Teacher Perspectives of Whole Brain Teaching in A Suburban Middle School: A Program Evaluation

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TEACHER PERSPECTIVES OF WHOLE BRAIN TEACHING IN A SUBURBAN MIDDLE SCHOOL: A PROGRAM EVALUATION

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Wendy VanHosen

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TEACHER PERSPECTIVES OF WHOLE BRAIN TEACHING IN A SUBURBAN MIDDLE SCHOOL: A PROGRAM EVALUATION

By

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Dedication

I dedicate this dissertation to my three sons; Lawrence, Lance, and Lawson. When I embarked on this journey of completing my doctorate degree, I was a divorced single mother of three sons. Raising three sons while pursing my doctorate studies may seem like an overwhelming challenge but I count it as a tremendous opportunity. It is my hope that I have shown my sons through my journey that great things can be accomplished with perseverance, commitment, hard work, and prayer. They have watched me in moments of exuberation and moments of great difficulty, perhaps without even realizing the extent they have motivated me to see this process through.

During the last summer of my doctorate studies, I was blessed to marry a wonderful God-fearing man who has shown me the power of love. He has shown great patience and provided enormous encouragement when my writings required my focus that at times kept me awake all night. For these reasons, I also dedicate my dissertation to my loving husband Harry. We have a second chance in life to experience a love like never before and accomplish our dreams.

Also pivotal during my doctorate studies was my calling to ministry and the preaching of my initial sermon. Completion of this process would not have been possible without the help of my Lord and Savior Jesus Christ. This process has matured my faith. Only an omniscient God could use the events of my life to culminate to this great outcome. I dedicate my dissertation to my heavenly Father.
Table of Contents

Dedication ........................................................................................................... iii

Table of Contents ............................................................................................... iv

Acknowledgements .......................................................................................... vii

List of Tables ........................................................................................................ viii

List of Figures ........................................................................................................ ix

Acknowledgements .............................................................................................. x

Abstract ................................................................................................................ xi

Chapter 1: Introduction ........................................................................................ 2

Background ........................................................................................................... 5

Program Description ........................................................................................... 7

Context ................................................................................................................... 7

Description of the Program ................................................................................... 9

Overview of the Evaluation Approach ................................................................. 10

Program Evaluation Model .................................................................................. 11

Focus of the Evaluation ....................................................................................... 12

Logic Model ........................................................................................................... 13

Evaluation Questions ........................................................................................... 14

Definition of Terms .............................................................................................. 14

Chapter 2: Review of Literature ......................................................................... 16

Neuroscience Findings and Basis ......................................................................... 16

Infusing Neuroscience in Education .................................................................... 21

Neurological Impact of Trauma on Learning ....................................................... 24
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intense Emotion and Leaning</td>
<td>25</td>
</tr>
<tr>
<td>Movement and Neural Pathways</td>
<td>26</td>
</tr>
<tr>
<td>Critics and Opposition</td>
<td>27</td>
</tr>
<tr>
<td>Whole Brain Teaching</td>
<td>30</td>
</tr>
<tr>
<td>Hermann Whole Brain Teaching Method</td>
<td>31</td>
</tr>
<tr>
<td>Whole Brain Teaching for Challenging Kids</td>
<td>32</td>
</tr>
<tr>
<td>Summary</td>
<td>36</td>
</tr>
<tr>
<td>Chapter 3: Method</td>
<td>39</td>
</tr>
<tr>
<td>Evaluation Questions</td>
<td>40</td>
</tr>
<tr>
<td>Study Participants</td>
<td>40</td>
</tr>
<tr>
<td>Data Sources</td>
<td>41</td>
</tr>
<tr>
<td>Individual Written Reflections</td>
<td>42</td>
</tr>
<tr>
<td>Focus Group Meetings</td>
<td>43</td>
</tr>
<tr>
<td>Classroom Observations</td>
<td>44</td>
</tr>
<tr>
<td>Data Collection</td>
<td>44</td>
</tr>
<tr>
<td>Data Analysis</td>
<td>46</td>
</tr>
<tr>
<td>Assumptions, Delimitations, and Limitations</td>
<td>54</td>
</tr>
<tr>
<td>Assumptions</td>
<td>51</td>
</tr>
<tr>
<td>Delimitations</td>
<td>51</td>
</tr>
<tr>
<td>Limitations</td>
<td>52</td>
</tr>
<tr>
<td>Ethical Considerations</td>
<td>52</td>
</tr>
<tr>
<td>Chapter 4: Results</td>
<td>57</td>
</tr>
<tr>
<td>First Research Question</td>
<td>58</td>
</tr>
</tbody>
</table>
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List of Tables

Table 1. Whole Brain Teaching “Big Seven” Descriptions Areas……………………..33
Table 2. Teacher Participants in the Whole Brain Teaching Study Group……………41
Table 3. Evaluation Questions, Data Sources, and Analysis…………………………..50
Table 4. Common Components in Working Definitions……………………………..59
Table 5. Facilitating Factors in Implementing Whole Brain Teaching………………..62
Table 6. Selected Teacher Excerpts Regarding Challenges in Implementation ……..70
Table 7. Teachers With Perceptions of Ineffectiveness for Critical Thinking…………77
Table 8. Frequency of Whole Brain Teaching Strategies Used……………………….82
Table 9. Frequency of Whole Brain Teaching Strategies Used With Increase Column….83
Table 10. Learning Intentions with Strategies Used and Count of Occurrences …….85
Table 11. Number of Students Engaged by Segment During Observations……………86
Table 12. Selected Successes Observed Using Observation Protocol…………………..87
Table 13. Summary of Evaluation Question Findings………………………………….92
List of Figures

Figure 1. Logic Model ........................................................................................................13

Figure 2. Hermann Whole Brain Teaching Model.........................................................31
Abstract

The purpose of this program evaluation case study was to seek the perceptions of a group of teachers based on their experience with Whole Brain Teaching strategies at a suburban middle school. Perceptions and factors that lead to teacher use of the strategies were explored with the intention of informing stakeholders of whether teachers view these strategies as viable to their practice and how these beliefs influence implementation. Challenges pertaining to implementation were uncovered as well as the frequency and intended purposes of teacher use of the Whole Brain Teaching strategies. Further, there is limited research available on Whole Brain Teaching and this study along with a review of literature seeks to add to the emerging research base of educational neuroscience. The findings determined that teacher perceptions for the study group were influenced by factors such as the dynamics and characteristics of the group itself and whether the strategies were used in a co-teaching environment. Other key findings were that the teacher’s perceptions evolved over the course of the study to where teachers perceived the strategies to be effective for lower levels of thinking such as remembering but were not effective for promoting their students to think critically. Recommendations offered include the use of a professional learning community focused on the teacher’s experience with the Whole Brain Teaching strategies and continuous evaluation that considers needs, successes, challenges, and necessary improvements.
TEACHER PERSPECTIVES OF WHOLE BRAIN TEACHING IN A SUBURBAN MIDDLE SCHOOL: A PROGRAM EVALUATION
CHAPTER 1
INTRODUCTION

Technology advances of the 21st century have created a globally competitive environment, coupled with pressure for American students to be college and career ready (Greenhill, 2010). The trends of technology advancement have created a highly skilled workforce demand that the current American education system is struggling to fulfill (Darling-Hammond, 2010; Golden & Katz, 2008; Kliebard, 2004; National Governors Association, 2014). The 2015 Every Student Succeeds Act (ESSA), reaffirming federal requirements for the academic achievement and growth of all students, also focuses on the incorporation of college and career readiness standards for all students (United States Department of Education, 2015). The requirement of “all” students necessitates that school divisions look for ways to reach students that have historically underperformed while also increasing academic growth for those who are above the standard. In an effort to meet the academic needs of all students, some school divisions are looking to nontraditional teaching strategies including a broad body of brain-based instructional strategies (Caine & Caine, 1990; Jensen, 2005; Kane, 2013). Whole Brain Teaching is one of a plethora of strategies referred to as brain-based. However as more educators invest time and resources into these brain-based teaching programs, it remains unclear whether these strategies actually work and are worth the investment.

The emerging field of educational neuroscience demonstrates that there is significant interest in considering how neuroscience findings can infuse with education to
influence teacher practices (Ansari et al., 2012). Although this field is constantly evolving and has been met with contentious skepticism, an increasing number of educators are giving consideration to the potential of brain-based instructional strategies which posits that there is a relationship between neuroscience and the teaching and learning process (Ansari et al., 2012; Bruer, 1997, 2005). The dichotomy between brain-based instruction enthusiasts and skeptics is fueled by gaps in communication between neuroscientist and educators, limited research of the impact of specific brain-based strategies, applications that extend beyond neuroscience findings, and varying perceptions of what constitutes a brain-based strategy (Ansari et al., 2012). Yet, this divide has not extinguished the intrigue of brain-based instructional strategies and the potential positive implications for teaching and learning. Both sides agree that further research is needed to delineate myths and extensions of the data from viable findings.

The Whole Brain Teaching program is a specific brain-based instructional program that postulates consideration of certain simultaneous brain processes as the foundation of its instructional strategies. Although understandings and definitions of Whole Brain Teaching are still forming, the following program tenants can be identified (Battle, 2010; Biffle, 2013.

- Teaching should be based on how the brain learns
- The more brain processes simultaneously involved in learning, the better the information is retained
- Student engagement is vital to learning
- Learning necessitates students talking about the content more than the teacher
Kinesthetic movements, emotion, and environmental stimuli are vital to learning.

The Whole Brain Teaching program is specifically designed to reach what the developer refers to as challenging students (Biffle, 2013). Challenging describes students who are struggling academically and may demonstrate behaviors that interfere with the learning process (Biffle, 2013). Brain-based approaches consider underpinnings that impact learning such as chemical imbalances, traumatic emotional experiences, genetic predispositions, and limited exposure (Sanchez, 2008). Students who possess any combination of these underpinnings are apt to struggle with excelling in the current federally mandated educational climate without proper consideration of how these factors influence learning processes. Although the program description states that the strategies are beneficial to all students, the emphasis is on students who have not responded favorably to traditional teaching methods. For this reason, the Whole Brain Teaching program, despite its limited research-based effectiveness was introduced to teachers and administrators in the school division of study to potentially reach students who have traditionally underperformed.

Such endeavors reflect the imperativeness of continued study of brain-based instructional practices. The cost of not considering if neuroscience findings can inform instructional practices or if brain-based strategies are viable in increasing student learning outcomes particularly for challenging students, is that the unknown impact is harmful to all. Either valuable resources or efforts are being wasted by enthusiasts or an opportunity to positively change instructional practices is being ignored by skeptics. This program evaluation will focus on teacher’s understandings and perceptions of Whole Brain
Teaching as effective instructional strategies based on their classroom experience with the strategies and participation in a Whole Brain Teaching teacher group.

**Background**

The momentum of infusing neuroscience findings with educational practice emerged within the past two decades, largely influenced by key developments in neuroscience research which debunked previous findings that intelligence was fixed from birth (Carew & Magsamen, 2010). The connection between neuroscience and education gained support with the availability of Magnetic Resonance Imaging, which captures images of active brain regions that are stimulated during cognitive processes such as reading or arithmetic (Ansari et al., 2012). During the learning process, chemical interactions take place within the brain and structures called dendrites expand as new information is learned (Tate, 2015). The action of thinking requires the chemical transmission of information through neurons. A chemical process involving neuron communication in the human brain occurs with every thought, word, or behavior produced. Neuroscience indicates that the brain is plastic, meaning that it has the capability of being changed through experiences (Bishop, Blakemore, Butterworth, & Goswami, 2013; Kolb & Gibb, 2011). This creates a potential opportunity for educators to provide stimulating learning experiences. As educators provide new experiences for students, it is important to understand how the brain processes new information and how to account for the chemical imbalance that many underperforming students experience. Brain-based teaching approaches are teaching methodologies based in neuroscience and incorporate strategies to encourage optimal effectiveness in how the brain processes new information and stimuli by maximizing student engagement. The idea that the
relationship between student and teacher are vital to engaging the minds of students is supported through brain-based teaching approaches when considering academics and student behaviors (Pianta, Hamre, & Allen, 2012). A consideration of neuroscience research is appropriate as classrooms are complex multicomponent social systems with complex interactions (Pianta et al., 2012). Maximizing student engagement and decreasing challenging student behaviors is an intended outcome of the Whole Brain Teaching strategies (Biffle, 2013). These approaches are based on a body of research that considers how the brain learns and has been used to infuse unconventional teaching strategies to facilitate traditional curricula (Brown, 2012; Franklin, 2005; Jensen, 2005; Mitchell, 2008). Such strategies include but are not limited to the inclusion of music as an instructional tool, movement to promote retention, chunking new information, repetition, and engaging multiple senses simultaneously. Brain-based approaches also consider underpinnings that impact learning such as chemical imbalances, traumatic emotional experiences, genetic predispositions, and limited exposure (Sanchez, 2008). Students who possess any combination of these underpinnings are apt to struggle with excelling in the current federally mandated educational climate without proper consideration of how these factors influence learning processes.

The Whole Brain Teaching program for challenging kids is a packaged program that has gained the attention of many educators seeking to improve instructional practices, although the program’s academic achievement impact is research poor (C. Biffle, personal communication, October 6, 2016). This program evaluation of the Whole Brain Teaching program with a group of teachers at the middle school of study will provide feedback to the participating teachers and stakeholders at the school of study on
the teacher’s understandings and perceptions of the program. This program evaluation seeks to provide clarity on the usefulness of Whole Brain Teaching as an instructional strategy while adding to the limited research based literature on Whole Brain Teaching.

**Program Description**

A description of the program to include its context is provided here to consider the intended and tacit elements that impact how the program is perceived.

**Context.** The school district of study is part of the Hampton Roads area located in the southeastern part of Virginia. It ranks sixth in size in the region with 19 schools serving approximately 14,400 students. The demographics of the district include a population of 56% African-American, 37% White, 5% Multi-Ethnic, and 2% Asian. Approximately 47% of the student population is eligible for free and reduced-price lunch. The middle school of study is one of four middle schools and it serves approximately 1,220 students in grades sixth through eighth. The population of the middle school of study includes 47% African-American, 36% White, 7% Multiple Races, 7% Hispanic, and 3% Asian. Of the 48% of African-American students, 47% are males. There are 97 teachers on staff at the middle school of study including, 21 sixth grade, 26 seventh grade, 25 eighth grade, and a combination of 25 physical education, gifted resource, fine arts, and career and technical education teachers. Special education students comprise 13% of the total school population.

The middle school of study has demonstrated a tradition of active support from community stakeholders through Parent Teacher Student Association (PTSA) membership, business and community partnerships, and parental involvement. The contextual components that have a potential impact on the effectiveness of the Whole
Brain Teaching program include the characteristics of the close knit communities within the district. Many teachers are graduates of the school district and it is not uncommon for teachers to teach the children of former students. These dynamics are important because they speak to the power structures that exist within the cultures and communities within the school district. How a program such as Whole Brain Teaching is received and perceived throughout the school community is a key factor in soliciting and solidifying parental and community partner support. The audience impacted by this investigation includes the stakeholders who are students, teachers, school leaders, district leaders, school board members, and community partners. The focus of the program evaluation is to determine teacher perceptions of the program, if it is yield the desired outcomes, and to determine any potential for Whole Brain Teaching to become a systematic mainstay.

The comprehensive plan of the district includes a goal to enhance academic achievement through enhanced instructional skills gained by professional development. This goal outlined provides clear evidence that district leaders deem improving instruction to be an integral part in improving student achievement for all students and ultimately adding value to the community through the skills and preparedness of the students entering college and careers as stated in the district’s mission. The teachers and administrators of the school division participated in a two-day professional development introductory training on Whole Brain Teaching during the summer of 2014, conducted by developer Chris Biffle. Additional professional development was provided for administrators upon request and with their faculty members. The previous administrator at the middle school of study did not elect to participate in additional school-wide professional development for teachers. An elementary school principal within the district
introduced the program to the school division and this school piloted the program during the 2013-2014 school year. All instructional staff members participated in targeted training of the seven core techniques of the program and were provided the *Whole Brain Teaching for Challenging Kids* book and a teacher handbook as resources. Continued interest in the Whole Brain Teaching strategies has been generated by individual teachers. This interest has been expressed through continued classroom use by individual teachers throughout the district and highlighted as instructional practices of the division-wide teachers of the year for the 2013-2014 and 2014-2015 school years.

**Description of program.** Critical to understanding the Whole Brain Teaching program is understanding the foundational neuroscience research and its application to education. The validity of the program’s philosophy of creating more effective teaching and learning through the use of a brain-based multi-sensory approach hinges on the appropriate application of neuroscience research findings in the development of the program’s instructional strategies (Wolfe, 2001). The specific brain areas that the Whole Brain Teaching program identifies are the motor cortex, visual cortex, pre-frontal cortex, amygdala, Broca’s area, limbic system, and the hippocampus (Biffle, 2013). Each brain area responds to specific senses and the ability to properly respond is impacted by established neurological pathways established from previous experiences, environmental factors, emotion generated, and the strength of the neural connections associated with the process (Jensen, 2005). A chemical process takes place as information reaches each brain area and the Whole Brain Teaching program indicates that the more areas of the brain that information is processed through, the likelihood of learning increases (Biffle, 2013; Sanchez, 2008). The focus of the program is adjusting teacher behavior to increase
student engagement and provide a more effective learning experience for students. For example, the teacher becomes more of a facilitator as students use the teach-okay peer teaching Whole Brain strategy which requires the students to teach small chunks of information to a peer student in multiple one to two minute intervals, using specific kinesthetic gestures to help explain the content to their peer.

**Overview of the Evaluation Approach**

This program evaluation case study primarily falls within the constructivist paradigm. Meaning is constructed through reflection and dialogue about the “lived experience” with the program (Mertens & Wilson, 2012). In addition to the neuroscience research findings, the theoretical basis of the Whole Brain Teaching program includes the community of practice theory (Biffle, 2013). The unit of analysis of this program evaluation will be the community of practice at the middle school of study. The development of a community of practice is an intended output of the program as indicated in the logic model in Figure 1. Wenger describes communities of practice as “groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly” (Wenger & Wenger-Trayner, 2015, p. 1). A community of practice has three attributes to include domain, community, and practice. Domain is characterized by having a shared interest, commitment, and value in learning from one another; community indicates that relationships are built through sharing and reflection of their experiences; and practice involves sharing resources and ideas, addressing concerns, and having sustained interactions over time (Wenger & Wenger-Trayner, 2015). Teachers participating in a Whole Brain Teaching teacher group represent a community of practice at the middle school of study for this evaluation.
**Program evaluation model.** The purpose of this program evaluation is formative in nature. It is an ongoing process that seeks to determine perceptions of participants. Daniel Stufflebeam’s Context Input Process Product (CIPP) method is used to design the evaluation (Mertens & Wilson, 2012). As reflected in the logic model presented in Figure 1, identified inputs, processes, outputs, and outcomes are considered when evaluating the Whole Brain Teaching program. The logic model provides a basis to study teacher perceptions of the Whole Brain Teaching program in the middle school of study. The inputs are those items that contribute to the processes or activities outlined in the model. These inputs include feedback from parents, teachers, and students regarding their perspective of the program as well their perspective on the brain-based teaching strategies. Other inputs for the program include training, professional development conducted on the school level facilitated by instructional leaders, resources and funding for program implementation, and state and local testing data used as a pre and post outcome measure. As indicated by the connecting lines between the inputs, these items together influence the processes.

The processes are the actual activities that are included in the implementation of the Whole Brain Teaching program. These activities include establishing school-wide expectations, ongoing process of observations, feedback, and evaluation conducted by school leaders, and modeling program strategies with parents, stakeholders, and community members. Each of the indicated processes is intended to yield outputs and outcomes. If-then statements can be derived from the developed model to help evaluate if the intricacies of the program meet its intended purpose. Determining the underlying hypotheses of the model can also reveal how to better support the individuals involved in
the process. For example, the model establishes that if school-wide expectations of
Whole Brain Teaching are set, then the effectiveness of professional learning
communities will be increased and students will become more confident, which will
increase scores on state and local tests, which will reduce achievement gaps, which will
eventually cause other teachers to use the Whole Brain Teaching program. It is important
to note that the only output provided in the logic model that this program evaluation case
study utilizes it the short term output of increased student engagement. The other short
term, medium, and long term outcomes are beyond the scope of this study.

**Focus of the evaluation.** This study is an exploratory study of teachers’
perceptions about Whole Brain Teaching. The focus of this program evaluation case
study is on the experience of the teachers in the Whole Brain Teaching teacher group.
This program evaluation case study seeks to determine teacher perspectives of the
strategies and how and if these strategies are changed with the teachers experience using
the strategies as part of a Whole Brain Teaching teacher group. The processes of
establishing the teacher group, holding the teacher group meetings, and implementing the
strategies are indicated in the logic model.
TEACHER PERSPECTIVES OF WHOLE BRAIN TEACHING IN A SUBURBAN MIDDLE SCHOOL: A PROGRAM EVALUATION

Figure 1. Logic Model – Depiction of Whole Brain Teaching at a suburban middle school
**Evaluation questions.** To conduct the Whole Brain Teaching program evaluation case study, four evaluation questions will be used. These formative questions provide a basis for the evaluation and reveal what the evaluation seeks to uncover and determine.

1. What are teachers’ working definitions of Whole Brain Teaching?
2. What are teachers’ perceptions of the facilitating factors in implementing Whole Brain Teaching?
3. What are teachers’ perceptions of the the challenges in implementing Whole Brain Teaching?
4. What are teachers’ perceptions of the effectiveness of Whole Brain Teaching strategies in terms of student engagement and in meeting the needs of challenging students?
5. What Whole Brain Teaching strategies are being used and for what purposes?

**Definitions of Terms**

To clarify understanding of key terms used throughout this study, definitions for the terms are provided here.

*Brain-based Teaching.* An intentional and purposeful engagement of strategies in the context of education that consider how the brain functions and based on findings derived from scientific research (Jenson, 2005).

*Challenging Students.* Students who are struggling academically and/or demonstrate behaviors that interfere with the learning process (Biffle, 2013).

*Neuroplasticity.* The brains ability to develop new brain cells and neural connections throughout a person’s life span (Kolb & Gibb, 2011).
Neuroscience. The study of the brain and nervous system including functions, structure, connectivity, processes, and responses (Bishop et al., 2013).

Whole Brain Teaching. A method of teaching that simultaneously engages multiple areas of the learner’s brain through the use of specific brain-based techniques to facilitate an attention getter, direct instruction, peer teaching, collaborative learning, and assessment (Biffle, 2013).
CHAPTER 2
REVIEW OF RELATED LITERATURE

As the research of how neuroscience and education work together continues to evolve, the challenge for many educators is determining how to translate this insight into practical strategies and effective instructional practices that reach all students (Franklin, 2005). The implications of infusing neuroscience research based approaches is particularly important for teaching challenging students, who for a myriad of reasons, have not been as academically successful as their peers through the use of traditional teaching methods. A review of research on brain-based teaching programs, including Biffle’s Whole Brain Teaching program, is provided. Lastly, a critical review of opposing literature that advises caution with using evolving neuroscience findings in education field is provided.

Neuroscience Findings and Basis

The human brain is the most complex organism of all living creatures, it is larger than the brain of any animal, and its ability to reason and solve complex problems is uniquely human. Neuroscientists have concluded that the cells of the brain, called neurons, are not fixed throughout a person’s lifetime but are able to grow in certain conditions and deteriorate in others (Jensen, 2005; Willis, 2006, 2007). Neurons are a part of literally every “thought” process and their ability to grow and regenerate has implications for learning. It was once held that the human brain was hardwired at birth and incapable of regeneration, but researchers have now determined that the human brain
is capable of neurogenesis, the ability to grow new brain cells (Kempermann & Gage, 1999; Kokovay, Shen, & Temple, 2008). The findings of this research have profound implications for the adult human brain, however neuroscientists disagree on the degree to which the neurogenesis observed impacts the development of the human brain of a child after birth (Kolb & Fantie, 2009; Kolb & Gibb, 2011). Earlier research determined that neurogenesis was a process that primarily occurred in the brain of a growing baby while still in the mother’s womb and completion of the process by birth (Ernst & Frisen, 2015). More recent research indicates that not only do cells continue to grow, but also that their supporting branches, called dendrites, continue to grow and are strengthened over a period of time by frequent, active, stimulation (Hyland, 2015; Sousa, 2011; Tate, 2015; Willis, 2007). This means that intelligence is not fixed, learning can create new neural pathways, and that the brain’s ability to learn is significantly influenced by external environmental factors (Dweck, 2006; Gray & Thompson, 2004).

There is also considerable literature on how genes and the brain’s ability to learn are related. Although intelligence is not fixed, that does not mean that every person’s brain can perform at the same level. Current research of “epi-genetics” indicates that a person’s genes have the potential to be over-ridden by their environment (Brendtro, 2015). This controversial area of epi-genetics has been met with enthusiasm by those who believe this body of research confirms theories that learning and environment have an inextricable connection (Katz, 2013). However, skeptics express caution in making a blanket application of a very complex process and that all genes can be over-ridden based on environmental factors (Juengst, Fishman, McGowan, & Settersten, 2014). Neuroscientists conclude that both genes and environment play a role in brain functioning
Genes provide a disposition for a person’s learning ability and partial basis for some cognitive deficits. Neuroscientists have also discovered that some genes can be turned on and off by social interactions (Champagne & Curley, 2005). Learning capacity is determined by genetic and environmental influences (Bishop et al., 2013).

Neuroplasticity is the term used to describe the brain’s constant change throughout a person’s life span and the brain is referred to as being “plastic” (Kolb & Gibb, 2011; Phelps, 2004). Neuroscientists have discovered that the lifelong process of generating new cells and dying of other cells occurs in the hippocampus, an area of the brain that is significantly responsible for memory and emotion (Phelps, 2004; Willis, 2006). Closely interacting with and attached to the hippocampus is the amygdala, which researchers call the emotional center of the brain. The amygdala responds to emotional stimuli and this close relationship between the amygdala and hippocampus is the reason why memories connected to emotional events seem to have a lasting imprint or encoding in the brain. Children who have traumatic emotional experiences such as abuse or depravity are likely to have damage to the hippocampus which can alter their responses to stimuli and lag learning processes (Sanchez, 2008). In one study the hippocampus of children who suffered physical, emotional, or sexual abuse and identified with post-traumatic stress disorder (PTSD) were studied for a period of 12-18 months. The study determined that the more severe the experiences, the more cortisol hormone released in the brain and the more hippocampus brain cells were killed (Carrion, Weems, & Reiss, 2007). The findings of this study are profound because the extreme stress that these children experienced adversely impaired an area of the brain that plays a major role in
memory formation and processing new information. The hippocampus and amygdala are part of the brain’s complex limbic system and work together with the enfolded cerebral cortex to regulate emotion and studies show that this system produces fight, flight, or freeze behaviors in children who have suffered trauma or who struggle with anxiety (Brendtro, 2015). Also, the neurobiological process of responding to stress is chemically escalated when the brain has previous trauma reference points and de-escalation or recovery time is often elevated (Sanchez, 2008). Neuroimaging scanning has been an integral part of current findings related to neuroplasticity. This imaging has allowed researchers to watch how the brain responds to stimuli, new information, and stress. The scans indicate increased brain activity in certain areas of the brain as a direct result of the variable introduced.

Neuroscience research indicates that a memory is stored in multiple areas of the brain, broken apart into visual images through the visual cortex, emotion through the amygdala and hippocampus, movement through the motor cortex and cerebellum, and other sensory areas of the brain (Willis, 2007; Wolfe, 2015). When the brain recalls information it reconstructs it from each sensory area of the brain (Jensen, 2005; Schacter, 1992). Neuroscientists have found that memories are encoded to a large degree in the areas in the brain through which they are received and that there is bidirectional influence between movement and cognition (Leisman, Moustafa, & Shafir, 2016). Other neuroscientists have concluded that memories associated with high levels of emotion are found specifically in the hippocampus neurons before being distributed throughout the brain. The strength of a memory depends upon the number and strength of synapses, or neural connection points, associated with the memory (Mellanby & Theobald, 2014).
According to neuroscientists, this long term potentiation (LTP) is a result of repetitive stimulation (Mellanby & Theobald, 2014). Research further concludes that engaging multiple parts of the brain provides multiple pathways for processing information and promotes the development of a long term memory (Sousa, 2011; Wolfe, 2015). An interplay exists between the hippocampus, which is associated with long-term memory, and the prefrontal cortex, which helps to assimilate new information with previously learned information (Preston & Eichenbaum, 2013). Other areas of the brain that interact during learning processes are the Broca’s area, which regulates speaking, and Wernicke’s area which regulates the human ability to listen (Biffle, 2013).

It is also important to consider literature on the areas of the brain that primarily regulate movement. Neuroscientists agree that there is a positive connection between movement and cognition (Griss, 1998; Wilson & Conyers, 2013). In order for a person to move, a process involving thousands of neurons must occur in the brain between the motor cortex and the cerebellum. One study found that there are identifiable patterns of activity in the motor cortex when a movement is being learned and that this pattern transfers to the processing of new information (Peters, Chen, & Komiyama, 2014). Another critical finding in neuroscience research is that the cerebellum contains over 40% of all the neurons contained in the brain and information learned with movement has a greater chance of retention because of the large number of neurons that are stimulated in order for movement to occur (Jensen, 2005). Retention gained from learning with movement is even greater with repetition of the same movement associated with the same information (Griss, 1998).
One thing that neuroscientists agree on is that the human brain is complex and that there is still a vast amount of knowledge to discover (Bishop et al., 2013; Champagne & Curley, 2005; Gray & Thompson, 2004; Kolb & Gibb, 2011; Phelps, 2004). There is also consensus that although research indicates that various areas of brain are associated with specific functions, high levels of processing in the brain require the simultaneous integration of multiple areas of the brain (Gray & Thompson, 2004; Peters et al., 2014; Preston & Eichenbaum, 2013; Willis, 2006).

**Infusing Neuroscience in Education**

Educational neuroscience is an emerging field that has generated excitement and expectation for some and skepticism and criticism from others (Alferink & Farmer-Dougan, 2010; Butler-Kisber, 2011). Caution is noted when reviewing the literature which suggests neuroscience research offers potential solutions to improve persistent problems in education such as the achievement gap (Battle, 2010; Brown, 2012; Franklin, 2005; Gozuyesil & Dikici, 2013; Jensen, 2005; Mellanby & Theobald, 2014; National Council for Accreditation of Teacher Education, 2010; Sousa, 2011; Wilson & Conyers, 2013). This caution is given because the infancy of the field of educational neuroscience and the potential for misapplication of findings to educational practice.

Literature asserts that teachers who are knowledgeable about brain based strategies and who use their understanding of how the brain acquires information to teach their students, are more likely to be able to help their students learn how to think critically and make meaning of information (Hruby & Goswami, 2011; Jensen, 2009; Smith, 2007). Kurt Fischer, Harvard University Graduate School of Education professor and director of the Mind, Brain, and Education program (MBE), postulates that our tools
for teaching must no longer be one-dimensional but multi-dimensional (Fischer, Daniel, Immordino-Yang, Stern, Battro, & Koizumi (2007). Neuroscience-based instruction that utilizes multiple regions of the brain simultaneously increases the likelihood that information will enter the student’s long term memory and be easy to retrieve (Sanchez, 2008; Willis, 2007).

One study conducted by a principal and four teachers found that the MBE instructional strategies yielded significant increases in student outcomes that could not be attributed to maturation alone (Brown, 2012). The study involved 5 year old special education students and a pre/post evaluation tool was used to measure growth. Outcomes were measured for four years and each year showed positive outcomes directly attributed to the brain-based instruction provided through the MBE program. In one particular year, the composite quotient which measured the results of a pre and post assessment, increased from 80.57 to 112.00 (Brown, 2012). Students in this study were also administered the Measures of Academic Progress (MAP) assessment which is a researched-based instrument designed to provide growth data (Cordray, Pion, Brandt, Molefe, & Toby, 2012). The MAP assessment results of sixth grade students who had four years of instruction using the MBE program, indicated that the students significantly exceeded the norm scores for math (Brown, 2012). Through survey results, responses indicated that students believe their education is their personal responsibility, take ownership for their learning, and that parents play a vital supportive role in this process (Brown, 2012). It is important to note that students who were English-language learners and students with disabilities were included in this study.
Another study conducted through the Turkish University of Firat of 8th grade science and technology students, examined the impact of brain-based instruction on achievement, attention, and motivation (İnci & Erten, 2011). A pre/post evaluation tool was used on an experimental and control group. The experimental group was provided instruction using brain-based learning approaches. This study considered a particular lesson on “States of Matter and Heat” and was conducted during the second semester of a school year. Results of the pre/post evaluation were analyzed using the SPSS program, Friedman test, and the Wilcoxon sign rank test. The results of the study indicated statistical significance as determined by the Friedman test, for the experimental group based on the results of the pre and post assessments. The Friedman test was applied using the SPSS program and evaluates several measurements including the mean, standard deviation, and statistical difference between the two groups of students. The study concludes that students who received instruction using the brain-based learning approaches performed better academically, indicated by a 27% increase in mean scores, and displayed a more positive attitude towards learning than students who were taught using traditional methods.

A quantitative study that examined the effectiveness of brain-based learning on student outcomes found positive results. This meta-analysis of thirty-one studies on brain-based learning concluded that when compared to traditional methods of teaching, brain-based learning resulted in greater academic outcomes (Gozuyesil & Dikici, 2013). The effect size of this meta-analysis was 0.649 and used a random effects model. The results indicated that there was no significant variance in effect sizes that could be attributed to subject, sample size, or educational level measured. The studies included in
this meta-analysis were all completed in the United States and Turkey, with the Turkish studies having the greater sample size (Gozuyesil & Dikici, 2013). It is interesting to note that countries other than the United States are taking a progressive approach and are leaders in studies conducted on brain based strategies.

Neuroplasticity provides a basis for the long held sentiment in education that all students can learn (Caine & Caine, 1990; Sousa, 2011; Wolfe, 2015). This discovery can play an integral part in a teacher’s ability to have a growth mindset and it also is a motivator for students to know that they are capable of increasing their intelligence (Dweck, 2006; Jensen, 2005). As students learn new information and experience frequent stimulation to the same area of the brain, new neuron connections are made and synapses are strengthened (Jenson, 2005). Over time, the new dendrites that are formed play a key role in the student’s ability to reshape and reorganize their thoughts (Hyland, 2015; Tate, 2015). This is significant for instruction that is intended to create new patterns of thinking or behavior. Understanding of these cognitive processes informs the teacher of how to best approach instruction so that delivery is most effective in captivating and activating learning (Almarode & Miller, 2013). Just as brain cells increase with increased stimulation, brain cells also decrease with sustained non-use and teachers who consistently utilize brain-based strategies are intentional in creating a classroom environment that immerses students in the learning experience (Franklin, 2005; Willis, 2006). Such findings encourage proactive measures for educators, particularly teachers of students who have a history of low academic performance.

**Neurological impact of trauma on learning.** There is a robust body of research that indicates that trauma, stress, and anxiety can impair brain functioning and interfere
with learning processes (Jensen, 2009; McInerney & McKlindon, 2015). Specifically, trauma and chronic stress makes an indelible impression as the brain releases chemicals in response to the experience. Neuroscientists have determined that trauma can cause a deficiency in the pre-frontal cortex, which is an area of the brain essential for problem solving (Asplund, Todd, Snyder, & Marois, 2010; Shin, Rauch, & Pitman, 2006). Researchers have also linked trauma with critical changes in the amygdala and hippocampus causing deficits in attention, concentration, and memory (Shin, Rauch, & Pitman, 2006). Having a working knowledge of research on how the brain’s ability to learn is impacted by trauma potentially can assist the teacher create an environment that carefully considers how stimuli is used and promotes optimal learning for students. One out of every four children in American schools have experienced a traumatic event that affects their behavior and learning (National Child Traumatic Stress Network, 2008).

**Intense emotion and learning.** There is a substantial relationship between emotion and the brain’s learning processes (Jensen, 2005). Learning experiences that create and replicate intense positive emotions stimulate the amygdala, associating the emotion with memory of the experience (Killcross, 2000; Phelps, 2004). Emotions are also closely intertwined with interest and motivation and one study concluded that a student’s ability to learn is significantly impacted by the emotions in the instructional and social environments (Pekrun, Goetz, Titz, & Perry, 2010). Emotionally stressful school environments can be counterproductive learning (Sylwester, 1994). Memory and emotion share an interacting web of connections within the brain and for this reason, emotionally charged events are likely to be better retained. Also research indicates that the brains ability to recall the details of an experience is closely connected to the emotion
experienced with the learning (McGaugh, 2003). Teachers who are equipped with the knowledge that the brain’s ability to retain information is heightened by the intensity of emotion generated during the acquisition process, can intentionally create meaningful learning experiences that are charged with emotion to help students remember key elements of that experience.

**Movement and neural pathways.** Brain based instruction provides students with the tools to not only recall information but to engage their brains in thinking processes that promote generation of new thoughts (Brown, 2012; Worden, Hinton, & Fischer, 2011). One way that this is achieved is by building and strengthening new neural pathways. Researchers have determined that connecting movement when learning new content strengthens synaptic connections. One study of middle school students indicates that the incorporation of movement to teach content yielded significant growth for students who were previously identified as underachieving (Lister & Ansalone, 2006). Whole brain teaching incorporates movement through repetitious hand gestures and symbols that become associated with specific words or chinks of information in the learning process. Student attitude and the degree to which students are involved in their own learning is also an important factor, especially with underachieving students. Research reveals that both achievement and attitude towards learning are enhanced when tactual strategies are employed (Griss, 1998). This suggests that delivery systems that use movement to actively involve students in the leaning process, may facilitate the development of positive academic and attitudinal outcomes (Lister & Ansalone, 2006). Whole brain teaching methods attempt to synthesize the neuroscience research of how the brain processes information and the connections to learning including the consideration
of trauma, emotion, and movement. It is still too early to determine how the application of neuroscience findings to education produces sustained impact.

**Critics and Opposition**

Skeptics of the usefulness of neuroscience in education state that not enough information is known for neuroscience to be embraced as an effective way to reform teaching (Purdy & Morrison, 2009; Varma, McCandliss, & Schwartz, 2008). Neuroscience findings have evolved quickly within the past two decades and gained excitement amongst educators, seen as a solution to improve teaching and learning, and thus increase academic results. However, there is a concern presented over a decade ago by, that neuroscience findings have been overgeneralized and stretched beyond their actual meaning to fit the desperate need to improve education, and premature in their application to teaching practices (Bruer, 1997; Epstein, 2008). Critics posit that the pronounced gaps in student performance within schools across the United States, that continue despite many reform efforts is a catalyst to accept brain-based teaching strategies even though studies are scare that specifically link brain-based teaching strategies to increased learning outcomes (Purdy & Morrison, 2009). Even more absent, are studies of the effectiveness of whole brain teaching methods on learning, motivation, and negative behavior. This reductionist view of overemphasizing the role of neuroscience in learning to solve complex problems in education creates a further divide between science and education (Bishop et al., 2013).

The answer to the question of brain-based instruction having a direct and substantial impact on teaching and learning still remains unanswered for many educators and researchers. Neuromyths have influenced the use of the label “brain-based” on
strategies and programs that misuse and misrepresent neuroscience research to promote a product or make generalities (Dekker, Lee, Howard-Jones, & Jolles; 2012). Neuromyths are described as “incorrect assertions about how the brain is involved in learning” and the prevalence of neuromyths have been used to promote commercial instructional packages (Dekker et al., 2012, p. 2). One study which sought to determine the prevalence of neuromyths surveyed 242 teachers with an online questionnaire containing 32 statements of which 15 were neuromyths. The researchers found that over 50% of the teacher participants believed 7 of the 15 neuromyth statements to be true (Dekker et al., 2012). This study supports that incorrect neuroscience research assertions to education have made it difficult to determine what is an appropriate application of neuroscience research and what is not. Although there is acceptance that sound neuroscience research findings have potential to influence teaching practices, there is a lack of consensus as to what this application should include. For example, neuroscience research may provide methods for early diagnosis of learning difficulties but does not provide a clear indication of how to translate this research into new teaching advances (Gabrieli, 2009).

A second criticism is that strategies that attempt to target the left or right brain based on neuroscience research of how information is processed in different areas of the brain, negates the evidence that information is processed throughout the brain simultaneously and that it is ineffective to target only one hemisphere (Alferink & Farmer-Dougan, 2010; Dekker et al., 2012). Previous brain research on left and right hemispheres similarly generated excitement for educators and gave rise to the promotion of instructional strategies that claimed to target the left or right brain learner (Alferink & Farmer-Dougan, 2010). It was later determined that although the brain processes
information differently based upon brain hemisphere, the information is processed simultaneously (Chabris & Kosslyn, 1998). This gives caution to critics who view the excitement of recent neuroscience findings as another trend that will eventually be replaced.

Another criticism is that the neuroplasticity which allows for continuous growth of neurons and increases in dendrites is not an overnight process that can be achieved through a singular activity. An inaccurate portrayal of this research has influenced misuse and an overrepresentation of the findings. The research clearly indicates that long term potentiation is a critical requirement for increases in synaptic strength to occur, which allow for increases in dendrites (Freeberg, 2006; Garrett, 2008; Mellanby & Theobald, 2014). Some critics have asserted that brain based strategies claiming to stimulate dendrite growth are no different and offer no more benefit than traditional instructional strategies that used repetition to promote memorization and mastery learning (Alferink & Farmer-Dougan, 2010; Kirschner, Sweller, & Clark, 2006). These critics suggest that brain-based programs are merely repackaged traditional teaching strategies.

Another argument from the critics of brain based approaches is that some applications of neuroscience have jumped beyond the data. Possible reasons for this include misinterpretation of the data and overrepresentation leading to enthusiasts filling in the research gaps in an effort to fix concerns in education (Alferink & Farmer-Dougan, 2010). The accuracy of neuroscience findings is not in question. Their application and effectiveness to increase learning outcomes is where the research gap exists. Studies revealing a direct link between brain-based strategies or programs and positive student outcomes are not in abundance. As a result, debate continues as proponents and critics
discuss the potentiality of bridging neuroscience and education (Carew & Magsamen, 2010; Fischer et al., 2007; Sousa, 2010).

Another contributing factor to the opposition’s skepticism with brain-based strategies are the explosion of commercially packaged products, teaching resources, and training materials that are marketed as being backed by science (Bishop et al., 2013). Due to educators’ common unfamiliarity with neuroscience research studies and results, it is difficult to know the credibility of claims made by the developers of brain-based instructional programs. Bifle’s (2013) Whole Brain Teaching program has not escaped this concern. The Whole Brain Teaching website provides numerous testimonials from teachers, but lacks specific facts pertaining to stated outcomes. The website includes a research link but it does not include the findings of brain-based research. The website’s lack of substantive research pertaining to outcomes and effectiveness coupled with numerous generalizations only enhance the credibility concerns of skeptics and opponents. The lack of research coupled with heightened interest in brain-based programs along with the abundance of neuromyths as a basis for application, is precisely why more studies are needed.

**Whole Brain Teaching**

Whole brain teaching is based on the premise that the greatest opportunities for students to learn are provided when teachers intentionally facilitate instruction that causes students to utilize multiple regions of the brain. Two whole brain teaching methods that will be discussed in this review.

1. The Hermann Whole Brain Teaching Method
2. Whole Brain Teaching for Challenging Kids
**Hermann whole brain teaching method.** The Hermann Whole Brain Teaching Method was developed with the basis of neuroscience research involving the interplay of the four quadrants of the brain as depicted in Figure 2 (Hermann, 1988). Researcher Ned Hermann developed the model presented in Figure 2, based on neuroscience findings that certain types of processes are dominant to each quadrant of the brain. Hermann concluded that individuals have a dominant quadrant but that learning takes place in each quadrant.

**Hermann Whole Brain Teaching Model**

![Diagram of Hermann's Whole Brain Teaching Model](image)

*Figure 2* This figure depicts Hermann’s Whole Brain Teaching Model adapted from “The Creative Brain,” by N. Herrmann, 1991, *The Journal of Creative Behavior*, 25(4), 275-295. This model is a precursor to Biffle’s Whole Brain Teaching for Challenging Kids.

In a study conducted through the School of Educational Studies at the Universiti Sains Malaysia, researchers investigated the effectiveness of this whole brain program as
compared to traditional teaching methods (Bawaneh, Zain, & Saleh, 2011). Two hundred and seventy three eighth grade students participated in this study, of which approximately half were randomly selected to be in either the experimental group receiving whole brain teaching instruction or the control group with conventional instruction. Researchers concluded that it is beneficial for curriculum writers to consider Hermann’s whole brain teaching model, based on Hermann’s dominance theory which postulates that the brain is divided into four quadrants that work systematically together (Hermann, 1988). It is also important to distinguish a key difference of Hermann’s Whole Brain Teaching method. The reliance on brain dominance research suggests that teachers should consider the student’s dominant learning style but understand that a classroom is likely to include students representing each dominant quadrant. This method supports the connection of neuroscience to learning but differs from the Whole Brain Teaching for challenging kids method that suggests that teachers intentionally utilize strategies that prompt processing in multiple regions of the brain at the very same time.

**Whole brain teaching for challenging kids.** Developer Chris Biffle created this program to help educators meet the learning needs of challenging students by merging neuroscience based strategies (Biffle, 2013). As an author and educator, Biffle posits that educators must reach challenging students because the consequence of not doing so is harmful to all students (Biffle, 2013). The main components of the Whole Brain Teaching program shown in Table 1 are referred to as “The Big Seven” and a description of each component and the associated brain area is provided. It is important to note here that the associated brain areas for each component are a simplification of very complex brain processes explored through neuroscience research.
Table 1

Whole Brain Teaching “Big Seven” Description and Associated Brain Areas

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
<th>Brain Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-Yes</td>
<td>A call and response strategy used to gain the student’s attention. When the teacher says “Class”, the students reply “Yes”.</td>
<td>Prefrontal cortex</td>
</tr>
<tr>
<td>Five-Classroom</td>
<td>A set of five rules taught with accompanying movements and include:</td>
<td>Prefrontal cortex, Broca’s area, Wernicke’s area, limbic system, hippocampus, visual cortex, and motor cortex</td>
</tr>
<tr>
<td>Rules</td>
<td>Follow directions quickly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raise your hand for permission to speak</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Raise your hand for permission to leave your set</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Make smart choice</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Keep your dear teacher happy</td>
<td></td>
</tr>
<tr>
<td>Teach-Okay</td>
<td>A small chunk of content is taught with accompanying movements. The teacher tells the students “Teach” and the students reply “Okay”. The students then teach the content to their peer partner.</td>
<td>Prefrontal cortex, Broca’s area, Wernicke’s area, visual and motor cortex, and hippocampus</td>
</tr>
<tr>
<td>Hands and Eyes</td>
<td>The teacher says “Hands and Eyes” and the students clasp their hands and direct their eyes on the teacher. Used when the teacher needs to quiet the class before using “Mirror Words”.</td>
<td>None listed</td>
</tr>
<tr>
<td>Mirror Words</td>
<td>The teacher tells the students “mirrors on” and the students mimic the teacher’s words and movements. When the teacher is finished with the segment, the teacher tells the students to turn their “mirrors off”.</td>
<td>Visual cortex, motor cortex</td>
</tr>
<tr>
<td>Scoreboard</td>
<td>A system of tallying positive behavior designed to motivate students and reinforce positive behaviors. Tally mark awarded when the class as a whole demonstrates their ability to follow the rules.</td>
<td>Limbic system, amygdala</td>
</tr>
<tr>
<td>Switch</td>
<td>When a pair of students use the Teach-Okay strategy, the teacher announces “switch” to inform students that they are to switch roles with their peer partner.</td>
<td>Broca’s area and Wernicke’s area</td>
</tr>
</tbody>
</table>

Table 1 This table provides “The Big Seven” developed by Chris Biffle as part of the Whole Brain Teaching program. Also included is a description of each strategy and the brain areas Biffle states are associated with each of the seven components and each strategy (Biffle, 2013).
In a recent study published in the *International Journal of Research Studies in Education*, researchers from the Institute of Teaching and Learning at Philippine Normal University studied the effectiveness of Whole Brain Teaching on academic performance and student motivation (Torio & Cabrillas-Torio, 2016). This is an inaugural published study of the Whole Brain Teaching program. The study considered the ideas of Hermann and Biffle, but focused primarily on the more recent program developed by Biffle. The study uses a Quasi-experimental method involving a pre/post test assessment tool which was used to measure academic gains. This test, developed by the researchers, was a 40 question multiple choice instrument compromised of released test items from a bank of questions used on previous international examinations. A table of specifications was developed to determine alignment with the science curriculum. No control group was used, allowing all students involved to be exposed to the program. It is important to note that without the use of a control group, the study results are limited to the participants involved and it is not possible to compare the results with traditional teaching methods. The Physics Motivation Questionnaire was used to provide indication of changes in student motivation. This questionnaire measures six components of motivation including intrinsic, extrinsic, relevance of task, self-determination, and assessment anxiety (Glynn & Koballa, 2006; Torio, 2015). The students involved in this study were two classes of tenth grade Physics students. Teachers received training on the Whole Brain Teaching program through six pre-service sessions. The results of the study were that students had an average academic increase of 20% as measured by the pre/post test assessment. Based on the results of the Physics Motivation Questionnaire used, students were more
intrinsically motivated after being taught using the Whole Brain Teaching strategies (Torio & Cabrillas-Torio, 2016).

The Whole Brain Teaching program is being used on every level in K-12 education but research examining outcomes and effectiveness are few. One reason for this is that the program is less than two decades old, developed in 1999 as a grassroots effort (Biffl, 2013). Since that time, teachers have reported positive results including significant academic gains (Battle, 2010; Brobeck, 2015; Calhoun, 2012). The Florida Department of Education (2015) released best practices from their 2015 Teachers of the year. The Whole Brain Teaching program was identified as a best practice used by five separate teachers in the report. This group of teachers taught a variety of content areas and grade levels to include early childhood education, fifth grade English, elementary art, middle school music, and middle school business technology. The teachers indicated significant academic gains, increased student engagement, and decreased behavior disruptions. In an anecdotal study (Palasigue, 2009) conducted by a 5th grade teacher that sought to evaluate the impact of Whole Brain Teaching on the behaviors of challenging students, nine types of student behaviors were evaluated with fifth grade students. The results of this study indicated a 50% decrease in student negative behaviors from the pre-observations to the post-observations after implementing Biffl’s Whole Brain Teaching strategies. In another anecdotal study (Prashnig, 2004; Szott & Molitoris, 2010) conducted by two elementary school teachers, student surveys, behavior charting, reflective teaching journaling, and video recorded observations were used to measure the effectiveness of Whole Brain Teaching instruction. These studies determined that by implementing the Whole Brain Teaching strategies, students were more accountable for
their academics, focused, and significant increases in on-task behaviors. Teachers have also concluded in anecdotal reports that teacher and student confidence increased as a result of implementing the program.

An increasing number of educators and neuroscientists believe that brain based research offers help in determining how to reach students who have traditionally faced academic challenges (Jenson, 2009). Sanchez (2008) states that, “What is known about how the brain functions should be incorporated into every teaching process and practice in order to help high-risk children and their families” (p. 10). Brain-based instruction that considers the impact of emotion in the learning process is a vital tool for establishing a safe learning environment for students who struggle with processing new stimuli and unfamiliar information. Emotion can either be a catalyst or blocker for connecting information through the brains neurons (Mitchell, 2008; Sylwester, 1994). For example, if the student experiences a traumatic event prior to arriving to school, the student’s brain can block the pathways for the neurons within the brain to connect. Whereas a student who becomes excited about learning a particular lesson, experiences a positive biological response in the brain which encourages the ability to process new information (Sylwester, 1994). This finding is compelling for teaching challenging students who often experience traumatic events outside of the school environment.

Summary

Not only are school educators considering neuroscience findings and the potential implications for teaching and learning, college education programs are emerging as well. Columbia University established the Neuroscience and Education graduate program as part of its teacher college, the first such program in the United States. The stated
objective of the program is “to prepare a new kind of professional with dual preparation able to bridge the gap between research underlying brain, cognition and behavior, and the problems encountered in schools and other applied settings” (Columbia University Department of Biobehavioral Sciences Neuroscience and Education, 2016). Neuroscientists recommend that learning about cognition development and neuroscience be a part of teacher preparatory programs and a report developed by the National Council for Accreditation of Teacher Education (NCATE) agrees, stating that such preparation is believed to have benefits for teachers and students (Eisenhart & DeHaan, 2005).

Education reform efforts have identified a focus to meet the needs of all students but many teachers lack the knowledge and skills to address the social, emotional, and cognitive challenges of the students who enter many of today’s classroom. Research indicates that a student’s ability to learn is impacted by cognitive and environmental factors and the teachers’ ability to provide instruction that considers brain-based research can significantly improve outcomes (Darling-Hammond & Bransford, 2005). Armed with neuroscience knowledge of cognition development and socio-emotional impacts on learning, an educator is better prepared to provide targeted instruction and an instructional climate conducive for all students to learn (Pianta, Belsky, Houts, & Morrison, 2007). One meta-analysis study found that a program called the Comer School Development program, grounded in neuroscience research on brain and cognition development, to have positive student outcomes (Borman, Hewes, Overman, & Brown, 2003). Another meta-analysis involved students who experienced instruction that focused on approaches based in developmental sciences and that considered the socio-emotional needs of students yielded significant increases in student outcomes (Durlak, Weissberg,
Dymnicki, Taylor, & Schellinger, 2011). These studies suggest that the continued exploration of how neuroscience research can positively impact teaching and learning continue.
CHAPTER 3

METHODS

This program evaluation case study is grounded in the constructivist paradigm that necessitates the use of qualitative methods to identify multiple values and perspectives (Mertens & Wilson, 2012). A case study approach was appropriate for this program evaluation because of the particular focus on “a specific, unique, bounded system” within the complex context of the school district of study, its descriptive nature, and exploration to understand stakeholder perceptions (Mertens & Wilson, 2012, p. 331). In this case study, the specific focus of the perceptions of teachers in the Whole Brain Teaching teacher group was responsive to the stated interest of these particular stakeholders. Aligned with the recommendations of Stake (2004) who developed responsive evaluation theory and methods, and Yin (2014), this responsive evaluation considered the nature of the case, contextual factors, and the informants through whom the case was explored (Stake, 2004; Yin, 2014).

Responsive evaluation “orients more directly to program activities than to program intents” (Stake, 1991, p. 65). For this reason, the methods used to answer the evaluation questions were primarily focused on the teacher’s experience with using the brain-based strategies rather than the intended outcomes of the strategies as indicated in the logic model (see Chapter 1). The qualitative data collection protocols used in this study encouraged teachers to reflect on their experience with Whole Brain Teaching and assess if their reflections changed throughout their experience with the strategies. In
addition, the use of observations helped to reveal the level of fidelity with implementation of the strategies in classroom use. Consistent with the characteristics of responsive evaluation, the responses of the participants helped to frame the evaluation process which responded to key issues based on the experiences of the participants (Mertens & Wilson, 2012).

**Evaluation Questions**

The evaluation questions listed below were used to guide this case study program evaluation.

1. What are teachers’ working definitions of Whole Brain Teaching?
2. What are teachers’ perceptions of the facilitating factors in implementing Whole Brain Teaching?
3. What are teachers’ perceptions of the challenges in implementing Whole Brain Teaching?
4. What are teachers’ perceptions of the effectiveness of Whole Brain Teaching strategies in terms of student engagement and in meeting the needs of challenging students?
5. What Whole Brain Teaching strategies are being used and for what purposes?

**Study Participants**

Ten teachers at the middle school of study participated in a Whole Brain Teaching teacher group. The teacher working group constituted as the unit of analysis for this study. An email invitation was sent to all 97 teachers at the school to determine teacher interest in participating in the Whole Brain Teaching teacher group and ten teachers and a library media specialist responded expressing that they would like to be a part of the
group. The library media specialist was not be included in this study because of the absence of opportunities to interact with the strategies in a classroom setting. Table 2 below provides the content area and grade level taught for the ten participating teachers.

The teachers who responded to the email were invited to an initial informational meeting that provided the stated purpose of the group which includes to reflect, collaborate, and discuss perceptions of Whole Brain Teaching based on their experience at this school. A schedule of future bi-weekly meeting dates was discussed. Also, teachers were provided with the Whole Brain Teaching teacher’s manual as a resource that was made available from the district’s professional development office.

Table 2

Teacher Participants in the Whole Brain Teaching Study Group

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Content Area</th>
<th>Grade Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher A</td>
<td>English</td>
<td>6th</td>
</tr>
<tr>
<td>Teacher B</td>
<td>English</td>
<td>7th</td>
</tr>
<tr>
<td>Teacher C</td>
<td>Math</td>
<td>6th</td>
</tr>
<tr>
<td>Teacher D</td>
<td>Geography</td>
<td>8th</td>
</tr>
<tr>
<td>Teacher E</td>
<td>Gifted Resource</td>
<td>6th, 7th, 8th</td>
</tr>
<tr>
<td>Teacher F</td>
<td>Gifted Resource</td>
<td>6th, 7th, 8th</td>
</tr>
<tr>
<td>Teacher G</td>
<td>Math</td>
<td>7th</td>
</tr>
<tr>
<td>Teacher H</td>
<td>Science</td>
<td>6th</td>
</tr>
<tr>
<td>Teacher I</td>
<td>Science</td>
<td>7th</td>
</tr>
<tr>
<td>Teacher J</td>
<td>Special Education</td>
<td>7th</td>
</tr>
</tbody>
</table>

Data Sources

The data sources used in this study include individual reflective journals, focus group meetings, and classroom observations. A discussion of how these sources were used to collect data for this study is provided here.
**Individual reflective journals.** Teachers completed biweekly written reflections for a total of four reflections from each teacher. Each participating teacher was asked to provide a definition of Whole Brain Teaching based on their understanding. They used the individual reflective journals to record their use of the Whole Brain Teaching strategies used and their perceptions of the effectiveness of the strategies. The journal entries included the frequency with which they used the strategies. The teachers received guidance on how to record this data to include how to complete a strategy checklist indicating which strategy was used. The checklist was used to show which strategies the teacher used for each day over a two week period and the completed checklists and reflective questions were submitted every two weeks. Due to the district’s promotion of the Whole Brain Teaching program as a way to address the needs of challenging students and reduce achievement gaps, the participating teachers were also asked about their perception of the effectiveness of the strategies in achieving these goals. The individual reflective journal protocol is provided in Appendix A. To validate this protocol, a field test was completed with a panel of practitioners. Sample questions from the individual reflections protocol are:

1. **What is your definition of Whole Brain Teaching? What are some of the primary components?** How does it differ from my traditional forms of teaching?

2. **What are your perceptions on the effectiveness of the Whole Brain strategies?** What has been their effect in meeting the needs of challenging students? In terms of student engagement?
Focus group meetings. For eight weeks, the participating teachers came together biweekly for a one hour focus group meeting to discuss perceptions surrounding implementation of Whole Brain Teaching strategies. The meetings were held in the central location of the library media center conference room immediately after students were dismissed. Teachers were relieved of their after school bus duty on the days that the focus group meetings were held. During these meetings the protocol provided in Appendix B was used to guide discussion. A sample of the questions included on the protocol are:

1. What factors have facilitated your use of the Whole Brain strategies? What resources have been the most helpful? What organizational dynamics of conditions have you found to be the most supportive?

2. What were your experiences with using Whole Brain Teaching strategies the past two weeks?
   a. What successes did you have with using the strategies? Please elaborate.
   b. What challenges did you face with using the strategies? Please elaborate.

The leading question for each biweekly meeting is identical to the question on the individual reflective journal for the specified week. This gave the participants an opportunity to discuss their reflective responses with the group. Participants were asked permission to audio record the meetings and all of the teachers agreed to being recorded. The audio recordings were transcribed and used to ensure accuracy in analyzing
responses. To validate this protocol, a field test was completed with a panel of practitioners.

**Classroom observations.** Observations were conducted on a voluntary basis when a participating teacher extended an invitation to the observer to see the strategies being used with a particular learning objective. Conducted observations were for 30 minutes using the observation protocol provided in Appendix C. This protocol collected data including a description of the content being taught and context, teaching and learning intentions, student engagement indicators, a tally of the strategies used, the observer’s reflection of what went well and what did not go well with using the strategies. Specific classroom contextual look-fors included the number of students, a description of the physical classroom space, and evidence of learning intentions. The specific Whole Brain Teaching strategies were included in the protocol as a table to tally the frequency of how often the each strategy was used during observations. This was also noted in the individual reflections from teachers. To record evidence of student engagement, the room was scanned every five minutes and the number of students visibly engaged was recorded.

**Data Collection**

Data was collected in the natural setting of the participants, which was best suited to study the experience of the participants with the Whole Brain Teaching strategies (Creswell, 2009). A meeting was held on site with the principal at the middle school of study and the teachers who were a part of the Whole Brain Teaching teacher group to gain support for conducting the case study. Preliminary support was gained from the building principal who approved the organization of the Whole Brain Teaching teacher
group, and the teachers who expressed interest in the group. Each teacher received the informed consent letter in Appendix D which provided the name and description of the research project, collection dates and times, descriptions of the questionnaire and interview protocols, and an area indicating agreement to participate in the study. Based on the voluntary nature of the participant group, it was possible that a participant could decide to opt-out of some parts of the study. However, provisions were made for participants to help overcome barriers for participation such as time and location of meetings. All participants in the case study received a VIP teacher savings card which entitled the educator to a 20% savings on all purchases of school supplies over a four month period of time. The participants were also provided with snacks, water, and soda during the focus group meetings.

The data from the teacher’s individual reflections were collected on a biweekly basis. The bi-weekly focus group meetings were held immediately after school so that all participants could attend. These one hour meetings were mainly facilitated by the researcher initially but there were also opportunities for the teacher participants to facilitate the meetings by leading the discussion. Observations were only conducted on a voluntary basis and lasted for approximately 30 minutes. It is also noted that data collected on the specific strategy of “Switch” was not listed as a strategy on the data collection protocols but is instead included in the data totals for “Teach-Okay.” The reason for this inclusion here is because the “Switch” strategy is a repetition of the “Teach-Okay” strategy. See Table 1 for a full description of each strategy.
Data Analysis

The research questions were answered by analyzing qualitative data collected from individual reflections, focus group meetings, and classroom observations. Data analysis also included frequency counts of how often the strategies were being used. Utilizing the multiple data sources as listed in Table 3 provided an opportunity to triangulate the data, strengthening the credibility of the findings (Mertens & Wilson, 2012). The open-ended questions and statements from the individual teacher reflection and focus group meeting protocols allowed the participants to provide detailed responses. Although the questions were identical, qualitative responses have the potential to have great variation and coding procedures were necessary to make sense of the data and identify emergent themes (Creswell, 2009). For this reason, narrative responses were coded and categorized. The transcriptions were used to ensure accuracy in the analysis of coding participant responses. The procedure for coding responses began with the understanding that qualitative data collection and coding exist in tandem, with each influencing the other throughout the research process (Creswell, 2009). Coding procedures followed Tesch’s Eight Step Process below offered in Creswell’s writings on qualitative methods (Creswell, 2009).

1. Begin by reading all of the responses to get a sense of the whole and make note of initial ideas that come to mind.

2. Read one participants complete document with the mindset of “What is this about?”. Record thoughts in the margin about the underlying meaning of the participant’s responses. Complete this for each of the documents.
3. Make a list of topics that emerge and cluster together similar topics. Place these topic clusters in columns including a column for any outlier responses.

4. Create codes for the topic clusters by abbreviating the cluster name given to each column. Write these codes on the protocol next to the appropriate response. New categories and codes may emerge, if so incorporate in the process.

5. Use descriptive wording to rename topics as categories and look for interrelationships between the categories.

6. Make a final decision on the abbreviation code that will be used for each category and put them in order my frequency.

7. Place the data belonging to each category in one place and analyze for meaning.

8. If necessary, recode the data.

Coded and categorized data were then be summarized and salient themes were identified. The themes were determined by consistent phrases, expressions, or ideas (Turner, 2010). Particular attention was paid to descriptive terms used by the participants. Consistent with constructivist paradigm, preliminary codes were not developed but emerged from the data (Mertens & Wilson, 2012).

**Individual reflective journal protocol analysis.** The narrative responses to the individual reflection protocol were used to answer each of the five evaluation questions. For example, the individual reflective journal protocol asked “What is your definition of Whole Brain Teaching? What are some of the primary components? How does it differ from my traditional forms of teaching?” and these responses were used to answer the first
evaluation question of “What are teacher’s perceptions of working definitions of Whole Brain Teaching?”. The responses helped to determine if the teachers have the same understanding of how Whole Brain Teaching is defined and any variances. This was important in considering the development of Whole Brain Teaching exemplars and strengthening professional learning communities at the school of study as outputs shown on the logic model.

The protocol also asked the teachers to complete a checklist that indicated their usage of the strategies. The checklist listed each strategy and asked the teacher to place a check next to each strategy they used for each day over a two week period. The responses from the checklists were quantified by totaling the number of responses from each category. The totals of the responses per strategy were analyzed to determine any changes in teacher usage of the strategies. Such changes included new occurrences of usage, increases in usage, decreases in usage, or eliminating usage of a strategy. Teachers were then asked “What worked well this week with the brain-based strategies?” and “What were challenges in using brain-based strategies this week?”. The narrative responses to these questions were coded and categorized.

**Focus group meeting protocol analysis.** The focus group protocol responses were also be used to answer the first four research questions. For example, the research question of “What are the facilitating factors in implementing Whole Brain Teaching based on teacher perceptions?” was explored by analyzing focus group protocol responses to “What factors have facilitated your use of the Whole Brain strategies? What resources have been the most helpful? What organizational dynamics of conditions have you found to be the most supportive?”. Consideration of pertinent factors influencing
implementation of the strategies was valuable when considering implementation as a process as indicated in the logic model. The research question of “What are the challenges in implementing Whole Brain Teaching based on teacher perceptions?” was answered through focus group meeting protocol responses to “What have you found to be the most challenging aspects of implementing the Whole Brain strategies? What kinds of supports would you have liked that have not been available to you? What have you attempted to do to overcome these challenges?” Analyzing the responses to “What are your perceptions on the effectiveness of the strategies?” and “What has been their effect in meeting the needs of challenging students? In terms of student engagement?” helped to answer the fourth research question which sought to determine teacher’s perception of the effectiveness of the Whole Brain Teaching strategies in terms of student engagement and in meeting the needs of challenging students. The responses were also analyzed to determine if perceptions changed over the course of the study.

Observation protocol analysis. The observation protocol was used to answer the research questions two, three, and five which consider implementation factors by documenting which of the strategies are being used, if students are engaged, and if learning intentions are being met. The analysis of the observation data included categorizing the descriptive contextual data and tallying the number of responses for each item on the protocol in the specific areas of teaching and learning intentions, and the strategies used. The frequency of student engagement was assessed using the tallies recorded from visual scans taken every five minutes by the researcher during the observations. Table 3 below provides a summary of the evaluation questions, data sources, and the data analysis used in this program evaluation case study.
Table 3

Evaluation Questions, Data Sources, and Analysis

<table>
<thead>
<tr>
<th>Evaluation Questions</th>
<th>Data Sources</th>
<th>Data Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are teachers’ working definitions of Whole Brain Teaching?</td>
<td>Teacher Reflections</td>
<td>Qualitative Analysis and interpretation of teacher reflections and focus group meetings</td>
</tr>
<tr>
<td>2. What are teachers’ perceptions of the facilitating factors in implementing Whole Brain Teaching?</td>
<td>Focus Group Meeting Transcriptions</td>
<td>Qualitative Analysis and interpretation of teacher reflections, focus group meetings, and observations</td>
</tr>
<tr>
<td>3. What are teachers’ perceptions of the challenges in implementing Whole Brain Teaching?</td>
<td>Teacher Reflections Transcriptions Observations</td>
<td>Qualitative Analysis and interpretation of teacher reflections, focus group meetings, and observations</td>
</tr>
<tr>
<td>4. What are teachers’ perceptions of the effectiveness of Whole Brain Teaching strategies in terms of student engagement and in meeting the needs of challenging students?</td>
<td>Teacher Reflections Transcriptions</td>
<td>Qualitative Analysis and interpretation of teacher reflections, focus group meetings, and observations</td>
</tr>
<tr>
<td>5. What Whole Brain Teaching strategies are being used and for what purposes?</td>
<td>Teacher reflections Focus Group Meetings Observations</td>
<td>Frequency count of strategies used and purposes for each use</td>
</tr>
</tbody>
</table>
Assumptions, Delimitations, and Limitations

**Assumptions.** An assumption for this program evaluation case study was that the teachers in the Whole Brain Teacher group would provide honest candid responses to the individual reflections and focus group meeting protocols. There was also an assumption that the participating teachers would commit to participating in the case study for the duration of the study. Whole Brain Teaching was initially introduced to teachers through a district initiative and there was no indication that teacher use of the strategies would be discouraged due to emphasis on other areas of focus such as equity. Confidentiality was preserved by nondisclosure of identifiable information and it was assumed that I the researcher would take the stated precautions to protect participant data. Participation in this action research study was voluntary and teachers were able to opt out at any time, from the entire study or in part. However, the study facilitated opportunities for participant reflection and collaboration based on the assumption that the intervention would be implemented with fidelity.

**Delimitations.** A delimiting factor was the selection of the case study program evaluation method. Action research was considered as a model but the case study approach was most applicable to uncovering the experience of teachers with the Whole Brain Teaching strategies and their perceptions about the viability of the strategies. It is also important to note that the case study approach also created a significant limitation with the findings only being applicable to the middle school of study (Yin, 2014). However, teachers sharing their experiences through a series of consistent meetings brought about the potential to continue well beyond the study. In addition, the findings of
this study can be used to help school leaders determine the level of investment that should be placed in the program.

**Limitations.** One limitation was that the teacher participants were volunteers and could choose to opt out of the study at any time. Also it was possible that the participants may have only been willing to only participate in one aspect of the study instead of all components, which would have altered the participant’s “lived experience.” Another limitation was the lack of additional district training on Whole Brain Teaching available to the participating teachers. The teachers in the Whole Brain Teaching teacher group had varying levels of experience with the strategies. For some, this group provided an introduction to the Whole Brain Teaching methods and others had used varying elements of the program previously. There were also variances in the level of training that the teachers had received. Some experienced the training provided by the district during the 2013-14 school year while others who were new to the district did not have that opportunity and learned by doing.

**Ethical Considerations**

In this program evaluation case study, the researcher is an internal instrument at the school of study and the positionality of the researcher is discussed here as an ethical consideration. Also, the Program Evaluation Standards developed by the Joint Committee on Standards for Education Evaluation (JCSEE) are used in this discussion of propriety, utility, feasibility, and accuracy (Yarbrough, Shulha, Hopson, & Caruthers, 2011). These standards provide an ethical framework of guiding principles for educators and scholars to use in the program evaluation process (Yarbrough et al., 2011). In addition, the
process for gaining approval to conduct the study within the context and from the College of William and Mary’s Institutional Review Board are discussed.

**Positionality.** The internal role of the researcher as an assistant principal in the school of study is disclosed as an ethical consideration of how this potentially influenced the production of knowledge and interpretation of experiences (Sultana, 2007). The researcher’s role as the assistant principal included the responsibilities of specifically supervising the content areas of science, gifted, foreign language, and career and technical education teachers. In addition, the assistant principal provided supervision for specific special education teachers not to include the special education teacher participating in this study. However, the researcher was responsible for the evaluation of the two science teachers and two gifted education teachers who participated in this study. To minimize the potential influence of the researcher as evaluator, observations were conducted on a voluntary basis and were not used for evaluatory purposes. In addition, the researcher used the observation form in Appendix C instead of the district’s observation form to keep observation data from being available in the district’s observation database.

The positionality of the researcher brings transparency to this study by recognizing the researcher as part of the context. Acknowledging the potential influence of this positionality gave the researcher an opportunity to pay attention to implicit biases and work to maintain a scholarly perspective. This positionality also provided a unique opportunity for the researcher to have a “lived experience” where new perspectives and meaning were gained.
Propriety standards adherence. The role as researcher in this case study included gathering and analyzing the data. As an administrator at the school of study, I had a valid interest in studying teacher perceptions of Whole Brain Teaching as a valuable means to meeting the division’s goal of improving instructional practices. I gained the support of the building principal to oversee the case study process. To guard against a perception of bias based on my position as an administrator, I encouraged teachers to review literature of both supporters and critics. I also offered opportunities for the teacher participants to lead group discussions and to engage in dialogue without my attendance. In addition, participants agreed through the informed consent letter in Appendix D of their role, my role with the division, and purpose of the study. This provided transparency to address any real or perceived conflicts of interest. Also I established agreement with the building principal as to meeting times and location for the Whole Brain Teaching teacher group.

The design of the case study protected the identity of all participants. The names of the participants are not be reported in the findings. The outcome of the study includes a written report with a complete description of findings, limitations, and conclusions made available to all stakeholders. This evaluation was fiscally responsible in that no cost was incurred by study participants. The primary cost was the time invested. The only fiscal cost was the cost of the reward discounts.

Utility standards adherence. The researcher had established credibility within the school of study as an instructional leader. Using the individual reflections and focus group meeting protocols in the data collection process allowed me to analyze and extract meaning from data, and also allowed the participants to reflect on their teaching and
learning experience using the Whole Brain Teaching program. Such reflection encouraged teachers to revisit their understandings and make adjustments to their practice.

**Feasibility standards adherence.** This study utilized effective project management strategies through the consideration of a logic model and the organization of research activities. The logic model provided the researcher with a framework for maintaining contextual viability by considering how inputs connect with processes, outputs, and intended outcomes. The organization of the research activities with the building principals provided feasibility to accomplish the tasks.

**Accuracy standards adherence.** The evaluation questions were answered using the data collection and analysis measures described in the methods of the study. The results were summarized and implications for educational practice are provided. This study included detailed descriptions of the program and contextual factors to provide the appropriate scope for the study. These details include a comprehensive review of literature pertaining to the research basis of the Whole Brain Teaching program and how neuroscience and education come together. A systematic process for managing the data was used for collecting, reviewing, safeguarding, and storing. The use of the researcher’s journal and audio recorder during the interview process encouraged accuracy of the data collection process. Also, the use of coding for responses to open ended questions provided an accurate way to determine themes and summarize responses.

**The approval process.** The Institutional Review Board (IRB) has established that the approval process for research involving human subjects include the completion of training modules on the proper procedures for handling human subjects. I have satisfied
this component of the IRB approval process by completing the required training modules through the Collaborative Institutional Training Initiative at the University of Miami. These on-line training modules satisfy the requirements set forth by the U. S. Department of Health and Human Services. After the research proposal was successfully defended, I used the Protocol Compliance Management System to complete and submit the research proposal to the IRB for review. This project was found to comply with appropriate ethical standards and was exempted from the need for formal review by The College of William and Mary protection of human subjects committee (757-221-3966) on January 23, 2017 and expires on January 23, 2018. In addition, I also completed an approval process for the division of study. This process involved the submission of a description of the study including participants, procedures, protocols used, and data that was to be accessed. Once approval was granted from the IRB and the division of study, I began conducting the research.
CHAPTER 4

RESULTS

The purpose of this program evaluation case study was to investigate teacher perceptions and their working definitions of Whole Brain Teaching. Specifically, this study sought to uncover the facilitating factors and challenges related to implementation and teacher perceptions of the effectiveness of Whole Brain Teaching strategies. In addition, this investigation was an inquiry to identify the specific strategies being used and the intended purpose of their use. Data were collected for this study for an eight week period, beginning on January 23, 2017 and ending on March 17, 2017. The findings of this program evaluation case study are presented in this chapter.

The data sources discussed in the methodology provided in Chapter 3 include individual reflective journals, focus group meetings, and observations. The findings generated from these data sources are organized by research question with the understanding that, consistent with the constructivist paradigm, some overlap exists as participants constructed meaning through hermeneutical dialogue and their lived experience (Mertens & Wilson, 2012). The first four research questions correspond with the first question asked on each of the four individual reflective journals and at the four focus group meetings. This intentional systematic alignment of inquiry provided sufficient opportunities for participant reflection and dialogue while remaining responsive to stakeholder needs (Stake, 2004). The findings for the fifth research question
have been synthesized based on coding and categorizing of teacher reflections and observations.

It is also important to note that one teacher participant declined to participate in the study and an additional teacher joined the study. The teacher who declined was an 8th grade English teacher and the teacher who joined the study was a 6th grade math teacher. Both of these changes occurred at the beginning of the study during the initial meeting explaining the informed consent letter. The teacher who declined expressed that she could not commit to the time necessary to be a part of the study. The teacher who joined the group expressed interest in participating at the recommendation of another staff member. A total of 10 teachers participated in the study.

**Research Question #1: What are teachers’ working definitions of Whole Brain Teaching?**

The synthesis of teacher responses of their working definitions of Whole Brain Teaching focuses on responses provided from data gathered through the first individual reflective journal and the first focus group meeting discussion.

The findings indicate that the teachers did not hold a consensus on a universal definition for Whole Brain Teaching. However the teachers did identify some key components in their working definitions, such as use of movement to help students remember concepts and that the strategies use the “whole brain” through the use of multiple modalities such as kinesthetic, visual, and audio. The teachers share a common understanding that the strategies are intended to engage students and that key tenants such as those reported in Chapter 1 necessitate students talking to one another as part of the learning process and teachers teaching based on how the brain learns. Table 4 below
provides the common key components found for the teacher’s working definitions of Whole Brain Teaching, along with a count of the number of occurrences, the number of teachers included in the occurrences, and illustrative excerpts.

Table 4

Common Components in Working Definitions of Whole Brain Teaching

<table>
<thead>
<tr>
<th>Common Components</th>
<th>Frequency of Occurrences</th>
<th>Number of Teachers</th>
<th>Illustrative Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Movement</td>
<td>13</td>
<td>10</td>
<td>“It is incorporating the motion and the visual and they are hearing it with the words.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“I would have to say the movement is a large part.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We aren’t just repeating but we all are moving a part of our bodies to help them remember something.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“Strategies that help them remember the content.”</td>
</tr>
<tr>
<td>Memory</td>
<td>12</td>
<td>10</td>
<td>“People say you are left or you’re right but we are trying to activate all the areas.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“We are using the student’s whole brain by incorporating a variety of brain-based strategies that access student’s abilities and providing instruction in a variety of forms including audio kinesthetic and visual to create routines and procedures.”</td>
</tr>
<tr>
<td>Multiple areas of the brain</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
</tbody>
</table>

**Movement.** All of the teachers agreed through their responses from the individual reflective journal and focus group meeting discussions that incorporating movement was a key component to their understanding of and how they defined Whole Brain Teaching.
An example of this is provided by the response for Teacher I in Table 4, stating “I would have to say the movement is a large part.” All of the teachers spoke of the incorporation of kinesthetic gestures or motion as key components when defining Whole Brain Teaching. As examples, Teacher B expressed the inclusion of “kinesthetic” as part of Whole Brain instruction and Teacher F indicated “incorporating motion” when providing a working definition of Whole Brain Teaching. A follow-up question that was asked during the focus group discussion on working definitions was, “How does it differ from my traditional forms of teaching?” One teacher’s response was that “It’s not just about Class-Yes, it’s when students are using movement with specific words and the students are teaching each other this way. It’s not the normal PowerPoint and note taking.” All of the teachers agreed that movement tied to specific words or content was a key component in recognizing Whole Brain Teaching.

Memory. The teacher individual reflective journals and focus group meetings suggest that teachers included the purpose of “remembering” or memory retention as part of their working definitions. All of the teachers indicated that their understanding of the strategies was that the strategies were intended to help students remember information. For example, Teacher E specifically stated a working definition that includes “to help them remember the content.” Another teacher, Teacher I, stated “We aren’t just repeating but we all are moving a part of our bodies to help them remember something.” Teacher I’s response is indicative of this teacher’s definition of the strategies to involve a connection between memory and movement. The other teacher participants in the group agreed with this assertion.
**Multiple areas of the brain.** The findings from the teacher individual reflective journals and focus group meeting responses indicated that the teachers’ definitions of Whole Brain Teaching included the use of multiple areas of the brain. Although it is unclear as to whether the teachers had understanding of neurological processes or neuroscience research, their perceptions of working definitions included common references to multiple areas of the brain. The teachers’ responses often included the words “whole brain” as they defined Whole Brain Teaching. For example, Teacher B stated the use of the students’ “whole brain by incorporating a variety of brain-based strategies.” In addition, Teacher E made the clarification that Whole Brain Teaching is defined differently than the use of the “left or right brain” by stating, “People say you are left or your right but we are trying to activate all the areas.” These components of movement, memory, and use of multiple areas of the brain were identified as common in the teacher’s working definitions.

**Research Question #2: What are teachers’ perceptions of the facilitating factors in implementing Whole Brain Teaching?**

Through the data collected from individual reflective journals and focus group meetings, five themes related to facilitating factors emerged. These five factors were the introductory district training, collaboration of the teacher group, school culture, organizational structure, and useful resources. Table 5 below provides a count of occurrences, number of teachers, and illustrative excerpts related to each facilitating factor.
Table 5

Facilitating Factors of Implementing Whole Brain Teaching

<table>
<thead>
<tr>
<th>Facilitating Factor Code</th>
<th>Frequency of Occurrences</th>
<th>Number of Teachers</th>
<th>Illustrative Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introductory District Training</td>
<td>11</td>
<td>7</td>
<td>“I had never heard of Whole Brain Teaching until we had that training. In the training it seemed like something that could help my students.”</td>
</tr>
<tr>
<td>Collaboration of Teacher Group</td>
<td>17</td>
<td>10</td>
<td>“Being new to teaching I just wasn’t sure where to start with this Whole Brain Teaching but being able to bounce things off other teachers is really helpful.” “This group is a community within a community and we have to set the stage for change.”</td>
</tr>
<tr>
<td>School Culture</td>
<td>8</td>
<td>5</td>
<td>“This is a safe place to try something new.”</td>
</tr>
<tr>
<td>Organizational Structure</td>
<td>7</td>
<td>7</td>
<td>“We are treated like professionals”</td>
</tr>
<tr>
<td>Useful Resources</td>
<td>6</td>
<td>6</td>
<td>“The posters were great, I even put up another set on the other side of the room”</td>
</tr>
</tbody>
</table>

**Introductory district training.** The seven teachers who were present during the 2013-2014 school year reference their introduction to Whole Brain Teaching as a district initiative in response to continued achievement gaps with subgroups of students. All seven teachers recalled the training provided by developer Chris Biffle and various schools participating in school-wide efforts to implement the strategies. One teacher stated, “I had never heard of Whole Brain Teaching until we had that training. In the training it seemed like something that could help my students.” The three teachers who
implemented the strategies immediately after the training did not make reference to specific strategies from the training but spoke of their experience with the strategies after the training. For example, one teacher referenced her experience as a teacher on the elementary level and her experience with the strategies at an elementary school in the district that embraced a school-wide effort. This teacher’s experience with the strategies on the elementary level was positive and no doubt influenced her positive perception of the strategy’s overall effectiveness in this study stating, “It’s very effective at helping to manage student behaviors and with reinforcing concepts and skills that you want students to remember.” Two of the remaining four teachers who participated in the district training specifically expressed that their perception of the ‘Teach-Okay” strategy after the district training was that students were merely “parroting” the teacher.

Although this training provided an introduction to the strategies for seven of the participating teachers, only three of those teachers implemented the strategies in their classrooms with sustainability. The three teachers who implemented the strategies after the initial training all agree that their decision to try the strategies and continue to use the strategies were because they believed the strategies helped to meet an identified need in their classrooms and saw success. The remaining four teachers in the group who participated in the initial district training implemented the Whole Brain Teaching strategies after expressing interest in and joining the teacher group developed during the first marking period of the 2016-2017 school year. Their experience with implementing the strategies has been largely organic, without a structured school-wide implementation but influenced by the teachers’ dialogue about the strategies initially within the Whole Brain Teaching group and then through informal conversations outside of the group. The
remaining discussion of the findings for this section will focus primarily on facilitating factors germane to the teacher’s experience with the strategies for the 2016-2017 school year beginning with how of being a part of the Whole Brain Teaching teacher group was a factor for implementation. The teachers expressed that they would have liked additional follow-up training and access to observe teachers who are proficient with using the strategies and who have experienced success.

**Collaboration of the teacher group.** The formation of the Whole Brain Teaching teacher group was not primarily for the purpose of this study but based on the expressed interest of group members who sought to learn more about the strategies, to find a support system with other teachers with similar beliefs, and with the intention to increase their capacity as effective teachers. All of the teachers participating in the study implemented the strategies to some degree. One teacher stated, “Being new to teaching I just wasn’t sure where to start with this Whole Brain Teaching but being able to bounce things off other teachers is really helpful.” The participants all agreed that their attempts with using the strategies and/or stretching themselves beyond their previous use of the strategies was because of their participation in the group.

The teachers indicated that being in the group kept the strategies as a focused topic of discussion and helped them to remember to include the strategies in their plans and in their instruction on a more regular basis. One teacher stated,

I find that when you are actively keeping up with it, it does keep the children more engaged and focused. And when you start to step away and don’t reference the strategies as much, it begins to feel chaotic and uncontrollable.
The importance of consistency was a theme that emerged throughout the focus group conversations. Another teacher stated, “It’s challenging to keep remembering to add in new routines when you’ve been accustomed to doing things another way for years.” And another teacher offered, “Consistency is the hardest thing for me. I feel like I either need to do something completely or not at all.” For these reasons, the collaboration of the teacher group was a critical factor in the continued implementation of the strategies during the eight weeks of this study.

The teacher group provided an opportunity for the teachers to discuss why some strategies were implemented less frequently and any challenges they faced with implementation. The teacher group also provided a safe place where the teachers could ask questions of one another about the strategies throughout the implementation process. For example one teacher expressed,

I question well how often should I be adding in motion. Everyday? Every lesson? Every concept? Should everything have a movement or a trick or things of that nature to help the students remember? That is something that I am still struggling with.

This concern of trying to determine exactly how to best fit the strategies with each teacher’s class setting was something that was echoed throughout the focus group discussions. Other teachers discussed the impact of the strategies on students who are shy, with on stating, “Not all challenging students are those with off-task or attention seeking behaviors, what about the child who is shy and would rather shrink to the back of the class and be invisible?” The teacher group undoubtedly gave the teachers a platform to explore their concerns with implementation and dialogue with one another, often
uncovering new meaning and even redefining the role of the group. As one teacher stated, “This group is a community within a community and we have to set the stage for change.”

Finally, the teacher group allowed for the sharing of successes with the strategies. Much of this dialogue was an expansion of the teacher participant’s responses on their individual reflective journals. However, the discussions in the focus group meetings also prompted some deeper discussion about how the values of the teachers shaped their beliefs about what constitutes success with using the strategies in their classroom. For example, some teachers indicated that having all students actively participate as a result of the strategies was a success. While other teachers felt that success could only be measured by assessment outcomes, it was helpful for teachers to hear how the strategies worked in other classes and to hear other teachers describe their success.

**Safe school culture to risk new strategies.** The culture of the school where the teacher group was formed has a history of encouraging and supporting teachers to incorporate unconventional teaching strategies. Five of the teachers in the group have been at the school for over five years and they all agreed, as one teacher stated, that it is established that “this is a safe place to try something new.” Teachers are given the latitude to take risks in their classrooms to help determine how to best meet the needs of students without feeling that they will be fired if the implemented strategy does not produce the intended results. One way that the school is able to maintain this element of trust is through open ongoing dialogue between teachers and administrators. Teachers are used to an administrative presence in their classrooms. Six of the teacher participants in this study invited the researcher to their classroom for an observation and four of the six
teachers invited the researcher back for a second visit for a total of ten observations conducted.

**Organizational structure.** There are approximately 70 co-taught academic sections at the school and the co-teaching relationship was a factor in determining the level of implementation of the strategies. A school-wide emphasis for the academic year in which the study took place was on effective co-teaching relationships. For those teacher participants who worked with a co-teacher for at least one block, the dynamics of the co-teaching relationship became a determining factor in which strategies were implemented and how often. The perceived effectiveness of the strategies with the students was also influenced by whether or not both co-teachers planned together and incorporated the strategies within their lesson plans. Teachers who shared the same content area and grade level had a common planning time. The teacher participants who co-taught all agreed that in order to best facilitate the strategies, it is necessary to plan for their use.

**Leadership.** A change in administration for the 2016-2017 school year was also a key factor in facilitating the implementation of the strategies. The new principal hired for the 2016-2017 school year was previously an assistant principal at the school. Prior to taking on the role of principal for the 2016-2017 school year, the new principal previously spent 11 years as an assistant principal at the school of study and was also part of the district’s Whole Brain Teaching initiative during the 2013-2014 school year. The new principal expressed that he personally found the strategies “awkward for middle school students and better suited for elementary kids” but remained true to the established culture of allowing teachers an opportunity to explore unconventional strategies. He was
supportive of the formation of the Whole Brain Teaching group, and facilitated its work by providing a space for the teacher’s to collaborate, giving teachers the latitude to take risks to improve their effectiveness as a teacher, and through the positive rapport and experience that many of the teachers had with the principal when he was an assistant principal at the school. The teachers’ perception of the principal trusting them to take risks with instruction was a factor in the teachers deciding to implement the strategies. As one teacher stated, “we are treated like professionals” when referring to the administration.

**Useful resources.** The teachers indicated that they found the Whole Brain Teaching handbook and book to be resourceful. Also the teacher’s indicated that they made use of posters with the Whole Brain Teaching rules that were provided by the district’s print services upon request to each teacher to hang on the wall in their classroom. One teacher stated, “the posters were great, I even put up another set on the other side of the room.” During the focus group discussions, the teacher participants asked if a Google Drive folder could be created where Whole Brain Teaching video clips, related literature, and other Whole Brain Teaching resources could be placed in this one common place for their access. One of the teacher participants created the Google drive folder and multiple teacher participants contributed to the resources in the Google drive folder.

To summarize, the facilitating factors for implementing Whole Brain Teaching based on the teacher’s perceptions were the introductory district training provided in 2013-2014 school year, the collaboration of the teacher group, a school culture that encouraged non-traditional teaching, the organizational structure of the school,
leadership, and the resources provided. Each of these factors were key factors for the implementation of the strategies.

**Research Question #3: What are teachers’ perceptions of the challenges in implementing Whole Brain Teaching?**

The teacher participants provided candid responses in their Individual Reflective Journals and throughout focus group meeting discussions about the challenges experienced with implementing Whole Brain Teaching. The teachers expressed that they were well aware at the onset of the study that there are both critics and advocates of Whole Brain Teaching. Yet the teacher participants all agreed that because of their desire to increase their capacity for effective teaching, it was worth the experience to determine how and if Whole Brain Teaching plays a role. Also, participation in this group was not tied to the teacher’s evaluation which allowed the teachers to speak freely and take the risk of being a part of a small group of teachers within the school implementing the Whole Brain Teaching strategies. Teacher responses regarding challenges in implementing Whole Brain Teaching were coded and categorized. Table 6 below provides the challenge codes used and significant excerpts from focus group discussions. Themes that emerged surrounding challenging factors included the investment of planning time in order to incorporate the strategies with fidelity, difficulty with adjusting to change in practice, conflicts with teacher personality or style, and overcoming resistance from students.
Table 6

Selected Teacher Excerpts Regarding Challenges in Implementing Whole Brain Teaching

<table>
<thead>
<tr>
<th>Challenge Code</th>
<th>Frequency of Occurrences</th>
<th>Number of Teachers</th>
<th>Illustrative Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency of Use</td>
<td>21</td>
<td>10</td>
<td>“After you’ve done something the same way for so long and you try to incorporate something new in your routine it’s like I’m stumbling along. “Sounds simple but remembering to use the strategies is challenging. It can be fleeting at times.”</td>
</tr>
<tr>
<td>Co-Teaching</td>
<td>6</td>
<td>6</td>
<td>“I’ll add that a challenge is being an inclusion teacher with one teacher that uses the strategies and then another that looks at me like I’m crazy.”</td>
</tr>
<tr>
<td>Absence of Critical Thinking</td>
<td>8</td>
<td>10</td>
<td>“They hit on the lower levels of Bloom’s taxonomy, but not the deeper learning. Whole brain would seem to suggest more thinking.”</td>
</tr>
<tr>
<td>Feasibility and Planning for Implementation</td>
<td>10</td>
<td>8</td>
<td>“I question well how often should I be adding in motion. Everyday? Every lesson? Every concept? Should everything have a movement or a trick or things of that nature to help the students remember? That is something that I am still struggling with.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“When I did teach okay, I felt like everything lined up when we were doing it, but when I reflect back I wonder if it was too much information for that short period of time.”</td>
</tr>
<tr>
<td>Student Reluctance</td>
<td>18</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>----</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>We are introducing rules and I’m doing the action and I’m trying to get them to do it and I know what the book says… everybody has to do it and to keep doing it until everybody does it… I’m like “I’m tired” (laughter).”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>“It’s even different by class period. We have one class that will do anything and the other seems to not be that into it.”</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Style and Fit</th>
<th>4</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I really don’t mind if they get up and quietly take care of something while I am teaching. So now they are like “Can I go throw that away” and I’m like” why on earth did you ask me that?” But it’s the rules so I respond with “yes, thank you.”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“I felt like I needed to modify the rules instead of using exactly what was in the book. I have a lot of really low special education students.”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In addition to the individual reflective journals and focus group meeting discussions, observations were used to triangulate the data. The challenges observed during observations support the challenges that were indicated on the teacher’s journals and through focus group dialogue. A synthesis of the challenges observed through the ten completed observations is included in each of the category headings below. Also included here is a synthesis of the findings related to the challenges revealed through the individual reflective journals and focus group meetings.

**Consistency with using strategies.** The challenge of consistently implementing the Whole Brain Teaching strategies was the most prevalent, occurring 21 times during
the focus group discussions. The primary reason cited for difficulty with consistency was that using these strategies required a change in their teaching practice. For all of the veteran teachers, this challenge was magnified because of the length of time these teachers have invested in teaching in a more traditional manner. As one teacher stated, “You know 28 years of doing something the same way is hard to change it.” Even the three teachers who implemented the strategies after the district training in the 2013-2014 school year admitted that they continue to encounter difficulty with consistency because of the amount of time needed to plan for incorporating the strategies. In addition, there was inconsistency in which strategies were used and the frequency of their use. Some teachers have implemented all six of the strategies while others for example have only been able to implement “class-yes,” “hands and eyes,” and the “rules.” This inconsistency is further discussed in the frequency of use and specific strategies used provided in the section for Research Question #5.

The consensus amongst all of the participating teachers was that without consistency in implementation, the effectiveness of the strategies is weakened. Findings pertaining to this perception of effectiveness is provided for Research Question #4. Through the focus group dialogue, the teachers concluded that consistency with using the strategies is “very much a change in mindset.”

**Co-teaching.** There are approximately 70 blocks of instruction for the 2016-2017 school year that are co-taught at the school where this study was done. All ten of the teachers in the group co-teach with another teacher for at least one class block. The special education and gifted education teachers push into general education classrooms to provide instruction. The teachers all agreed that the relationship between co-teachers is a
factor for implementation and is a challenge if both teachers are not in agreement with using the strategies. One teacher reported that the co-teaching relationship was a barrier for implementation stating that, “The students are confused when we are not on the same page.” All of the teachers have participated in three co-teaching professional development sessions conducted by the school’s administration team during the 2016-2017 school year. The challenges that arose during implementation regarding co-teaching support the identified need of the administration to focus on strengthening co-teaching relationships within the building. This is particularly important when considering how or if these strategies can help to meet the needs of challenging students.

**Absence of critical thinking.** During focus group meeting three, when answering the question of “What challenges did you face with using the strategies?”, the teachers engaged in dialogue about their difficulty in using the strategies to help their students learn on a deeper level. For example a teacher asked the group, “How can I be confident that my students are getting it?” The question was promoted out of dialogue about students gaining true understanding or simply “parroting” the teacher or their “Teach-Okay” partner. Another teacher offered,

> I’m just trying to wrap my brain around ok yes. All of the children were engaged, and they had to actually be with me to repeat what I was saying and do the movements with me. But where does the understanding come in?

From this dialogue the teachers concluded from their experience that the strategies were best used to reinforce concepts but that other strategies were necessary to get their students to access higher levels of thinking.
Feasibility and planning. One teacher’s assertion during the fourth focus group meeting provides a summary of the sentiments of the group regarding the challenge of feasibility and planning. The teacher stated, “On the front end, it is probably just as difficult for us teachers as it is for the students to grasp all of this, plan all of this, and develop all of this, and then teach it!” The challenge of feasibility and planning was not limited to the amount of time necessary to adequately plan for how to best incorporate the strategies of “Mirror Words” and “Teach Okay.” It was also determined that the teachers struggled with how much of their lesson should be taught with the strategies. There was a concern that if Whole Brain Teaching is used exclusively as the primary way of teaching, it would not be feasible to teach in this manner and cover all of the required content. One teacher offered, “Personally, I think no to use it exclusively but that it is more effective to use as a supplement. There are other strategies that you are going to have to use.” During focus group meetings, all of the teachers agreed that they felt it necessary to choose portions of their lesson to apply the strategies of “Mirror Words” and “Teach Okay.” The individual reflection data and observation data corroborate this challenge of feasibility and planning. For the reasons stated above, the two strategies of “Mirror Words” and “Teach Okay” were implemented less often.

Student reluctance. The findings regarding the challenge of students being reluctant to participate is primarily focused on how the reluctance of students impacts the teacher’s ability to implement the strategies. When students were unresponsive or responded negatively, the teachers reported that it “didn’t make sense” to make students that uncomfortable. The teacher dialogue during focus group meetings focused on, as one teacher stated, “the gap between what the book says we should do and the reality of being
in the classroom with kids.” One teacher pointed out that “the Whole Brain Teaching book says that we should keep doing the strategy until every student joins in but that’s not reality.” The teachers were in disagreement about how to handle challenging students who were reluctant to participate. The teachers were unable to find consensus on who was considered a challenging students. For some the challenging student represented the attention-seeking student who displayed disruptive behaviors. Others considered the challenging students to be those who were reluctant to participate with the strategies and “silently miserable.” However, all of their teachers agreed that there are some students who are reluctant to participate and this impacts implementation. It was also found that the teachers perceived the strategies to be more effective with 6th grade students than 7th and 8th grade students. In addition, it was observed that differences in student receptiveness to the strategies differs from “class to class” based on the dynamics of the students in the class.

**Style and fit.** This challenge was raised in focus group dialogue and on the individual reflective journals. Two of the teachers expressed concern that they did not feel as though they had the personality to implement the strategies and that the movements take them too far away from their style of teaching. As one teacher stated, “If I’m uncomfortable doing the strategies, so will my students be.” The other teacher expressed, “I’m never really sure if I am doing this right.” The transparency of these two teachers opened the dialogue with the group exploring if the strategies are better fit for some classes versus others and also how the instructional style of the teacher impacts implementation. It was found based on the experience of these ten teachers that the Whole Brain Teaching strategies may not be best suited for every student and all
teachers. For this reason, the teachers agreed that the Whole Brain Teaching strategies should be part of the teacher’s toolkit but not the only strategies used.

Research Question #4: What are the teachers’ perceptions of the effectiveness of Whole Brain Teaching strategies in terms of student engagement and in meeting the needs of challenging students?

The teachers’ perceptions of the effectiveness of Whole Brain Teaching strategies evolved over the course of the study. At the start of the study, there was a wide margin in how the teachers perceived the strategies. The three teachers who were most familiar with the strategies started with a perception of the strategies as effective. However, other teachers in the group were more skeptical but interested in the exploration to either prove or disprove their skepticism. And yet other teachers were more neutral, not having the experience or exposure to form a definite positive or negative perception. Based on the data gathered from individual reflective journals and focus group meeting discussions, three themes were identified to reflect the teachers’ perceptions of effectiveness in terms of student engagement and in meeting the needs of challenging students.

The three themes that emerged from the findings as presented below in Table 7 were that all of the teachers by the end of the study perceived the Whole Brain Teaching strategies to be effective in engaging students but only with low-level thinking activities. They found the strategies to be ineffective for helping students to think critically. Their perceptions for the effectiveness for challenging students were divided and therefore inconclusive. The findings pertaining to these three themes are provided in this section.
### Table 7

Teacher Perceptions of Effectiveness

<table>
<thead>
<tr>
<th>Effectiveness Code</th>
<th>Number of Teachers</th>
<th>Frequency of Occurrences</th>
<th>Illustrative Excerpts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaging for Low Level Activities</td>
<td>10</td>
<td>12</td>
<td>“I’m just trying to wrap my brain around ok yes all of the children were engaged. And they had to actually be with me to repeat what I was saying and do the movements with me. But where does the understanding come in?”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“All of my students were participating, but I’m not sure if they all were comprehending or just repeating what I told them.”</td>
</tr>
<tr>
<td>Ineffective for Critical Thinking</td>
<td>10</td>
<td>17</td>
<td>“I thought brain-based meant that our students would think on a higher level.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“It comes back to the same fundamentals of good teaching, whether we call it brain-based or not.”</td>
</tr>
<tr>
<td>Inconclusive for Challenging Behaviors</td>
<td>10</td>
<td>16</td>
<td>“Then you have the kids who want to get up and move and will try to climb on the chairs and play around. That can become chaotic.”</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>“The strategies worked well for my challenging students. They were like you are giving me a chance to be noisy so let’s do it and I think they got it.”</td>
</tr>
</tbody>
</table>

**Effectiveness in engaging students.** The teachers perceived that the Whole Brain Teaching strategies were effective with engaging students but only in engaging students
in lower level thinking activities. The teachers based this perception on the number of students who were participatory with the strategies versus those who were not. For example, one teacher expressed that “All of my students were participating, but I’m not sure if they all were comprehending or just repeating what I told them.” These perceptions gathered from individual reflective journals and focus group meeting discussions align with observation data presented in Table 11 in the next section for Research Question #5 which indicates high levels of student engagement. While the data indicates that teachers perceived the strategies to be engaging, what is unknown is the students’ level of comprehension of the content.

**Ineffectiveness for critical thinking.** The teachers did not perceive the strategies to be effective in helping students to think critically. The teachers were in agreement that the strategies were tools for lower levels of learning such as remembering but it became difficult to gauge students’ understanding when they were “just repeating the teacher verbatim.” One teacher suggested that in order to make the strategy of “Teach-Okay” more effective, it was necessary to allow the students “to prepare themselves and their thoughts for what they will say to their neighbor because a lot of them can’t think on the fly.” The teachers surmised that if the strategies do not cause the students “think on their own” in the process of teaching one another then it must be asked, “Did they really teach each other?” Teachers also determined that having the students to share out to the class in their own words what their partner “taught” them was a way to increase the effectiveness of the “Teach-Okay” strategy. Observation data includes an example of this with the teacher stating to a pair of students, “Kennedy what did Laura teach you about genotypes?” The teacher asked each pair a question pertaining to the information they
“taught” one another. A different question was asked to each pair and the students were required to share out to the class in their own words. The teachers felt like without this type of follow-up after using the “Mirror Words” and “Teach Okay” strategies that, short of an assessment, it would be difficult to determine how effective their use was with students.

Some of the teachers were concerned that the strategies were promoted as “brain-based” because their perception of brain-based strategies was that these strategies would promote higher levels of cognition, which they perceived these strategies failed to do. Table 7 above provides the number of teachers, count of occurrences, and illustrative excerpts from the teachers who expressed this concern based on their perception that the strategies were ineffective for critical thinking.

Those teachers who had experience with the strategies prior to the study and who began the study with a positive perception of effectiveness concluded by the end of the research that the strategies are “brain-based” in the sense that as one teacher stated, “audio, kinesthetic, and visual methods are integrated to stimulate the students.” But this teacher also concluded that the “strategies stop at retention” and are not effective for critical thinking. The teacher further offered that,

I do not use Whole Brain strategies in my lessons for critical thinking, they are just a way to introduce my students to new concepts or terms that are unfamiliar; like some of the science terms[that] are really hard for them to remember. So I use other things to get them to those higher levels of thinking.

**Challenging students.** The teacher’s perception of the effectiveness of Whole Brain Teaching strategies for reaching challenging students was mixed. Five teachers
indicated perceptions of effectiveness in meeting the needs of challenging students while others perceived ineffectiveness. For example, the special education teacher indicated that the strategies were effective when she used them with a small group of students who receive special education services and who have had difficulty with disruptive behaviors, stating “So we’ve been using Teach-Okay and it’s been helping with keeping them engaged and on task.” Two math teachers expressed that when their most challenging student was reluctant to participate, “He joined in when he realized that his classmates were having fun learning.” The remaining five teachers expressed that they did not perceive the strategies to be effective with students who were challenging because they did not want to participate. One teacher expressed that, “You can throw gasoline on that fire or you can throw a blanket on that fire. It’s all in how you choose to react to that challenging child.” The sentiment of these teachers was that for a teacher to pressure a challenging student to participate in the strategies was not an effective way of teaching and that “another approach is needed” to reach challenging students.

In summary, the teacher’s perceptions of effectiveness in terms of student engagement were that the strategies effectively engaged the students but only with lower level thinking activities and that the strategies were ineffective for helping students to think critically. The perceptions of effectiveness in meeting the need of challenging students were split, with five teachers perceiving effectiveness and five teachers perceiving ineffectiveness.
Research Question #5: What Whole Brain Teaching strategies are being used and for what purposes?

This section provides findings for the frequency of Whole Brain Teaching strategies used and the purposes that the strategies were used for. Findings for purposes used are presented in two sections; learning intentions and student engagement. Also focus group discussions and observation data revealed teachers’ perspectives of successes with using the strategies. Below is a synthesis of the successes that teachers discussed during focus group meetings as well as successes based on the observation data.

- All of the teachers agreed that class-yes consistently worked well for its intended purpose of gaining the student’s attention and that it was the easiest strategy to incorporate because many students have been exposed to a teacher who has used this attention getter. Overall, students were receptive to class-yes. The 6th grade teachers added that the strategies of “hands and eyes” and class-yes work well together. One teacher stated that “transitions between segments were much smoother” when these strategies were used together.

- Teachers who used teach-okay reported that students were more engaged than when direct instruction was primarily used.

- Teachers revealed that the Whole Brain Teaching “rules” helped to provide structure and easy behavior redirection. The last teacher to join the group, who had never been exposed to the training and had never tried the strategies prior to joining the group, commented during the second focus group meeting, “Just implementing the rules, “I’ve seen a difference. They are not up out of their seat all day long. They are raising their hand instead of blurting out.”
There was variation in frequency of use and the specific strategies used. This was best captured through the checked charts that were a part of the individual reflective journals which showed that the strategies of “class yes” and “hands and eyes” were used most frequently. All ten participating teachers used the individual reflective journals. Table 8 provides the total number of days that the teachers used each strategy for the eight week study period.

Table 8

Frequency of Whole Brain Teaching Strategies Used as Reported in Teacher Individual Reflective Journals

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Journal 1</th>
<th>Journal 2</th>
<th>Journal 3</th>
<th>Journal 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Yes</td>
<td>35</td>
<td>45</td>
<td>51</td>
<td>59</td>
</tr>
<tr>
<td>Mirror Words</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>Hands and Eyes</td>
<td>27</td>
<td>34</td>
<td>41</td>
<td>48</td>
</tr>
<tr>
<td>Teach Okay</td>
<td>14</td>
<td>15</td>
<td>18</td>
<td>20</td>
</tr>
<tr>
<td>Score Board</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Rules</td>
<td>7</td>
<td>21</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

The data indicate that the two strategies of “Class-Yes” and “Hands and Eyes” were used the most by the end of the study as evidenced by the fourth Individual Reflective Journal data. Table 9 below has an added column to show the amount of increase in the number of times each strategies was used from journal one to four. The amount of increase provides an indication of the teacher’s commitment to using the strategies throughout the study. The number of times the teacher participants used the
“Class Yes” strategy increased by 24 from the data provided in Journal 1 during the first two weeks of the study to the last two weeks of the study in Journal 4, and “Hands and Eyes” increased by 21. However, the strategy of “Mirror Words” only increased by 8, “Teach Okay” increased by six and the “Score Board” showed no increase.

Table 9

Frequency of Whole Brain Teaching Strategies Used With Increase Column

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Journal 1</th>
<th>Journal 2</th>
<th>Journal 3</th>
<th>Journal 4</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Yes</td>
<td>35</td>
<td>45</td>
<td>51</td>
<td>59</td>
<td>24</td>
</tr>
<tr>
<td>Mirror Words</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Hands and Eyes</td>
<td>27</td>
<td>34</td>
<td>41</td>
<td>48</td>
<td>21</td>
</tr>
<tr>
<td>Teach Okay</td>
<td>14</td>
<td>15</td>
<td>18</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Score Board</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Rules</td>
<td>7</td>
<td>21</td>
<td>24</td>
<td>24</td>
<td>17</td>
</tr>
</tbody>
</table>

These data align with the focus group discussions where teachers revealed that consistency with using the strategies to related to their experience that the strategies of “Class-Yes” and “Hands and Eyes” can be implemented with little planning time, whereas the strategies of “Teach Okay” and “Mirror Words” are much more time consuming to plan and difficult to implement. The strategies that were easier to implement were utilized more than those that were more difficult or required more planning. More on the findings related to the challenge of planning will be provided under the Feasibility and Planning section.
**Purposes for strategies used based on learning intentions.** The purpose of the strategies used was captured through the observations which provided evidence of the learning intentions that the strategies were used with. Table 10 below provides the count of occurrences of the strategies and learning intentions for each observation (Ob1 through Ob10). This count was determined by tallying the number of times the researcher observed the strategies in use during the ten, thirty minute observations.

The observations included the participation of six teachers, four of which invited the researcher in for a second observation. Specifically, the observations included six science, three math, and one English. The science observations are comprised of four 7th grade and two 6th grade observations. The math observations included two 8th grade and one 7th grade. The English observation was completed with the 6th grade English teacher participant. The findings from this data show that “Class Yes” was used in all ten of the observations, “Teach Okay” was used in seven observations, “Mirror Words” was used in four observations, “Rules” was used in three observations, “Hands and Eyes” was used in two observations, and “Score Board” was not observed in the observations. Data from the Individual Reflective Journals and Focus Group Meetings indicated that the strategy of “Teach Okay” was used much less frequently than “Class Yes”. When considering the use of “Teach Okay” in the observation data it is important to point out that the observations were conducted at the invitation of the teacher for the researcher to see the strategies in practice. The finding that the “Teach-Okay” strategy was used in seven of the ten observations although individual reflective journals reflected infrequent use infers that the teachers used the “Teach-Okay” strategy partially for the purpose of being observed.
<table>
<thead>
<tr>
<th>Observation</th>
<th>Learning Intentions</th>
<th>Strategy Used</th>
<th>Frequency of Occurrences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ob1</td>
<td>Identify subject, pronoun, and object pronoun</td>
<td>Class Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rules</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hands and Eyes</td>
<td>3</td>
</tr>
<tr>
<td>Ob2</td>
<td>Describe and sequence the major parts of cell theory</td>
<td>Class Yes</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rules</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>1</td>
</tr>
<tr>
<td>Ob3</td>
<td>Understand the structure of the periodic table and the different types of elements</td>
<td>Class Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rules</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hands and Eyes</td>
<td>1</td>
</tr>
<tr>
<td>Ob4</td>
<td>Explain corresponding complementary and supplementary angles</td>
<td>Class Yes</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>2</td>
</tr>
<tr>
<td>Ob5</td>
<td>Explain differences between plant and animal cells</td>
<td>Class Yes</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>1</td>
</tr>
<tr>
<td>Ob6</td>
<td>Describe cells, tissues, organs, and systems</td>
<td>Class Yes</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirror Words</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>2</td>
</tr>
<tr>
<td>Ob7</td>
<td>Identify the coordinates of an graphed images</td>
<td>Class Yes</td>
<td>3</td>
</tr>
<tr>
<td>Ob8</td>
<td>Compare and contrast elements, compounds, and mixtures</td>
<td>Class Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirror Words</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>1</td>
</tr>
<tr>
<td>Ob9</td>
<td>Understand the meaning of terms genotype, phenotype, recessive, dominant,</td>
<td>Class Yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirror Words</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>2</td>
</tr>
<tr>
<td>Ob10</td>
<td>Graph coordinates and reflection image on a graph</td>
<td>Class Yes</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mirror Words</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Teach Okay</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note.* Ob1 through Ob10 represents Observation 1 through Observation 10.
Purpose of strategies used based on student engagement. The observations also included a visual scan every five minutes of students who were visibly engaged. All teachers agreed that student engagement was an intended outcome for using the strategies. Therefore, it is important to consider findings on how many students were engaged during the lessons where the Whole Brain Teaching strategies were being used. Table 11 provides the number of students visibly engaged for each observation and the number of students in each class. The class sizes ranged from 18 to 28. The segments (S1 through S6), represent the five minute intervals where the six visible scans were made by the researcher to record how many students were engaged.

Table 11

Number of Students Engaged by Segment During Observations

<table>
<thead>
<tr>
<th>Observation</th>
<th>S 1</th>
<th>S 2</th>
<th>S 3</th>
<th>S 4</th>
<th>S 5</th>
<th>S 6</th>
<th>Number in Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ob 1</td>
<td>22</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>24</td>
<td>25</td>
<td>26</td>
</tr>
<tr>
<td>Ob 2</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Ob 3</td>
<td>19</td>
<td>20</td>
<td>21</td>
<td>21</td>
<td>19</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Ob 4</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>Ob 5</td>
<td>22</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Ob 6</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Ob 7</td>
<td>24</td>
<td>25</td>
<td>27</td>
<td>28</td>
<td>28</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Ob 8</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Ob 9</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Ob 10</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
<td>24</td>
</tr>
</tbody>
</table>

Note. S1 through S6 represents Segment 1 through Segment 6.
During six of the ten observations all students were visibly engaged at each of the five minute segment scans. Another two observations indicated that all but one or two students were visibly engaged during at least four of the six segments. For example, in Observation 3, there were 21 students in the class and at the visible scans one, five, and six, there were two students not engaged and at scan two there was one student not engaged. The remaining two observations revealed that three or more students were off task during at least three segments during the observation. For example, in observation seven, there were 28 students in the class and four students were not engaged at the visible scan for segment one, three not engaged at scans two and six, and one not engaged for segment three.

In addition, key points from the observations regarding student engagement were shared by the researcher with the permission of the observed teachers during the focus group meeting discussions. These data were coded and provided below in Table 12.

Table 12
Selected Significant Successes of Student Engagement

<table>
<thead>
<tr>
<th>Selected Significant Successes of Student Engagement</th>
</tr>
</thead>
<tbody>
<tr>
<td>• In 8 of 10 observations, all students participated and were engaged with the Class-Yes attention getter strategy as evidenced by their participation and responses to the teacher.</td>
</tr>
<tr>
<td>• The Teach-Okay strategy was used in 7 of the 10 classes observed. For 6 out of the 7 observations of Teach-Okay, all students were visibly engaged throughout the lesson (see Table 11) and the students were able to articulate accurate understanding.</td>
</tr>
<tr>
<td>• In two observations, the teacher provided at least one minute of wait time before the students were released to teach their peer partner so that they had an</td>
</tr>
</tbody>
</table>
opportunity to process their thoughts. The students then put the chunked information into their own words to teach to their peer.

Overall, the findings from individual reflective journals and focus group discussions were that the strategy of “Teach-Okay” was used less frequently than “Class-Yes” and there was a high level of visible engagement when the strategies were observed. The observation finding of high levels of student engagement triangulates with the findings from the individual reflective journals and focus group meetings that showed a theme of high engagement, specifically with low level thinking activities. Based on the observation data, focus group meeting discussions, and individual reflective journals the intended purposes of the Whole Brain Teaching strategies were largely for learning intentions in the areas of math and science and for the purpose of increased student engagement.

**Summary of Findings**

The findings indicate that the teacher’s perceptions of Whole Brain Teaching are still being shaped by their experience with using the strategies. The teachers determined that the best use for the strategies are as reinforcements and that additional strategies must be incorporated to help students to think critically or on a higher level. Overall, students were engaged during the use of the strategies as based on the visible scans conducted during the ten observations. What is unknown is how this compares to classrooms where the strategies were not being used. Perceptions of effectiveness were also interdependent on the frequency and consistency of use. The teachers determined that consistency was necessary for the strategies to be effective and their perception of effectiveness influenced the frequency with which they used the strategies. Finally, the
teachers expressed similar concerns related to the “brain-based” label of the strategies as discussed in the literature review provided in Chapter 2. The implications and meaning for stakeholders will be discussed in Chapter 5.
CHAPTER 5
DISCUSSION

This program evaluation case study was conducted to seek the perceptions of teachers with regard to Whole Brain Teaching. In an age where educators are seeking more effective ways to increase student achievement and academic growth, and are met with a plethora of strategies labeled as “brain-based” (see Chapter 1), this study sought to evaluate the experience and perceptions of a group of teachers who used the specific brain-based strategies called Whole Brain Teaching (Caine & Caine, 1990; Jensen, 2005). There is limited research available on Whole Brain Teaching although there is evidence that these strategies are being used in classrooms. This program evaluation case study was purposed to uncover perceptions and factors that lead to teacher use of the strategies. This exploration of perceptions is intended to inform stakeholders of whether teachers view these strategies as viable to their practice and how these beliefs influence their decisions to implement these strategies or not. Also factors and challenges pertaining to implementation were explored. In addition, this inquiry sought to determine the frequency and intended purposes of teacher use of the Whole Brain Teaching strategies. This chapter provides a discussion of the findings, implications for practice, and recommendations for future research inquiry.

As discussed in the methods section (see Chapter 3), there were limitations with the study. One limitation was that the teacher participants were volunteers who could opt out of the study in part or whole at any time. The one teacher who declined participation
in the study was replaced with another teacher during the initial meeting where the informed consent letter was signed. The teacher’s discussion and investment of time to participate in the study from beginning to end, was evidence of their commitment to experiencing the strategies to inform their own perceptions and to determine if Whole Brain Teaching adds to their quest to increase their capacity for effective teaching.

Finally, the findings are only applicable to the ten teachers who participated in the study for the setting where the study took place. The potential for broader implications in teacher practices will be offered in this section based upon the study findings and the literature review provided in Chapter 2.

To guide the discussion of findings, a summary synthesizing the evaluation findings for each evaluation question from Chapter 4 is presented in Table 13.
<table>
<thead>
<tr>
<th>Evaluation Question</th>
<th>Summary of Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are teachers’ working definitions of Whole Brain Teaching?</td>
<td>• Common elements of definitions included movement, memory, and the use of multiple areas of the brain</td>
</tr>
<tr>
<td></td>
<td>• Teachers with more experience with the strategies maintained positive views of the strategies</td>
</tr>
<tr>
<td>2. What are teachers’ perceptions of the facilitating factors in implementing Whole</td>
<td>• Strategies introduced to teachers through district training in response to continued achievement gaps</td>
</tr>
<tr>
<td>Brain Teaching?</td>
<td>• Collaborative teacher group important for implementation</td>
</tr>
<tr>
<td></td>
<td>• School culture provided safe environment for risk</td>
</tr>
<tr>
<td></td>
<td>• Organizational dynamics offered logistical support and instructional latitude</td>
</tr>
<tr>
<td></td>
<td>• Resources provided were helpful tools in implementation</td>
</tr>
<tr>
<td>3. What are teachers’ perceptions of the challenges in implementing Whole Brain</td>
<td>• Strategies that required more planning were used less often.</td>
</tr>
<tr>
<td>Teaching?</td>
<td>• Teachers found it difficult to change their teaching practices from the established norm. However when implemented some successes were shown.</td>
</tr>
<tr>
<td></td>
<td>• Consistency with using the strategies</td>
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<td></td>
<td>• Coteaching relationships are a barrier when teachers have different beliefs about the strategies</td>
</tr>
<tr>
<td></td>
<td>• Teacher use limited to lower level thinking activities</td>
</tr>
<tr>
<td></td>
<td>• Introverted teacher and student personalities influenced willingness to use</td>
</tr>
<tr>
<td>4. What are the teachers’ perceptions of the effectiveness of Whole Brain Teaching</td>
<td>• Teacher effectiveness evolved over the course of the study. Some who were initially hesitant to use the strategies had positive outcomes when used.</td>
</tr>
<tr>
<td>strategies in terms of student engagement and in meeting the needs of challenging</td>
<td>• Perceptions of effectiveness were clarified to mean effectiveness for retention and reinforcement but not for critical or higher levels of thinking</td>
</tr>
<tr>
<td>students?</td>
<td>• Findings for effectiveness for challenging students were mixed</td>
</tr>
<tr>
<td>5. What Whole Brain Teaching strategies are being used and for what purposes?</td>
<td>• Class-Yes attention getting strategies was used the most and the Score Board was used least</td>
</tr>
<tr>
<td></td>
<td>• Observations show overall high student engagement and lower levels of thinking</td>
</tr>
</tbody>
</table>

Discussion of Findings
The commonality that all of the teachers participating in the Whole Brain Teaching group shared was that they believed there to be an identified need at the school for improved instruction and they all considered themselves to be learners who held a continuous desire to improve the capacity for effective teaching. These shared beliefs created a trusting dynamic within the group in which the teachers were able to speak candidly about their experiences with the strategies. These group characteristics align with the key characteristics of professional learning communities to include, shared beliefs and vision, collective responsibility, reflective professional inquiry, collaboration, and a desire for individual and group learning (Stoll, Bolam, McMahon, Wallace, & Thomas, 2006).

Although all of the teachers had an interest in learning more about Whole Brain Teaching, they varied in how they perceived the strategies at the onset of the study. This mixture of experienced proponents, skeptic veterans, and neutral novices made for a potentially clashing dynamic. However the teacher’s common desire of wanting to form an authentic perception motivated their participation in the group and outweighed their differences. The most profound finding that can be synthesized from all of the data sources is that teacher perceptions evolved and/or were clarified by their “lived experience” with the strategies and as part of the teacher group. The discussion to follow in this section will expand on how the findings relate to literature.

**Working Definitions**

The three themes that emerged from the teacher’s expressions of their definitions of Whole Brain Teaching were movement, memory, and use of multiple parts of the brain. These three components which were expressed by teachers through their individual reflective journal and focus group meeting responses can also be found in the literature
provided in Chapter 2 that relates to how neuroscience findings is used as a basis for brain-based strategies. This discussion also reiterates the caution given to the application of neuroscience findings to teaching practices because of the infancy of the field and potential misapplication of neuroscience findings (Alferink & Farmer-Dougan, 2010).

Movement. The teachers’ assertion of movement being a key component in how Whole Brain Teaching is defined coincides with literature that suggests that there is a connection between movement and brain-based learning. As provided in the literature review, neuroscientists agree that there is a positive connection between movement and cognition (Griss, 1998; Wilson & Conyers, 2013). Literature also states that information learned with movement has a greater chance of retention because of the large number of neurons that are stimulated in order for movement to occur (Jensen, 2005). According to educational neuroscience literature, brain imaging shows enhanced cognitive processing when movement is incorporated with learning (Jensen, 2005). In addition neuroscience researchers have found that the brain’s plasticity and movement possess bidirectional influences on each other (Leisman et al., 2016). Thus, this research indicates that movement can play an influential role in how the brain changes and is important here because movement is being associated with how Whole Brain Teaching is being defined. Although there is reservation given in the literature about how these neuroscience findings should be applied to teacher instructional practices, the teacher’s identification of movement as a key component suggests that the teachers have made a connection in their understanding of the strategies that Whole Brain Teaching means the inclusion of movement with instruction.
Memory. The teachers’ working definitions not only indicated memory as a key component but they expressed their definition of Whole Brain Teaching to be an interplay between memory and movement. For example one teacher explicitly stated, “We aren’t just repeating but we all are moving a part of our bodies to help them remember something.” This teacher’s assertion aligns with neuroscience research that indicates movement with repetition strengthens memory and that retention increases with repetition of the same movement associated with the same information (Griss, 1998; Mellanby & Theobold, 2014). Some critics have asserted that brain based strategies claiming to stimulate memory retention are no different than traditional instructional strategies that used repetition to promote memorization and mastery learning (Alferink & Farmer-Dougan, 2010; Kirschner et al., 2006). However it was clear that the teacher’s understandings and working definitions of Whole Brain Teaching were not viewed as a traditional method of teaching. In fact, the teacher’s expressed significant difficulty in changing from their traditional practices of teaching to incorporate the “Mirror Words” and “Teach-Okay” components of the Whole Brain Teaching strategies. As one teacher implied that her traditional methods of teaching were less active, stating that “Before I felt like I was doing less modeling, it was more auditory and lecture.”

Multiple parts of the brain. The teacher’s identification of using multiple parts of the brain as a key component in their working definitions of Whole Brain Teaching is significant because it aligns with the limited literature pertaining specifically to Whole Brain Teaching developed by Chris Biffle (Biffle, 2013). According to Biffle, the simultaneously engagement of multiple parts of the brain is a key separating tenant when characterizing Whole Brain Teaching from other brain-based strategies (Biffle, 2013;
Torio & Cabrillas-Torio, 2016). The teachers were able to identify this simultaneous engagement of multiple parts of the brain but they struggled to move from identification to making meaning of this component in their practice. Furthermore, by the end of the study the teachers struggled in their understanding of the strategies as “brain-based” because they believed that simultaneously engaging multiple parts of the brain should increase critical thinking and their experience with Whole Brain Teaching limited students to lower levels of thinking.

The teachers all agreed that they perceived the strategies to create an active classroom environment. However, their disagreement of how they perceived the strategies would influence classroom behaviors is not unlike the views presented in the literature of those who are eager to accept brain-based strategies as viable teaching practices versus those who have a more skeptical lens. Enthusiasts are eager to incorporate brain-based strategies as a possible way to improve instruction (Caine & Caine, 1990; Darling-Hammond & Bransford, 2005; Jensen, 2005). For example in this study, one teacher stated that “I have some really challenging students this semester, with their behaviors and low academically, and I really think these strategies might help.” Critics argue that it is precisely these leaps of faith with strategies that lack research that are concerning and potentially harmful (Purdy & Morrison, 2009; Varma et al., 2008). These findings pertaining to the teacher’s perceptions of how Whole Brain Teaching influences classroom behaviors are key because these strategies are marketed to target what the developer calls “challenging kids” (Biffle, 2013). According to literature, there is evidence that students with behavior challenges may benefit from strategies that involve routine (Sanchez, 2008). However the teacher’s in this study struggled with
consistency in using the strategies so therefore (as discussed further with Evaluation Question #5) the findings were inconclusive regarding teacher perception of the strategies’ effectiveness with challenging students. Without a research base or experience with the strategies, it is often difficult for educators to know the credibility of claims made by the developers of brain-based instructional programs.

The three teachers with the most experience with the strategies, having implemented them into their practice immediately after their introduction to the strategies in the 2013-2014 school year, were clear proponents throughout the study. Yet their perceptions of effectiveness and best suited application were clarified by the end of the study. One teacher stated,

I’m glad I did this. At first I was trying to do all of the strategies in one lesson and I felt overwhelmed. Sometimes I think my kids felt overwhelmed. Now I just use what works best for what I’m teaching on that day.

This finding points back to the importance of the teacher group in shaping teacher perceptions. Professional learning communities not only provide a safe mechanism for teachers to implement new strategies, but also can provide teachers a safe place to learn from the experiences of other teachers and help determine what works best for their practice (DuFour, 2004; Stoll et al., 2006).

Based on their experiences with the strategies and discussions in the teacher group, these three teachers now assert that the strategies are effective at specifically gaining student’s attention and engaging students in learning on lower levels such as remembering but not effective for engaging students in higher levels of thinking such as analyzing and synthesis. This finding is in direct contradiction to the literature of
proponents that suggests brain-based strategies help students to become more adept at critical thinking (Jensen, 2005). In addition, this strengthens the position of critics and skeptics who posit that the label of brain-based does not have clear parameters and that teachers are using commercially packaged strategies marketed as brain-based with little to no supporting research (Dekker et al, 2012).

One teacher stated, “Class-Yes works great for getting their attention!” The same teacher also stated,

I don’t feel that my students are thinking critically when they are just re-wording what I have told them in a one minute lesson to the kid beside them. To think critically, they need more time. Time to analyze, synthesize, and draw conclusions.

Triangulation of the data sources indicated that agreement exist amongst all of the teacher participants as evidenced in their individual reflective journals, focus group meeting discussions, and observations. These findings are in contradiction to literature which asserts that teachers who use brain-based strategies are more likely to be able to help their students learn how to think critically and make meaning of information (Hruby & Goswami, 2011; Jensen, 2009; Smith, 2007).

It can be inferred that there was an inextricable relationship between teacher perceptions and frequency of strategy use. Those strategies that the teacher’s perceived to be effective at getting the student’s attention and easy to implement, were used more frequently than those that required significant planning time or crafting coordination with a co-teacher. This suggests that teacher perceptions matter when it comes to
implementation of strategies as indicated in literature on building teacher capacity for effectiveness (Stoll et al., 2006).

The finding that the strategy of ‘Class-Yes’ was used most frequently with a total of 190 occurrences based on reflective journal data indicates that the teachers perceived it easier to incorporate this strategy and that their perception included their frequency of use. This infers that teacher perception is an important element in considering implementation of the strategies. In addition, many of the teachers felt that “Class-Yes” was effective for its intended purpose of getting the attention of students. Albeit, the teachers also perceived that all of the strategies were best received with 6th grade students, the youngest grade level in the school and most applicable to the content areas of Math and Science. In essence, the perceptions of the teachers became a facilitating factor in implementing the strategies. This finding is important in informing stakeholders that teacher perceptions play a critical role in their use of the strategies.

**Facilitating factors.** As presented in the literature review provided in Chapter 2, one of the criticisms that sceptics raise about Whole Brain Teaching is that it is simply the latest fad in education and it will eventually be replaced (Bishop et al., 2013; Purdy & Morrison, 2009). The lack of follow up provided to teachers after the initial professional development, leaving individual administrators with the autonomy to make Whole Brain Teaching a focus and individual teachers the option for implementation, has contributed to the teacher’s skepticism about the longevity of the strategies. The formation of and participation in the Whole Brain Teaching group became a facilitating factor with regard to implementing the strategies and for this school it is likely to be a factor in determining
if the teacher group will develop into a sustainable community of practice, as depicted in
the logic model presented in Figure 1 of Chapter 1.

The importance of the teacher group. The teacher group for this study
functioned as a professional learning community in the sense that the participating
teachers shared a common goal to increase their capacity as effective teachers and a
common belief that participation in the group would help in this endeavor by determining
if the Whole Brain Teaching strategies add to their teaching capacity. Also, the teachers
collaborated with one another and engaged in consistent regularly scheduled reflective
inquiry as part of the group and individually. As noted previously, these characteristics
are vital to professional learning communities (Stoll et al., 2006).

The role of this group was a critical factor in the shaping of perceptions and
facilitating the implementation of the Whole Brain Teaching strategies. Literature
indicates that professional learning communities play a significant role in capacity
building and sustainable improvement (Harris, 2011; Stoll et al., 2006). It was through
the teacher group that the participants developed collaborative relationships allowing the
teachers to share their perspectives and have the courage to allow their perceptions to
evolve. Not only do professional learning communities share beliefs, there is also a
shared trust developed between the participants in the group (Hallam, Smith, Hite, Hite,
& Wilcox, 2015). For the teachers who were initially fearful of implementing the
strategies, their indication of their willingness to take the risk of implementing the
strategies as part of the group speaks to the importance of the role that the teacher group
played in the implementation of the strategies.
Change. All of the participating teachers indicated that a facilitating factor was their ability to change how they have traditionally taught. This was particularly true for the seven veteran teachers with over ten years of teaching experience. Understanding that a process of change should be expected is significant when informing educators and stakeholders of results pertaining to strategies implemented (Fullan, 2006). This finding is a necessary consideration when determining the time investment and commitment that may be needed to become efficient with implementing strategies. In addition a concern is raised with the investment in a change process for implementing strategies that are yet to be directly linked with increases in academic achievement (Bruer, 1997; Epstein, 2008). During the fourth focus group meeting discussion held at the end of the study after teachers spent eight weeks using the strategies, concern was raised with how the learning curve of getting the teachers and students comfortable with the strategies may impact the teachers ability to follow the necessary pacing in a high stakes testing environment. Literature on professional learning communities submits that these groups are an effective way to help facilitate change in instructional practices (Hallam et al., 2015; Harris, 2011; Stoll et al., 2006). This again points to the significance of the teacher group in not only facilitating implementation of the strategies but in creating sustainable changes in teacher practices.

In addition, the teachers agreed that it is a risk to incorporate strategies that do not have a research base when a portion of their summative evaluation is based upon the academic growth of their students, with one stating “how these students learn is reflected on my evaluation.” When weighing this risk, one must ask how much time can teachers afford to sacrifice when “testing” to see if the strategies are effective and viable to their
practice (Bruer, 1997; Epstein, 2008). Teachers asserted that they are faced with balancing the pressure of continuously preparing their students to pass state assessments with their personal beliefs about teaching and learning, while trying to decipher from a barrage of strategies to determine those that best increase their capacity as an effective teacher. Such pressure continues to contribute to the stagnation of change efforts in education (Darling-Hammond, 2010). One teacher offered,

I really do believe that all of my kids can learn but if we measure a fish’s success on how well it can run, that doesn’t tell us a whole lot. I just want to figure out the best way to reach my students based on how they learn.

These factors give rise to the risk of improvement efforts being overshadowed by the totality of the responsibilities of teachers and fading away until the next new and exciting initiative (Bishop et al., 2013; Purdy & Morrison, 2009).

So what caused teachers to take this risk of implementing Whole Brain Teaching strategies? The first answer to this question that can be synthesized from the focus group discussions and individual reflective journals is that as discussed above, the group provided a safe place and a supportive network. Many of the teachers expressed fear and hesitation during the first focus group meeting which was minimized by the fourth focus group meeting. There was fear of losing control of managing behaviors and hesitation with trying something that they were not sure how it was going to turn out. However, the group provided a place to discuss their successes and challenges without scrutiny. Secondly, the opportunity cost and risk of not implementing strategies that may help in their quest to increase their effectiveness as a teacher for some was worth the risk. However, it is this type of risk that concerns some critics who posit that desperation to
Challenges. Consistency proved to be a reoccurring challenge throughout the study. In part, the lack of consistency may be attributed to the process of implementing a change in practice (Fullan, 2006). Also, teachers reported that their challenge to be consistent in using the strategies was partially due to having to remember to include multiple new components into their practice. Particularly for teachers who were new to the strategies, trying to implement up to six new practices into the planning and teaching was “overwhelming at times” and cumbersome. Such challenges may prove to be a deterrent for teachers who are considering implementation of the strategies.

For some this challenge was addressed by focusing on implementing a particular strategy for a particular week. For example, one teacher who expressed difficulty with changing her practice decided to focus on the strategy of “Class-Yes” for one week and then “Mirror Words” for another week. “Mirror Words” and “Teach-Okay” are often used together. When “Mirror Words” was used by teachers students were asked to “mirror” the teacher’s exact words and accompanying motions for a particular chunk of information. Then, the teachers used “Teach-Okay” to prompt the students to begin teaching their peer partner what the entire class just “mirrored” with the teacher, making certain to use the words and motions that the teacher used. As indicated by the data, teachers were able to implement “Mirror Words” and “Teach-Okay” significantly less than “Class Yes”. In addition, teachers who considered themselves to be competent yet naturally introverted were more inclined to implement “Class Yes” more than “Mirror
Words” or Teach-Okay” which required them to, as one teacher stated, “to step more out of my comfort zone.”

The pairing of the “Mirror Words” and “Teach-Okay” strategies was not something that the teachers could execute effectively without planning. Teachers found it necessary to pre-plan the exact motions that they would have their students use with specific words. The more times that the teachers decided to include the pairing of these two strategies for a particular lesson, the more planning time that was required. This challenge of planning for the implementation of the strategies was compounded when a co-teacher relationship was involved. Ideally co-teaching models intend to be proactive in creating a positive culture of inclusiveness (Beninghof, 2012). However constraints of planning time coupled with differences in perspectives can prove to be obstacles that make implementation virtually impossible. The findings showed that even when both co-teachers were in agreement to implement the strategies, there were differences in teacher personality and how the teachers felt about how often to implement and at what lesson segment. The individual reflective journals and focus group meeting discussion data which revealed the concern of determining how frequently to incorporate the strategies reveals the teachers uncertainty about balancing these facilitating factors of implementation of the strategies with desired outcomes.

It is important to note that when teachers were able to implement the “Mirror Words” and “Teach-Okay” strategies, some successes were reported. In triangulating the data of the reflective journals, focus group discussions, and observations it was found that, with the exception of a few students, overall students were visibly engaged and could articulate their understanding of the intended learning. By the end of the study, the
teachers clarified that the engagement was in lower level thinking activities. It is also important to note that teachers who encouraged their students to articulate their understanding in their own words when doing “Teach-Okay” with their peer partner, instead of simply parroting the teacher, felt this to be a more effective way to gauge the student’s understanding of the concepts. This is more in line with the intention of the strategy according to develop Biffle who writes, “Students will be putting your point into their own words, with their own patterns, sometimes even with their own examples.” and Biffle adds, “Students will be practicing the extremely important critical thinking skill of paraphrasing” (Biffle, 2013, p.53). This distinction of how teachers are using the strategies indicated their uncertainty with what is considered the “correct way”. After an observation one teacher who asked her students to take one minute to gather their thoughts before teaching their peer, commented that “I hope I’m doing this right. I think they are getting it.” When the participating teachers prompted their students to put the “Teach-Okay chunked material in their own words, they all agreed that this was more effective than “parroting” but they still did not perceive this strategy to cause their students to think critically.

**Brain-based?**

The participating teachers were not specifically asked about their perceptions of Whole Brain Teaching as a form of brain-based teaching based upon neuroscience research or if they perceive neuromyths at work. However, data from the focus group meeting discussions found that teachers have some reservations about the strategies in total being referred to as “brain-based” based on their perception that the strategies alone do not invoke critical thinking. The teacher’s perception that the strategies do not cause
students to rise to a critical thinking level also therefore caused the teachers to question the developer’s basis of the assertion that students paraphrasing when using the “Teach-Okay” strategy is based upon neuroscience research. As provided in the literature review in Chapter 2, these incorrect assertions called neuromyths, about how neuroscience should be applied is the argument of critics who believe that neuroscience is being misused, misrepresented, and overgeneralized for the purpose of promoting instructional packages (Dekker et al., 2012).

There were components of the strategies that the teachers believed to be “brain-based.” Specifically, the teachers perceived the strategies to be effective for helping students to remember terms and reinforce concepts through the repetition of simultaneous kinesthetic, visual, and auditory mechanisms. As one teacher stated and others echoed in focus group discussions, “the movements help them to remember.” This was especially voiced by math and science teachers who offered that students would do the associated movement to help recall a characteristic of an angle or the name of a scientist. This multidimensional approach resonates with literature provided in the review in Chapter 2 which offers that “teaching must no longer be one-dimensional but multi-dimensional” and that neuroscience-based instruction that utilizes multiple regions of the brain simultaneously increases the likelihood that information will enter the student’s long term memory and be easy to retrieve (Sanchez, 2008; Willis, 2007). Also neuroscientists have found that memories are encoded to a large degree in the areas in the brain through which they are received (Willis, 2007). The teachers experience with this was when students learned a concept by associating a movement with it, and then remembered that concept by recalling the movement.
Implications for Practice

The findings of this study suggest that the teacher’s lived experience with using the strategies and being a part of the teacher group were significant factors in shaping their perceptions about the strategies and determining how and if the strategies can help to increase their capacity for effective teaching. This suggests that both experience using the strategies and support are important. When implementing new instructional strategies it is critical for teachers to be a part of a focused group such as a professional learning community where they can collaborate with other teachers in the community with shared beliefs and have opportunities for consistent reflective inquiry. This group is a key facilitating factor in building a safe and trusting environment where teachers are able to communicate openly about their experiences with the strategies (Hallam et al., 2015; Harris, 2011; Stoll et al., 2006).

Also, pertinent to implementing strategies into teacher practice is the consideration of co-teaching relationships. The obstacles that co-teaching relationships present can be difficult to overcome, particularly when the co-teachers do not share the same belief about brain-based instructional strategies. There must be agreement between the co-teachers before implementation of the strategies. Literature on co-teaching suggests that successful co-teaching relationships are inherently collaborative and require effective communication to build trust (Beninghof, 2012). The characteristics of collaboration, communication, and trust mirror those of teacher group or professional learning communities (Stoll et al., 2006). Co-teaching relationships that exhibit these characteristics are likely to have a positive experience in their relationship and within a larger group. Based on the findings of this study, it can be inferred that co-teaching
relationships have significant implications for implementing brain-based instructional strategies.

The findings of this study also show a significant gap between the training provided and the support needed for implementation. Teachers who desired to implement the strategies after the initial training were left to find for themselves if they did not have a building administrator who decided to make Whole Brain Teaching a priority. This contributed to misconceptions among teachers and the use of teacher crafted versions of the strategies or only partial use of the strategies. Unfortunately this is an all too familiar cycle where initial enthusiasm gives way to confusion about the fundamental concepts when insufficient support is provided (DuFour, 2004; Paul & Elder, 2007). These factors contributed to the study’s finding that the Whole Brain Teaching group was a critical part in facilitating the implementation of the strategies and the importance of this type of support.

Other implications for practice include the challenges that teachers faced. This study revealed that it takes significant time to plan for the use of the “Teach-Okay” and “Mirror Words” strategies. Teachers must consider the time necessary for planning and the potential challenges that may arise with the involvement of a co-teacher relationship. The participating teachers in this study did not anticipate how difficult it would be to change from how they have taught previously and to add in new strategies to their practice. This implies that teachers who decide to implement these strategies should anticipate that their comfort with using the strategies may take longer than they are willing to invest. Lastly, this study found that teacher’s experienced student reluctance from a small number of students. Teachers implementing the Whole Brain Teaching
strategies must have a plan for how to meet the needs of students who do not want to participate with using the strategies and/or who are introverted and uncomfortable with these practices.

On a broader scale, there are potential implications for practice when considering how and if to implement these strategies. The facilitating factors and challenges that were found in this study can inform stakeholders of potential concerns to consider and plan for how to account for these potential concerns. For example, when considering implementation of strategies that lack research, this study informs stakeholders of the importance of providing adequate training and support to teachers in their efforts. Instead of launching these strategies as a division-wide training, this study suggests that a better approach is to form a case study group consisting of teachers with diverse views, experiences, content areas, and grade levels with the purpose of experiencing the strategies and informing stakeholders of next steps. Stakeholders must also consider the risks associated with such implementation and the cost of time and resources as teachers determine if these strategies are viable. In an environment of high stakes testing and concerns of student growth outcomes tied directly to teacher evaluations, the cost of time cannot be overlooked.

**Recommendations and Future Research**

For many teachers, the Whole Brain Teaching strategies are a complete paradigm shift from their current teaching practice. If sustained implementation is the goal, continuous professional development and support are key factors and are recommended. I recommend this professional development be facilitated through a professional learning community. This type of professional development is critical because it can offer teachers
a safe environment to collaborate and dialogue as professionals, while revealing important insights about teacher perceptions and beliefs that influence implementation (DuFour, 2004; Snow-Gerono, 2005).

Also, in line with program evaluation research and the constructivist paradigm, I recommend that continuous evaluation be an integral part of the program evaluation process where evaluators consider needs, successes, challenges, and necessary improvements (Mertens & Wilson, 2013; Stake, 2004; Yin, 2014). The participating teachers in this study were part of a Whole Brain Teaching group with each teacher having varying levels of experience with the strategies. After being a participant in the two-day district training provided in the 2013-2014 school year, only three of the teachers in the group took the next steps and implemented the strategies in their classroom. These three teachers represent not only three of the 10 group members but also three of the 97 total teachers at the school. This suggests that some teachers held an interest but prior to the formation of the teacher group, were unwilling to implement the strategies on their own.

This study indicated that more administrative support and more resources are needed for implementation. Administrative support includes providing school-level professional development opportunities for Whole Brain Teaching where teachers are not only able to ask questions and discuss concerns, but participate in training that clarifies how to best use the strategies. The teacher participants in this study indicated that there is a need for a centralized pool of literature and video examples of the strategies in action. A recommendation is to include plans to provide these types of supports and resources as part of the implementation process.
Further research is needed to determine if teacher perceptions of the strategies continue to evolve with more frequent and extended use. Evaluating teacher perceptions gives an indication of if and how teachers will use the strategies and if they see them as viable. Also, additional research is necessary to help fill in the gaps between neuroscience findings and their application to learning. This exploratory study of teacher perceptions adds to the limited research on Whole Brain Teaching but further research is needed to consider if and how academic outcomes are directly impacted by the strategies. It is premature to suggest that these strategies cause increases academic outcomes and help to decrease achievement gaps. School divisions should give caution in encouraging teachers to utilize these strategies without research that indicates their effectiveness and for what purpose they should be used.

**Summary**

As indicated in the logic model presented in Figure 1 (see Chapter 1), one of the outputs is the development of a community of practice. The Whole Brain Teaching group has functioned as a community of practice within the school community. However, the sustainability of the Whole Brain Teaching group and practice of Whole Brain Teaching strategies at the school remains to be seen. One outcome of this study that aligned with an intended output in the logic model is the development of self-reflective practitioners. The participating teachers were a diverse group and all of them demonstrated the significance of their self-reflective practices through the shaping of their perceptions throughout the study. By the end of the study, teachers perceived the strategies to be effective to help students remember key terms and concepts but ineffective in helping their students to think critically.
This study of teacher perceptions about Whole Brain Teaching adds to the limited research available about these strategies. The findings of this study are informative to stakeholders and educators who are considering the implementation of the Whole Brain Teaching strategies. Further research and evaluation is necessary to determine the sustainability of the program at this school. Future research is also necessary to determine if student outcomes are impacted by these strategies. Such research may help to close the gap between critics and advocates of Whole Brain Teaching and brain-based teaching strategies.
APPENDIX A

Individual Reflective Journals
Reflective Journal One: Weeks One and Two

1. What is your definition of Whole Brain Teaching? What are some of the primary components? How does it differ from my traditional forms of teaching?

Week One

2. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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3. What worked well this week with the brain-based strategies?

4. What were challenges in using brain-based strategies this week?
### Week Two

5. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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6. What worked well this week with brain-based strategies?

7. What were challenges in using brain-based strategies this week?
Reflective Journal Two: Weeks Three and Four

1. What factors have facilitated your use of the Whole Brain strategies? What resources have been the most helpful? What organizational dynamics of conditions have you found to be the most supportive?

Week Three

2. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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3. What worked well this week with brain-based strategies?

4. What were challenges in using brain-based strategies this week?

Week Four
5. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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6. What worked well this week with brain-based strategies?

7. What were challenges in using brain-based strategies this week?
Reflective Journal Three: Weeks Five and Six

1. What have you found to be the most challenging aspects of implementing the Whole Brain strategies? What kinds of supports would you have liked that have not been available to you? What have you attempted to do to overcome these challenges?

Week Five

2. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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3. What worked well this week with brain-based strategies?

4. What were challenges in using brain-based strategies this week?
### Week Six

5. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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6. What worked well this week with brain-based strategies?

7. What were challenges in using brain-based strategies this week?
Reflective Journal Four: Weeks Seven and Eight

1. What are your perceptions on the effectiveness of the Whole Brain strategies? What has been their effect in meeting the needs of challenging students? In terms of student engagement?

Week Seven

2. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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3. What worked well this week with brain-based strategies?

4. What were challenges in using brain-based strategies this week?

Week Eight
5. Place a check indicating any of the Whole Brain Teaching strategies you used each day.

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6. What worked well this week with brain-based strategies?

7. What were challenges in using brain-based strategies this week?
APPENDIX B

Focus Group Meeting Protocol

The focus group meeting will be held two times each month with the Whole Brain Teaching teacher group to provide an opportunity to discuss and reflect on your experiences with Whole Brain Teaching strategies in your classroom.

Focus Group 1

1. What is your definition of Whole Brain Teaching? What are some of the primary components? How does it differ from my traditional forms of teaching?

2. What were your experiences with using Whole Brain Teaching strategies the past two weeks?
   a. What successes did you have with using the strategies? Please elaborate.
   b. What challenges did you face with using the strategies? Please elaborate.

Focus Group 2

1. What factors have facilitated your use of the Whole Brain strategies? What resources have been the most helpful? What organizational dynamics of conditions have you found to be the most supportive?

2. What were your experiences with using Whole Brain Teaching strategies the past two weeks?
   c. What successes did you have with using the strategies? Please elaborate.
   d. What challenges did you face with using the strategies? Please elaborate.

Focus Group 3

1. What have you found to be the most challenging aspects of implementing the Whole Brain strategies? What kinds of supports would you have liked that have not been available to you? What have you attempted to do to overcome these challenges?

2. What were your experiences with using Whole Brain Teaching strategies the past two weeks?
   a. What successes did you have with using the strategies? Please elaborate.
b. What challenges did you face with using the strategies? Please elaborate.

**Focus Group 4**

1. What are your perceptions on the effectiveness of the Whole Brain strategies? What has been their effect in meeting the needs of challenging students? In terms of student engagement?

2. What strategies did you find most effective and what evidence are you relying on to judge that effectiveness?

3. What strategies did you find least effective and what evidence are you relying on to judge that effectiveness?
APPENDIX C
Observation Protocol

Template Name: Informal Classroom Walkthrough Form
Invitee:
Observer:
Start Date: End Date:
Start Time: End Time:

Content and Classroom Demographics:
Describe the specific content being taught and student population in the classroom.

Teaching and Learning Intentions: List learning intentions here.

Student Engagement Indicators: Every five minutes scan the room, record the number of students visibly engaged with two minutes between each observation segment.

Observation Segment 1:

Observation Segment 2:

Observation Segment 3:

Observation Segment 4:

Observation Segment 5:
Observation Segment 6:

Strategies Used:

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Which strategies are being used most frequently and what learning objectives are they being used to support?

Overall Comments and Feedback:

What went well with the use of the strategies?

What did not go well with the use of the strategies?
APPENDIX D

Informed Consent Letter

Date: ________________

This letter is being provided to ask your participation in the study described below and inform you of the purpose of the research, procedures, and steps that will be taken to maintain confidentiality. Your participation in this study is voluntary.

TITLE OF STUDY
Teacher Perspectives of Whole Brain Teaching in a Suburban Middle School: A Case Study

PRINCIPAL INVESTIGATOR
Wendy VanHosen
Assistant Principal

PURPOSE OF STUDY
The purpose of this case study is to determine teacher perceptions about their experience with Whole Brain Teaching

PROCEDURES OF STUDY
The following procedures will be followed as part of the study.

- Participating teachers will complete individual reflection journals to record their perceptions and experience with using the strategies.
- The Whole Brain Teaching teacher group will participate in bi-weekly one hour focus group meetings to reflect on their experience with the strategies and provide perceptions.
- A thirty minute classroom observation will be conducted for participating teachers on a voluntary basis.

RISKS
The risks of participating in this study are minimum. Participating in the case study focus group meetings are an addition to regular scheduled faculty meetings for all teachers. Also, although not desired or intended, it is possible that the teacher’s experience with the strategies will not yield positive perceptions.

BENEFITS
The benefits of participating in this case study are as follows:
- This study provides the participants with an opportunity to practice self-reflection.
- Information gained from this study will directly inform participants about their practice.
- Participants have an opportunity to engage in dialogue with their peers about their successes and challenges with the strategies.
CONFIDENTIALITY
The identity for all responses to the individual reflection protocol, focus group meeting protocol, and observations will be kept confidential. The researcher will safeguard all identifying information in the following ways.

- Individual reflection and focus group meeting responses will be coded to ensure that identifiable information in participant responses is not disclosed.
- All notes or interview responses with participant identifiable information will be kept in a locked cabinet in researcher’s possession.

CONSENT

Questions or concerns regarding participation in this research should be directed to: Wendy VanHosen (757) 362-2297 or wmgray@email.wm.edu. I am aware that I must be at least 18 years of age to participate in this project. I am aware that I may report dissatisfaction with any aspect of this study to Dr. Tom Ward, the Chair of the Education Institutional Review Committee by telephone (757-221-3862) or email (tjward@wm.edu). I agree to participate in this study and have read all the information provided on this form.

Participant’s signature _____________________________ Date __________

Investigator’s signature _____________________________ Date __________

THIS PROJECT WAS FOUND TO COMPLY WITH APPROPRIATE ETHICAL STANDARDS AND WAS EXEMPTED FROM THE NEED FOR FORMAL REVIEW BY THE COLLEGE OF WILLIAM AND MARY PROTECTION OF HUMAN SUBJECTS COMMITTEE (Phone 757-221-3966) ON 2017-01-23 AND EXPIRES ON 2018-01-23.
REFERENCES


Preston, H., & Eichenbaum, H. (2013). Interplay of hippocampus and prefrontal cortex in
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