brain functioning, which often appear in ‘brain-based’ educational applications that are not supportive by scientific evidence and oftentimes are at odds with scientific evidence (Geake, 2009)

Neural Plasticity- The ability of neurons to change both their structure and relationships to one another in reaction to experience (Buonomano & Merzenich, 1998: Trojan & Pokorny, 1999, as cited in Cozolino, 2013, p. 16)

Prefrontal Cortex – Central to the processes of creating meaning and emotion and of enabling a flexibility of response. It sits at the juncture of lower regions (brainstem and limbic areas) receiving input from the body and higher regions (the cortex) involved in integrating information (Siegel, 2012, p. 397)

Resilience - A process where individuals positively adapt to life events, especially those that pose exceptional stress (Luther, 2003)

School and Classroom Climate - The learning environment created through the interactions of human relationships, physical setting and psychological atmosphere (Perkins, 2006, p. 1)

Self-Regulation – An ability to manage thoughts and emotions appropriately and to flexibly adjust internal goals and responses to the changing demands of a situation (Woltering & Shi, 2016, p. 1085)

Shared Regulation – The process by which multiple peers collectively regulate and co-construct learning goals (Hadwin et al., 2009)

Social Neuroscience – An integrative field that examines how nervous (central and peripheral), endocrine, and immune systems are involved in sociocultural processes. It emphasizes the importance of how the brain and body influence social processes, as well as how social processes influence the brain and body (Harmon-Jones & Winkielman, 2007, p. 4)

Synapses – The small gaps that separate individual neurons and are comprised by a variety of chemical substances that engage in synaptic transmission (Cozolino, 2013)

Synchrony – The social, behavioral, and physiological flow between people that results from human interactions (Kent, 2013)

Tier 1- The primary prevention level of the MTSS Framework that intends to support all students through universal supports that comprehensively address students' relational needs

Trandisciplinarity – An approach to conducting social research that involves synergistic collaboration between two or more disciplines with high levels of integration between the disciplinary sets of knowledge (Leavy, 2011, p. 9)

Appendix D. Role of the Researcher

In this section, I provide insight into the unique intersections embedded in my scholarly journey that have shaped my inquiry and prepared me for my dissertation study. Possessing Bachelor and Master's degrees in social work, I have committed over two decades of my professional life to social work practice and social work higher education. From my earliest inclinations, my pursuit of social work was focused on research and policy. Consequently, I have served in social work higher education in three institutions and two countries with the intention of building knowledge and practices to promote student learning.

While my faculty roles have varied from student services, field education, to teaching, my curiosity about how to facilitate learning that inspires critical thinking and evolved knowing has endured. My inquiry into educational neuroscience has germinated over the past decade as I have explored various trajectories involved with the scholarship of teaching and learning for social work education as well as the exclusionary discipline phenomenon occurring in US Preschool-12th grade school settings. Evidence of my investigations include my previous scholarship for social work education, including deep and surface learning; reflective practice; epistemology of assessment; teaching and learning strategies; and technology for field education delivery.

Concerned about our punitive pathways in Preschool-12th grade school settings, I have also served alongside community stakeholders and advocated at the state level in Indiana for more student support services and trauma-sensitive approaches to behavioral supports. My advocacy has occurred through invited and peer-reviewed scholarly presentations at numerous conferences across the State of Indiana on the implications of

exclusionary discipline. I have also provided expert legislative testimony outlining the need for student services to provide behavioral supports for students presenting with disruptive behaviors that are rooted in trauma and pain. My most recent position as a senior lecturer and curriculum leader for the School Social Work Practice Area at Indiana University has engendered a continuation of my teaching and learning corollary while incorporating a social justice quest of promoting educational practices that align with students' interpersonal neurobiology.

Through this scholarly and emancipatory pursuit, my path has merged with Butler University's "The Brain Collaborative," a tapestry of multidisciplinary community stakeholders. This collaborative has formed to integrate neuroscience into social and behavioral aspects of educational theory, philosophy and practices with the intention of providing scientifically based practices that align with students and other school community members' neurobiology. My purpose in the collaborative is to partner with other researchers to design research strategies that will build knowledge and rigor to inform responsible approaches to applied neuroscience in education settings. Equipped with knowledge, skills, and an anchoring community network, I am prepared to conduct this dissertation study examining the interpretive perceptions involved with the application of educational neuroscience in the classroom setting.

Research Assumptions

Building upon my role as a researcher, this section entails a reflexive explication of my unique positionality and inherent assumptions and biases that comprise my investigative lens. My ultimate epistemological anchoring posits that research is optimally conceived from an ontological braiding of post-positivist truths and multiple

co-created realities. It is my assertion that ethical research seeks to contribute to a complete narrative of knowing by including both objective, a priori hypotheses supported by research designs that extol validity and reliability of data as well as inductive investigations into the depths and nuances of lived experiences. It is my pursuit as a researcher to also operate with an acknowledgement of an epistemological imperialism that persists through hegemonic sociopolitical forces that privilege certain ways of knowing and evidence for applied practices. For the purposes of this research, my standpoint is that of a blend of critical theorist and constructivism.

My interest in applied educational neuroscience is emancipatory from an epistemological and methodological perspective as well as a means to further explore the relevance and rigor of applied neurosciences as they become a predominant focus in engineering evidence-informed social work and educational practices. From a paradigmatic perspective, I am impelled to generate qualitative knowledge that honors the deeply embedded psychosocial processes in our social contexts. Co-creating knowledge that is imbued with the nuanced intricacies of the human experience underpins my unique orientation that frames this proposed research study.

Appendix E. Recording Data for Classroom Observation: Identifying Practices

What are the places where activity related to practices occurs?

Who are the people involved in the practice incident?

What individual interactions are people engaged in during the practice?

What group interactions are occurring during the practice incident?

What are the objects people use for the practice?

What is the sequence of activity that takes place over time with the practice incident?

What things are people trying to accomplish (intentions) by engaging in the practice?

What emotions are expressed throughout the practice event?

Appendix F. Data Display Table: Classroom Observation Data Collection

Observation Date and Time:	Additional Notes:
Researcher Conducting Observation:	

Observed Practices	Teacher	Students	Researcher Notes

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Zhou, Q., Chen, S. H., & Main, A. (2012). Commonalities and differences in the research on children's effortful control and executive function: A call for an integrated model of self-regulation. *Child Development Perspectives*, 6(2), 112-121.

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Zull, J. E. (2011). *From brain to mind: Using neuroscience to guide change in education*. Sterling, VA: Stylus Publishing.

**Curriculum Vitae
Sheila R. Dennis**

Education

Doctor of Philosophy Indiana University School of Social Work, Indianapolis, IN	November 2018
Master of Social Work Indiana University School of Social Work, Indianapolis, IN	May 1999
Bachelor of Arts in Social Work Anderson University, Anderson, IN	May 1996
Postgraduate Certificate, Skills of Teaching to Inspire Learning Royal Holloway University of London, Egham, Surrey, United Kingdom	February 2006

Academic Appointments

**Indiana University School of Social Work (IUSSW)
Indianapolis, Indiana**

Senior Lecturer	October 2014 – Present
Master of Social Work Field Coordinator	January 2008 – October 2014
Interim Director of Field Education (Concurrent with MSW Field Coordinator Position)	August 2012 – August 2013
Bachelor of Social Work Student Services Coordinator	March 2006 – December 2007

**Royal Holloway, University of London
Department of Health and Social Care
Egham, Surrey, United Kingdom**

Teaching Associate	September 2004 – May 2005
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**Anderson University
Department of Sociology, Criminal Justice, Social Work & Family Science
Anderson, Indiana**

Visiting Lecturer	August 2003 – May 2004
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Professional Positions

Indiana University Hospital, Oncology Services Indianapolis, IN Medical Social Worker	December 2005 – March 2006
Indiana Youth Institute Indianapolis, IN Consultant	November 2005 – June 2006
National Council For Adoption Indiana Representative Trainer	October 2002 – January 2004
Bethany Christian Services Indianapolis, IN Counselor	June 2001 – June 2003
Health and Hospital Corporation Indianapolis, IN Medical Social Worker	September 1999 – June 2001
The Villages of Indiana, Inc. Indianapolis, IN Foster Care Social Worker	May 1999 – September 1999
Kids Plus, Community Hospital Anderson, IN Social Worker	April 1997 – May 1998
Indiana Academy for Science, Mathematics, and Humanities Ball State University, Muncie, IN Residence Counselor for Gifted and Talented Students	August 1996 – June 1997

Honors, Awards, Recognitions, Outstanding Achievements

Jerry Powers Esprit Award IUSSW Ph.D. Program	May 2018
Excellence in Teaching Award IUSSW Ph.D. Program	May 2018; May 2015
IUSSW Master of Social Work Student Association Top Teacher Award-Schools Concentration	May 2016; May 2015
Bachelor of Arts Summa Cum Laude Anderson University	May 1996
Center for Public Service Fellow Anderson University	January 1993 – May 1996

Scholarship Activities

Grants and Awards

Lilly Endowment Grant in partnership with Metropolitan School District of Lawrence Township Indianapolis, IN Award Amount: \$90,000	April 2018 – June 2019
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National and Regional Conference Presentations (Starred (*) Items are Peer Reviewed):

- Brandon-Friedman, R., Hutcherson, A., & Dennis, S. (2015, October). *Structure, deviance, and power: Enhancing social work with sociological theory*. Discussion session at the Council on Social Work Education 61st Annual Program Meeting, Denver, CO.*
- Dennis, S. (2012, April). *Towards epistemic integration: An evidentiary examination of reflective practice*. Poster session presentation at The 16th Annual Indiana University School of Social Work Ph.D. Symposium, Indianapolis, IN
- Dennis, S. (2012, October). *Assessing Competency in MSW field education through Learning Outcome Narratives*. Paper presentation at the Council on Social Work Education 58th Annual Program Meeting, Washington, DC.*
- Dennis, S. (2013, March). *The Field Liaison Role: An evidentiary examination*. Paper presentation at The 30th Baccalaureate Program Directors Annual Conference, Myrtle Beach, SC.*

- Dennis, S. (2015, April). *School social workers' use of reflective practice: A qualitative study*. Poster session presentation at The 17th Annual Indiana University School of Social Work Ph.D. Symposium, Indianapolis, IN.
- Dennis, S. & Cowles, H. (2011, October). *Reflective journals and rubrics: Assessing learning outcomes in school social work field settings*. Poster presentation at 2011 Coalition of Urban and Metropolitan Universities Conference, Indianapolis, IN.*
- Dennis, S., Cowles, H., & Majewski, V. (2011, February). *Assessing students' mastery of competencies through their field journals*. Workshop presentation at The 28th Baccalaureate Program Directors Annual Conference, Cincinnati, OH.*
- Dennis, S. & Friedman, R. (2014, April). *Impact of social supports on homosexual identity formation in young adults*. Poster session presentation at the 18th Annual Indiana University School of Social Work Ph.D. Symposium, Indianapolis, IN.
- Dennis, S. & Galyean, E. (2012, March). *The evolution of social work field education: Our past, present, and future*. Paper presentation at The 29th Baccalaureate Program Directors Annual Conference, Portland, OR.*
- Dennis, S., Gauss, C., Freburg, D., & Snyder, C. (2017, June). *Indiana Student Services Coalition: Building capacity to address the behavioral health needs of Indiana's students*. Workshop presentation at the Indiana School Health Network 2017 Annual School Health Conference, Indianapolis, IN.*
- Dennis, S. & Larimer, S. (2018, May). *Applied educational neuroscience in classrooms: A grounded theory study*. Roundtable presentation at the 2018 International Congress of Qualitative Inquiry, Champaign-Urbana, IL.*
- Dennis, S. & Nes, J. (2017, October). *Social neuroscience in social work education: Pioneering new pathways*. Workshop presentation at The Council on Social Work Education 63rd Annual Program Meeting, Dallas, TX.*
- Dennis, S. & Osborn, A. (2015, March). *Dismantling the school to prison pipeline for Indiana's youth*. Workshop presentation at The 14th Annual Indiana University School of Social Work Alumni Association Conference.*
- Dennis, S. & Osborn, A. (2015, September). *Dismantling the school to prison pipeline: Social work policy and practice implications*. Workshop presentation at The 71st Annual Indiana Association of Resources and Child Advocacy Conference, Indianapolis, IN.*
- Dennis, S. & Smart, J. (2015, September). *The exclusionary school discipline crisis: Advocating for Indiana's youth*. Workshop presentation at The 2015 Annual National Association of Social Workers-Indiana Chapter Conference, Indianapolis, IN.*

- Dennis, S. & Smart, J. (2015, November), *The Indiana School Social Work Survey*. Presentation at The 19th Annual Indiana School Social Work Association Conference, Fishers, IN.
- Galyean, E. & Dennis, S. (2012, March). *I have an app for that! Utilizing the Ipad in field education*. Workshop presentation at The 29th Baccalaureate Program Directors Annual Conference, Portland, OR.*
- Galyean, E., Dennis, S., Omorayo-Adenrele, A., Satre, C., Weiler, R. (2011, October). *Keeping on track: Assessing mastery of competencies in generalist and school, leadership, health, mental health and child welfare concentrations*. Workshop presentation at the Council on Social Work Education 57th Annual Program Meeting, Atlanta, GA.*
- Galyean, E., Dennis, S., Lamb, A., Majewski, V., Snyder-Brandon, K., & Weiler, R. (2011, October). *Partnering to provide survivor services: Exploring the benefits of student field placements*. Presented at Indiana Coalition Against Domestic Violence 29th Annual Fall Conference, Indianapolis, IN.
- Khaja, K., Queiro-Tajalli, I., Barkdull, C., Cunningham, D., Lay, K., Augustine, M. & Dennis, S. (2008, July). *Lived experiences of Muslims in selected western countries in a post 9/11 Era*. Research presentation at the International Association of School of Social Work Convention, Durbin, South Africa*
- Nes, J., Dennis, S. & Lyons, S. (2015, October). *Pre-placement prep sessions: Positioning MSW students for success in field placements*. Paper presentation at the Council on Social Work Education 61st Annual Program Meeting, Denver, CO.*
- Smart, J. & Dennis, S. (2015, May). *Optimizing school safety by utilizing your school social worker*. Workshop presentation at the Indiana Department of Education Indiana School Safety Specialist Academy, Advanced Level Training Spring Conference, Indianapolis, IN.

Scholarship Invitations

- Dennis, S. (2016, April). *The exclusionary school discipline crisis: Advocating for Indiana Youth*. Presentation at the Leadership Education in Adolescent Health (LEAH) meeting, Indiana University of Pediatrics Department, Indianapolis, IN.
- Dennis, S. (2017, February). *School social workers: Catalysts for change amid uncertainty*. Presentation at Indiana School Social Work Association Legislative Education Advocacy Day, Indianapolis, IN.
- Dennis, S. (2017a, December). *Applied educational neuroscience: Pioneering new pathways*. Presentation at American Association of University Women meeting, Indianapolis, IN.

Dennis, S. (2017b, December). *The social neuroscience of learning: New paradigmatic pathways for supporting students*. Presentation at the Monroe County Childhood Conditions Summit, Bloomington, IN.

Dennis, S. (2018, March). *Trauma-responsive care: Pioneering new pathways for Indiana youth services*. Presentation at the Indiana Youth Services Association board meeting, Indianapolis, IN.

Dennis, S. & King, J. (2018, April). *Building a bridge of evidence for applied educational neuroscience: Pathways of Possibility*. Presentation at the Butler University Educational Neuroscience Symposium, Indianapolis, IN.

Kersting, R., Dennis, S., & Muhammad, M. H. (2013, March). *Field education in a technological age*. Presentation at The 30th Baccalaureate Program Directors Annual Conference, Myrtle Beach, SC.

Print and Electronic Publications (Starred Items are Peer Reviewed):

Barkdull, C., Khaja, K., Queiro-Tajalli, I., Swart, A., Cunningham, D., & Dennis, S. (2011). Experiences of Muslims in four Western countries post 9/11. *Affilia*, (26)2, 139-153.*

Dennis, S. (2011a). Identity formation and the social environment. In Jumpper-Black, C. & Khaja, K. (Eds.). *Seeing different views of the elephant: Exercises in appreciating diversity* (pp.27-28). Dubuque, IA: Kendall Hunt.

Dennis, S. (2011b). Racism, privilege, and power: A critical review of social work history. In C. Jumpper-Black & K. Khaja (Eds.). *Seeing different views of the elephant: Exercises in appreciating diversity* (pp.15-16). Dubuque, IA: Kendall Hunt.

Dennis, S. (2014). Technology in field education. In Hunter, C., Moen, J., & Raskin, M. (Eds.), *Foundations for Excellence: Social Work Field Directors*. Chicago: Lyceum.

Moen, J., Liley, D., & Dennis, S. (2014). Facilitating student learning between classroom and field. In Hunter, C., Moen, J., & Raskin, M. (Eds.). *Foundations for Excellence: Social Work Field Directors*. Chicago: Lyceum.

Teaching

Teaching Assignments and Academic Instructions

Indiana University School of Social Work

Semester/Year	Courses Taught	Format	Enrollment
Fall 2006	S141 Introduction to Social Work	Lecture/Discussion	22
Fall 2009	S651 Social Work Practicum II	Outreach	16
Spring 2009	S652 Social Work Practicum III	Outreach	16
Fall 2010	S651 Social Work Practicum II	Outreach	16
Spring 2011	S652 Social Work Practicum III	Outreach	16
Fall 2011	S651 Social Work Practicum I	Outreach	16
Spring 2012	S652 Social Work Practicum II	Outreach	16
Fall 2012	S651 Social Work Practicum I	Seminar	12
Spring 2013	S652 Social Work Practicum III	Seminar	12
Fall 2013	S651 Social Work Practicum II	Seminar	12
Spring 2014	S652 Social Work Practicum II	Seminar	12
Summer 2014	S555 Social Work Practicum I	Seminar	15
Fall 2014	S651 Social Work Practicum II	Seminar	12
Spring 2015	S652 Social Work Practicum III	Seminar	12
Spring 2015	S618 Social Work Policy and Services: Schools	Lecture/Discussion	16
Summer 2015	S516 Social Work Practice: Organizations, Communities, and Societies	Lecture/Discussion	21
Summer 2015	S555 Social Work Practicum I	Seminar	15
Fall 2015	S503 Human Behavior and the Social Environment I	Lecture/Discussion	11
Fall 2015	S502 Research 1	Lecture/Discussion	23
Fall 2015	S616 Social Work Practice in Schools	Lecture/Discussion	17
Spring 2016	S618 Social Work Policy and Services: Schools	Lecture/Discussion	18

Spring 2016	S516 Social Work Practice: Organizations, Communities, and Societies	Lecture/Discussion	20
Summer 2016	S516 Social Work Practice: Organizations, Communities, and Societies	Lecture/Discussion	26
Summer 2016	S555 Social Work Practicum 1	Seminar	12
Fall 2016	S616 Social Work Practice in Schools	Lecture/Discussion	21
Fall 2016	S503 Human Behavior and the Social Environment I	Lecture/Discussion	26
Fall 2016	D505 Social Policy Analysis and Practice	Online Lecture/Discussion	20
Spring 2017	S618 Social Work Policy and Services: Schools	Lecture/Discussion	23
Spring 2017	S516 Social Work Practice: Organizations, Communities, and Societies	Lecture/Discussion	25
Summer 2017	D516 Social Work Practice: Organizations, Communities, and Societies	Online Lecture/Discussion	19
Summer 2017	D513 Human Behavior and Social Environment II	Online Lecture/Discussion	18
Fall 2017	S616 Social Work Practice in Schools	Lecture/Discussion	22
Fall 2017	D505 Social Policy Analysis and Practice	Online Lecture/Discussion	18
Fall 2017	D505 Social Policy Analysis and Practice	Online Lecture/Discussion	19
Fall 2017	S651 Social Work Practicum 2: Schools	Seminar	11
Spring 2018	S618 Social Work Policy and Services: Schools	Lecture/Discussion	24
Spring 2018	D516 Social Work Practice: Organizations, Communities, and Societies	Online Lecture/Discussion	19
Spring 2018	S652 Social Work Practicum 3: Schools	Seminar	11
Fall 2018	S616 Social Work Practice in Schools	Lecture/Discussion	23
Fall 2018	D509 Social Work Practice II: Organizations, Communities, and Societies	Online Lecture/Discussion	18
Fall 2018	S651 Social Work Practicum 2: Schools	Seminar	11

Royal Holloway University of London

Semester/Year	Courses Taught	Format	Enrollment
Fall 2004	BSc (Hons) in Social Work - Social Structures.	Lecture/Discussion	20-25
Fall 2004	MSc Diploma Social Work Course – Disability and Mental Health	Lecture/Discussion	20-25
Fall 2004	Field Planning and Advising	Outreach	12
Spring 2005	BSc (Hons) in Social Work: Social Structures	Seminar	20-25
Spring 2005	Needs Assessment for Practice Learning- Produced Report	Report	N/A
Spring 2005	Field Liaison for Practice Learning	Outreach	10
Spring 2005	Developed and Implemented BSc Social Work students initial Assessed Preparation for Practice	Outreach	22
Spring 2005	MSc Diploma Social Work Weekly Field Seminar	Seminar	6

Anderson University

Semester/year	Courses Taught	Format	Enrollment
Fall 2003	SOWK 2000 Introduction to Social Welfare and Social Work	Lecture/Discussion	12
Fall 2003	SOCI Social Problems	Lecture/Discussion	25
Fall 2003	SOCI Social Problems	Lecture/Discussion	40
Fall 2003	SOWK 2100 Introduction to Field Experience	Lecture/Discussion	12
Spring 2004	SOWK 3210 Child Welfare	Lecture/Discussion	6
Spring 2004	SOCI 3110 The Family	Lecture/Discussion	27
Spring 2004	SOWK 3100 Social Welfare Policy	Lecture/Discussion	24
Spring 2004	SOWK 2000 Introduction to Social Work	Lecture/Discussion	10

Teaching Administration

Developed and coordinated assessment structure for MSW graduates returning for Indiana Department of Education (IDOE) School Social Work License	Fall 2014 – Present
Advised MSW students and graduates seeking IDOE School Social Work License	Fall 2017 – Present
Coordinated 103 MSW Field Placements; Developed 20 Community Field Placement Sites	Spring 2014 – Fall 2014
Coordinated 55 MSW Field Placements; Developed 21 Community Field Placement Sites	Spring 2013- Fall 2013
Served as Interim Director of Field Education-Overseeing Delivery of Field Education across BSW, MSW, and emerging online MSW program on 7 Indiana University campuses	August 2012 – July 2013
Coordinated 79 MSW Field Placements; Developed 21 Community Field Placement Sites	Spring 2012 – Fall 2012
Coordinated 111 MSW Field Placements; Developed 43 Community Field Sites	Spring 2011- Fall 2011
Coordinated 77 MSW Field Placements; Developed 19 Community Field Placements Sites	Spring 2010 – Fall 2010
Coordinated 70 MSW Field Placements	Fall 2008 – Spring 2009
Delivered academic advising for approximately 150 current and prospective BSW Program students	Spring 2007 – Fall 2007
Recruited for BSW Program – Increased admission by 6%	Spring 2007 – Fall 2007

Curriculum Development

Designed the MSW Schools Practice Area course: <i>S614 School Social Work Practice with Children, Adolescents, and Families</i>	Spring 2017
Developed the school social work field evaluation measures that align with Indiana Department of Education license requirements	Spring 2016
Led the IUSSW system-wide effort to revise the structure of field assessment tools for BSW and MSW programs on 7 Indiana University campuses	August 2012 - July 2013
Created the MSW Schools Concentration assessment measures- Reflective Journal Assessment	Summer 2009
Learning Outcome Narratives	Summer 2011
Integrative Case Analysis and Student Services Plan	Summer 2015

Service

University Service

Indiana University School of Social Work

Faculty Leader for MSW Schools Practice Area	Fall 2014 – Present
Education Assessment Committee	Fall 2014 – Spring 2017
Accreditation Self-Study Committee	Fall 2016 – Present
Student Affairs Committee	Fall 2010 – Spring 2014
Search and Screen Committee Chair for System-wide Director of Field Education	Spring 2013
MSW Schools Concentration Work Group Leader	Fall 2011- Fall 2012
Search and Screen Committee Chair for MSW Student Services Position	Spring 2011

Indiana University Purdue University-Indianapolis

Enrollment Management Council	Spring 2006 – Spring 2008
Study Abroad Committee	Spring 2006 – Spring 2008
Campus Day Planning Committee	Spring 2006 – Spring 2008
Academic Policies and Procedures Committee	Spring 2006 – Spring 2008

Professional Service

Indiana State Teachers Association Trauma-Informed Workgroup Community Stakeholder	April 2017 – April 2018
Butler University Brain Collaborative Community Stakeholder	January 2017 – April 2018
<i>Advances in Social Work</i> Reviewer for Journal Submissions	May 2016 – Present
Indiana Commission on Improving the Status of Children, School Discipline and Climate Subcommittee Member	March 2016 – Present
Indiana Student Services Coalition Founder and Chair	January 2016 – Present
Children’s Policy and Law Initiative Board of Directors Advisory Board Public Policy Committee	October 2014 – December 2017
Indiana Department of Education McKinney-Vento Education for Homeless Children and Youth: Grant Reviewer	May 2016 – June 2016

Professional and Civic Organization Memberships

Council on Social Work Education
Indiana School Social Work Association
School Social Work Association of America
American Association of University Women
Society for Social Work and Research