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 endurably 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 (Hassevoort, 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

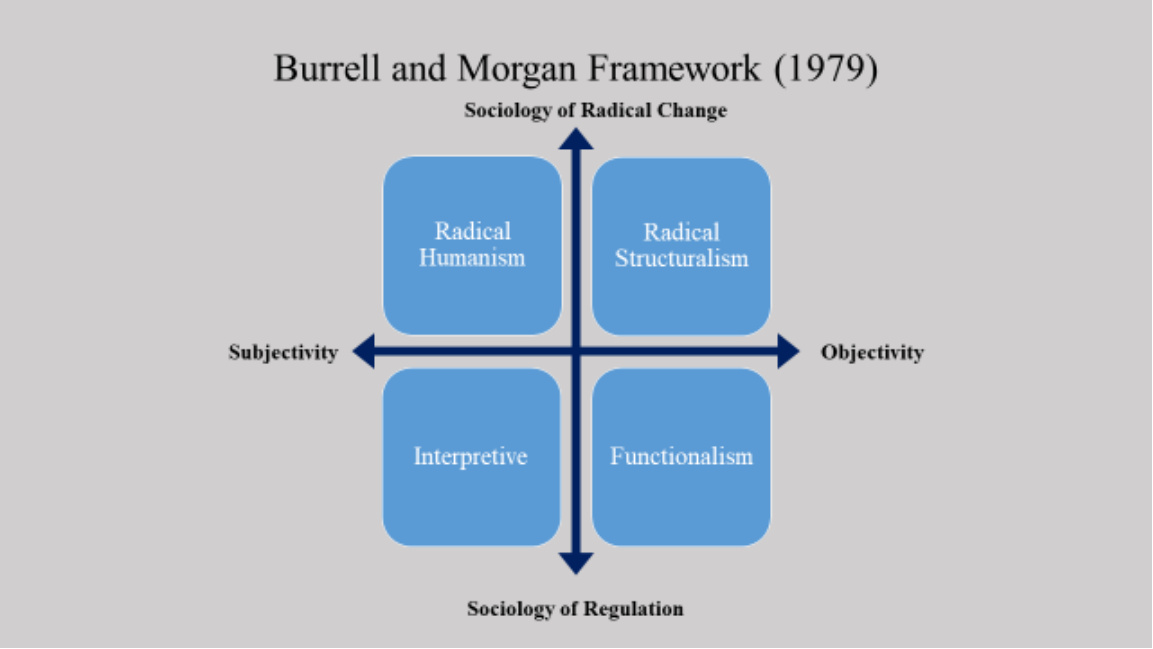
the organizational shift in culture that the findings unveiled. To analyze social phenomena in organizations, Burrell and Morgan conceptualized a four-cell matrix that defines fundamentally different perspectives along a continuum (O'Connor, Netting, & Fabelo, 2009). The intersection of a subjectivist - 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 5.1 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 5.1. The Burrell and Morgan Framework to illuminate the cultural shift from structural functionalism to a humanistic cultural framework.



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 (Durlek 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 individuals' 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). 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 individuated 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 1.3). 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. Yet, the literature shows that educators generally do not possess guidance with social-emotional curricula that incorporates knowledge on the interplay between emotional, cognitive, and social learning (Cohen et al., 2009). 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.