1-14-2013

Public School Teachers' Knowledge, Perception, and Implementation of Brain- Based Learning Practices

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PUBLIC SCHOOL TEACHERS' KNOWLEDGE, PERCEPTION, AND IMPLEMENTATION OF BRAIN-BASED LEARNING PRACTICES

A Dissertation

Submitted to the School of Graduate Studies and Research

in Partial Fulfillment of the

Requirements for the Degree

Doctor of Education

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December 2012

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The purpose of this study was to determine K-12 teachers' knowledge, beliefs, and practices of brain-based learning strategies in western Pennsylvania schools. The following five research questions were explored: (a) What is the extent of knowledge K-12 public school teachers have about the indicators of brain-based learning and Brain Gym?; (b) To what extent do K-12 public school teachers rate the value of brain-based learning and Brain Gym?; (c) To what extent do K-12 public school teachers report implementing brain-based learning indicators in their classrooms?; (d) What is the relationship between K-12 public school teachers' level of knowledge of brain-based learning and indicators of Brain Gym and their beliefs about brain-based learning?; (e) What is the relationship between gender, years of teaching experience, grade level being taught, and teachers' knowledge, perceptions, and implementation related to brain-based learning?

The participants (N=256) included in this study consisted of K -12 public school teachers within three selected school districts in western Pennsylvania. The data was collected by using the Brain-Based Learning Survey Questionnaire (BBLSQ), developed by Shelley Klinek (2009), and was administered electronically using an online survey software program called Qualtrics. The survey was designed to measure participants' knowledge, beliefs, and practices of brain-based learning strategies.

The results of the study indicate that teacher's knowledge of learning strategies are related to their beliefs about those strategies, as well as their instructional practices. It was further determined that teachers had positive attitudes towards learning new strategies; they feel it is important to demonstrate and show educators new ways of teaching; and they feel the need to be more adequately trained in the area of how the brain learns best. This study indicates that teachers are interested in how students learn best, and are willing to change their teaching practices to improve the learning process.

ACKNOWLEDGEMENTS

This project is dedicated to my father, David Wachob Sr., for instilling your knowledge and hard work ethic on me before passing. Completing this task would not have been possible if not for the love and support from my family. Especially my lovely wife, Amanda, for not only being by rock during the difficult times, but for taking on the extra burdens that resulted from my commitments to this study. To my two precious daughters, Mady and Ella, you gave me energy and motivation to continue when I wanted to quit.

I wish to express my greatest appreciation to my entire doctoral committee. A special thanks to my committee chair, Dr. George Bieger. Your expertise and calming personality made this project much more manageable. To the dedication and support from my committee members, Dr. Valeri Helterbran, and Dr. David Lorenzi, I thank you. I could not have made a better decision when forming my committee. Thank you all for being part of this process with me.

A special thanks to Christoph Maier and his staff at the Applied Research Lab. You were always there to answer my questions, and heavily supported me throughout the entire process.

Lastly, this project would not have been successful if not for the time and dedication of the public school teachers who participated in this study. For that, I thank you.

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DESCRIPTION OF THE STUDY

One of the biggest issues in education is how to best deliver instructions and promote learning in students (Bolliger & Martindale, 2004). The combination of low student motivation and high emphasis on standardized testing has strengthened the importance of understanding how students learn. Finding ways for students to actively participate in the learning process is an issue for many educators (Fredricks, Blumenfeld, & Paris, 2004). One theory behind this problem is low "teacher engagement" (Kennedy, 1998), or having a conscious awareness of his or her role in the learning process. Teacher engagement needs further investigation to better understand their knowledge of the learning process and how that knowledge impacts classroom activities and delivery of content.

Current teacher-preparation programs often do not take into account complex student learning characteristics (Alutu, 2006), and there is a growing need to better prepare teachers to adapt instruction in order to address the different learning styles found within today's classrooms (Ratey, 2008). Denton (2010) looked at how increasing teachers' knowledge of the learning process would impact future instruction to struggling readers. This study found that teachers who attended trainings on brain-based learning theories incorporated more reading strategies with their struggling students, and also reported that they viewed their own teaching practices differently. Throughout her study, Denton (2010) showed participants ways to open up pathways of the brain in order for quality learning to occur.

Both quantitative and qualitative research findings support the conclusion that effective instructional practices of teachers' are related to higher levels of student motivation, active engagement, and academic achievement (Foorman et al., 2006; Mahar et al, 2006; Taylor et al., 2000). Furthermore, teachers' conscious awareness and beliefs about learning often match their instructional practices (Artzt, & Armour-Thomas, 1999; Tsai, 2006), strengthening the need to increase teacher awareness of research-based learning practices.

Brain-Based Learning

Both teachers and students have a lot to gain by moving away from the traditional educational paradigms (Greenwood, Horton, & Utley, 2002), and into student-centered classrooms. Successful student-centered classrooms acknowledge that different intelligences, or learning-styles, vary from one student to the next, and that a certain learning task may not be appropriate for all students (Bas, 2010). One approach that recognizes and addresses the unique needs of a student-centered classroom is brain-based learning (Jensen, 2008).

Brain-based learning developed from the bridging of neuroscience research and educational learning practices. The groundwork of brain-based learning theory has emerged from researchers and theorists over the past several decades. Jean Piaget (1964) argued that children learn through experience and that quality instruction involves providing students with holistic interactions with their surroundings. In 1979, Steven Krashen's recognized the importance of the unconscious, and suggested that a learner's attitude is more important than their aptitude (Doherty & Jensen, 1998). Leslie Hart (1983) suggested that in order for teachers to be effective, they must understand and accommodate the "organ of learning," or the brain. Ornstein and Thompson (1984) posited that the brain is constantly performing multiple tasks and requires multiple approaches to learning in order for effective teaching to occur. In the early 1990's, Renate and Geoffrey Caine coined the term "Brain Based Learning" to integrate all the brain research that was being done with the educational practices used for learning.

Statement of the Problem

Despite the benefits of actively engaging students in the learning process (Roderick & Engle, 2001; Weiss & Pasley, 2004), many educators are continuing to use passive, or teacher-centered, practices in their classrooms (Goodlad, 2004; McDermott, Mordell, & Stoltzfus, 2001; Yair, 2000). Even with well-grounded educational theories, there is still a gap between research findings and teacher application (Carnine, 1997; Gravani, 2008; Robertson & Bond, 2005). Teachers frequently attribute this gap to 1) unfamiliarity with new instructional strategies, 2) lack of training for implementing these strategies, and 3) lack of support when trying to implement new practices in the classroom (Huberman & Miles, 1984; Williams, & Coles, 2007).

A national survey conducted by Indiana State University, reaching more than 81,000 students, found that students want more interactive classes and prefer activities that involve interaction with teachers and peers (Yazzie-Mintz, 2010). This study also reported boredom, loss of interest, irrelevant courses, and bad relationships with teachers as the top reasons for truancy or dropping out of school. Researchers have repeatedly found that students respond better to hands-on lessons and show increased achievement results with student-centered activities (Dunn, & Dunn, 1992; Favre, 2007; Fine, 2003). Fabry (2010) found that implementing research-based instructional strategies in the classroom improved students' motivation to learn and strengthened the teacher-student connection.

The gap between researchers and teachers may be due to low research-engagement by teachers (Fabry, 2010). Research engagement is the ability to seek out and implement evidence-based suggestions into the classroom (Williams & Coles, 2007). According to Chafouleas and Riley-Tillman (2005), researchers often fail to translate study results into application for teachers to use in the classroom. Richards and Skolits (2009) found that in order for teachers to use research-based strategies, they must understand the theory behind the research, observe the strategy being used, relate the strategy to their current teaching practices, and receive support when first using the new strategy.

Brandsford et al., (2000) suggest that "neuroscience has advanced to the point where it is time to think critically about the form in which research information is made available to educators, so that it is interpreted appropriately for practice – identifying which research findings are ready for implementation and which are not" (p.126). Identifying teachers' current body of knowledge around brain-based strategies can help identify what information still needs to be made available to them. Adding research-based knowledge to already established teachers' beliefs can lead to improvements in the classroom environment and ultimately the learning process (Richards & Skolits, 2009).

Purpose of the Study

The purpose of this study is to determine K-12 teachers' knowledge, beliefs, and practices of brain-based learning strategies in western Pennsylvania schools. As the global competition for a viable workforce increases, society will look to the schools to better prepare students to meet these demands. In order for schools to better meet the needs of students, they need to change the way they look at the learning process.

This study will add to the current body of knowledge on teacher awareness of the learning process in order to direct future training needs on how to better engage student learning.

Specifically, this study examines K-12 teachers': (1) knowledge of brain-based learning strategies; (2) beliefs about brain-based learning strategies; and, (3) implementation of brain-based learning strategies within their classrooms.

Definition of Terms

Analysis-inference Instruction- "Aims to develop students' higher order thinking skills in a way that facilitates their understanding and application of concepts" (Downer, Rimm-Kaufman, & Pianta, 2007, p.416). This instructional approach is found in small-group, interdependent type activities.

Brain-based learning- A learning approach based on neuroscience research. Whenever a teacher incorporates brain research into his/her classroom, it is called brain-based teaching (Denton, 2010).

Brain Gym- is a series of 26 simple movements that promote learning through brain-based strategies (Nussbaum, 2010).

Endorphins- are chemicals primarily released in the brain that reduce pain or give a relaxed sensation. (Encarta World English Dictionary)

Hippocampus- Part of the brain that breaks down information and determines how that information is stored, retrieved, and grouped (Encarta World English Dictionary).

Neural plasticity- The process of changing the brain's neural networks, or "re-wiring," due to being exposed to new experiences (Groen et al., 2007).

Neuroscience - the scientific study of the molecular and cellular levels of the nervous system, of systems within the brain such as vision and hearing, and of behavior produced by the brain (Ratey, 2008).

Reticular Activation System- Part of the brain that controls the overall level of Central Nervous System (CNS) activity, including alertness and wakefulness (Almarode & Almarode, 2008).

Sensory Systems- Neural pathways in the body that deliver internal and external information to parts of the brain for processing (Ratey, 2008).

Student Engagement- When a student actively participates in the learning process (Marks, 2000).

Teacher Engagement- A teacher's conscious awareness of his or her role in the learning process (Kennedy, 1998).

Working Memory- (Short-term memory) Responsible for temporarily storing information while completing tasks such as learning. Also determines if information is coded and stored into long-term memory (Almarode & Almarode, 2008).

Research Questions

1. What is the extent of knowledge K-12 public school teachers have about the indicators of brain-based learning and Brain Gym?
2. To what extent do K-12 public school teachers rate the value of brain-based learning and Brain Gym?
3. To what extent do K-12 public school teachers report implementing brain-based learning indicators in their classrooms?
4. What is the relationship between K-12 public school teachers' level of knowledge

of brain-based learning and indicators of Brain Gym and their beliefs about brain-based learning?

5. What is the relationship between gender, years of teaching experience, grade level being taught, and teachers' knowledge, perceptions, and implementation related to brain-based learning?

Theoretical Position

In order for teachers to be effective facilitators in the learning process, it is crucial for them to look at intelligence in different ways (Gardener, 2011; Hart, 1975), and see how it can be applied to the classroom. Neuroscience regarding brain-research can help educators improve student learning and achievement (Jensen, 2008). Brain-based teaching includes incorporating knowledge of brain research into classroom practices (Bransford, 2000).

Renate and Geoffrey Caines' 12 Brain/Mind Learning Principles are intended to provide educators with a framework for selecting different approaches to maximizing learning in students. These principles increase teaching options, and serve as a guide to educators already working to implement brain-compatible teaching practices (Denton, 2010). These principles are discussed further in Chapter 2.

Along with having knowledge of brain-based learning strategies, teachers need to have confidence in implementing these strategies in order for there to be an effective and ongoing benefit to the learner (Jensen, 1995). Factors that influence teachers' confidence of using new techniques in the classroom will also be examined in Chapter 2. Lastly, Gardner's (2011) Multiple Intelligences will be considered while analyzing best-practice applications for learning success within diverse classrooms.

Significance of the Study

The importance of understanding the learning process, as it relates to student motivation and success, is crucial for improving school atmosphere and performance (Ekeland, Heian, & Hagen, 2005). Student achievement can be improved when they are taught through their dominate learning styles (Gardener, 2011; Hart, 1975), and understanding how the brain retains knowledge can allow teachers to better engage students in learning (Jensen, 2008). Furthermore, academic achievement has been linked to teachers' beliefs about the learning process (Behar-Horenstein, Pajares, & George, 1996; Fenstermacher, 1979; Harris, 2008), and those beliefs impact how teachers address the learning process (Bolliger, & Martindale, 2004; Yair, 2000).

Brain-based learning research has many implications for changing classroom dynamics that many researchers believe can improve academic success (Greenwood et al., 2002; Mahar et al., 2006), decrease off-task behaviors (Dunn & Dunn, 1992; Favre, 2007; Fine, 2003), and improve overall school climate (Ekeland et al., 2005). One of the first steps to implementing these best-practice approaches is to get a better understanding of what teachers already know about brain-based learning strategies, what their perception of these strategies are, and if they incorporate any of these strategies into their classroom. The information from this study can help teacher-preparation programs, as well as professional development trainers meet the needs of K-12 teachers by showing them effective intervention techniques designed to improve student achievement and general classroom behaviors (Nussbaum, 2010).

Delimitations of the Study

This study will be limited to current K-12 teachers within four western Pennsylvania public school districts. The school districts chosen were selected based on distance and convenience to the researcher.

Limitations of the Study

Restricting analysis to K-12 educators who are currently teaching in the public school setting in only three school districts in Pennsylvania limits the ability to generalize the results. Further limitations of the study include the definition of brain-based learning, scope of the instrument being used (i.e. self-report questionnaire), and only having the analysis of one researcher. The instrument used in this study is a modified version of the Brain-Based Learning Survey Questionnaire (BBLSQ), originally developed by Shelly Klinek (2009). Being the original instrument was designed for higher education faculty, and has never been used on K-12 teachers, little validly or reliability can be determined at this point.

Summary

In this chapter, the problems that schools face in relation to teacher engagement and student achievement have been introduced. Furthermore, using brain-based learning as a catalyst for change has also been explored. The subsequent chapters provide a review of the literature, the methodology of the study, an analysis of the collected data, and a discussion of the results, and recommendations for additional research in the area of instruction.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

The purpose of this study is to determine teachers' understanding of the learning process as it relates to their instructional practices and beliefs about learning. This review of literature explores instructional themes that have emerged from neuroscience, and theories around the learning process. More specifically, this chapter will explore the theoretical framework that supports using the Brain-based Learning Theory as a best-practice guide to instruction. This chapter also explores the importance of understanding how teacher beliefs may impact the learning process, and how teacher-influenced environmental characteristics (i.e. motivating, engaging, relaxing) can contribute to student academic success. This chapter will also review research that looks at the impact that applying brain-based learning strategies into the classroom has on student performance. Lastly, the influence that brain-based professional development trainings have on instructional strategies will also be explored.

Theoretical Framework for Brain-Based Learning

During the past several decades there has been a strong shift away from the traditional teacher-centered (e.g. recitation method) approach to instruction, to a more dynamic approach to teaching (White, 1996). Theorists such as Howard Gardner (1983) and Albert Bandura (1977) disputed the traditional view of the time that teaching revolved around memorizing facts and the belief that intelligence was solely measured through standardized tests (Vennema, Hetland, & Chalfen, 1999). They argued that learning was a more complex process that couldn't be determined by one measurement. Their ideologies encouraged future theorists to look more closely at how the brain functioned and responded to learning. Through computer imaging, scientists began to understand that the mind (i.e. thoughts and thinking capacity) and body were not two separate entities, as once believed (Jensen, 2000); but instead interconnected through processes that impacted one another (Sousa, 2006). This section explores several theories and principles that have contributed to the foundation of the Brain-Based Learning Theory; which includes the Multiple Intelligences Theory, Social-learning Theory, Constructivist Learning Theory, and the Caines' Brain/Mind Learning Principles.

Multiple Intelligences

Howard Gardner's Multiple Intelligences Theory (1983) challenged the traditional views of Alfred Binet (1916) that intelligence could be accurately measured by taking a standard IQ test. He defined intelligence as having the ability to problem solve or create something of value (Gardner, 1983). Multiple Intelligences Theory focuses on instruction that "stimulates thinking, creativity and caring in all students; caters to individual abilities and learning styles; and is based on more equitable access" (Sulaiman et al., 2011, p.1146). Gardner (1983) believed that everyone possessed at least 7 fairly independent modes of intelligence that the brain preferred while completing tasks. Each is distinguished by core operations (Gardner, 1983), which according to Vennema et al. (1999), are "something (like a neural network) in the brain that takes a particular kind of input or information and processes it" (A Brief Overview of the Theory section, para. 3). Understanding these neural networks can help teachers identify ways to trigger the unique combinations of intelligences that contributes to students' unique abilities (Gardner, 1983).

One of the biggest challenges that educators face is finding ways to engage students meaningfully. Brain-based learning theory suggests that there are certain instructional strategies that can help address each student's unique combination of intelligences and core operations that Gardner (1983) proposed. Duman (2010) found that when students were taught using brain-based strategies, that factored in different learning styles, and academic achievement was higher when compared to students who were taught using traditional (i.e. lecture, question-answer) teaching methods. Table 1 applies brain-based instructional strategies that were derived from Eric Jensen's (2005) book, *Teaching with the Brain in Mind*, to the main components of the Multiple Intelligences Theory.

Table 1

Multiple Intelligences and Application to Teaching Practices

Modes of Intelligence	**Core Operations**	**Brain-Based Approaches**
Linguistic	syntax, phonology, semantics, pragmatics	Allow students to develop case studies, poetry, or make up stories.
Musical	pitch, rhythm, timbre	Have students create rhythms or songs for remembering concepts.
Logical-mathematical	number, categorization, relations	Break problem solving tasks into smaller components, and give students time to systematically test solutions.

Table 1 (Continued)

Multiple Intelligences and Application to Teaching Practices

Spatial	accurate mental visualization, mental transformation of images	Incorporate graphs and charts into the lesson, and allow students to map out content or “mind map”.
Bodily-kinesthetic	control of one's own body, control in handling objects	Allow students to create models for class projects, and incorporate movement into lessons.
Interpersonal	awareness of others' feelings, emotions, goals, motivations	Incorporate small group work into lessons.
Intrapersonal	awareness of one's own feelings, emotions, goals, motivations	Help students recognize their dominant learning styles and allow time for application of those styles when possible.
Naturalist	recognition and classification of objects in the environment	Use real life scenarios or allow students to apply the environmental examples to the content.

Educators should be shaping their instructional strategies around students' intellectual differences to utilize their unique abilities and provide a meaningful learning experience (Gardner, 1983). In conjunction with the instructional strategies suggested in Table 1, brain-based research also suggests positive social interactions as another way to activate meaningful learning experiences (Ekeland et al., 2005; Kirkcaldy et al., 2002; Pellegrini, 2005). When teachers incorporate instructional strategies that foster positive social interactions, students may gain assurance in their abilities to succeed (Flook et al., 2005). Brain-based strategies that focus on motivating students through social interactions and small group work exhibit some origins to the Social Learning Theory (Rotter, 1954); which are discussed in the following sub-section.

Social-Learning Theory

In his book, *Social Learning and Clinical Psychology,* Julian Rotter (1954) posited that behavioral motivation is controlled by more than just psychological factors. He proposed that the response that a behavior received, dictated whether or not that behavior would be repeated. This idea was an important motivational tool for educators to help students repeat positive learning behaviors (Flook et al., 2005). If a student believes there will be a positive social outcome for a particular behavior, than they are more likely to engage in that behavior (Rotter, 1954). For example, when a student participates in a supportive peer group activity, they are more likely to be engaged in that activity when compared to independent seat work activities (Willis, 2007).

Albert Bandura (1977) expanded on earlier works of Rotter to incorporate different pieces of learning, particularly, behavioral and cognitive aspects. Behavioral learning posits that the environment controls a person's behavior (Baum, 2010), and cognitive learning posits that learning occurs through an interaction between environmental input (e.g. listening, touching, watching) and physiological responses (Yilmaz, 2011). Bandura's social learning theory suggests that along with individual cognition, behavior is influenced by both environmental (social) and psychological factors (Deeming & Johnson, 2009). Figure 1 illustrates the process that Bandura suggested on how human behavior was determined.

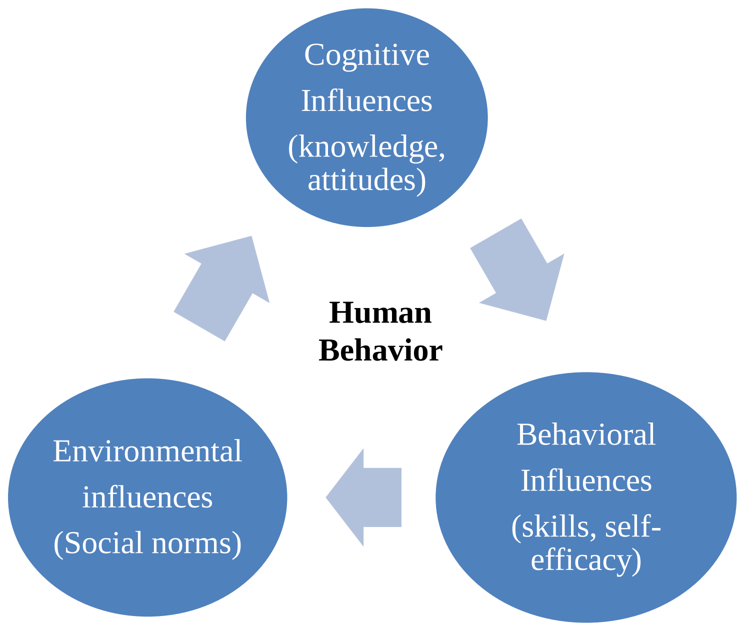

Figure 1. Influences of human behavior based on Bandura's Social Learning Theory.

Bandura (1977) thought that while some learning could be obtained through observation, not all observed behaviors were effectively learned. Instead, learning those behaviors required modeling. Bandura developed certain requirements that are needed in order for modeling to be successful, which include:

1. *Attention*. In order to maximize the impact of observational learning, the student needs to be paying attention. Research in neuroscience has shown that exercise

can increase a student’s attention systems (Almarode & Almarode, 2008; Ratey, 2008), and levels of academic engagement (Mahar et al., 2006).

2. *Retention.* The learner needs to utilize ways to efficiently store information in order to access it later. Research on memory suggests that information recall is improved when learning is distributed rather than concentrated (Barros, Silver, & Stein, 2009; Pellegrini, 2005). Applying different learning styles to the delivery of the model will increase the efficiency of the student to retain information into long-term memory (Sulaiman et al., 2011).
3. *Reproduction*. After paying attention to the model, the learner needs to practice the behavior in order to maximize skill development and improvement. Brain-based theorists (Jensen, 2005; Ratey, 2008; Sousa, 2006) recommend allowing students time to practice materials that best suits their individual learning style.
4. *Motivation*. Finally, after the student is given time to practice; they need to be motivated to increase the likelihood of repeating that behavior. Providing opportunities to study, to practice, and to use various learning techniques may increase students’ success and the likelihood that they will be motivated to display positive learning behaviors (Meisels et al., 2002).

As detailed above, Bandura’s modeling process has significant implications for the brain-based learning theory. A solid example of the connections between Bandura’s work and brain-based approaches can be seen in the Caine’s (1994) learning principles. These often cited principles provide further understanding to the framework of the brain-based learning theory, and are reviewed in the following sub-section.

The Caines' Brain/Mind Learning Principles

Renate and Geoffrey Caines' Brain/Mind Learning Principles are frequently cited as a model of Brain-Based Theories (Gulpinar, 2005). Their model includes 12 principles of learning that reveal different capacities to learning (Caine & Caine, 1994). These principles were developed to bridge brain research with implications for educational practices. The following principles provide a thorough basis for implementing brain-based practices into the classroom and are presented with associated research that supports these beliefs:

1. *All learning is physiological.* The brain changes with new experiences, which is often known as neural plasticity (Groen et al., 2007). Students need sensory input through action and physical movement (Sanes & Lichtman, 2001), and sitting at desks hinders the brain's ability to restructure neural connections (Levin et al., 2008; Ratey, 2008).
2. *The brain/mind is social*. Human beings are designed to learn through imitating and modeling by using mirror neurons in the brain (Rizzolatti & Fabbri-Destro, 2008). Teachers should allow students to process learning through informal interactions and discussions with each other.
3. *The search for meaning is innate.* Human beings seek meaning and purpose during topics of interest through an instinctual drive (Frankl, 2006). Teachers need to relate the content to student interests in order for deep cognition to occur.
4. *The search for meaning occurs through patterning.* The mind naturally connects material by grouping information into categories (Gilhooly et al.,

2007). Teachers should encourage the grouping of information through common threads of student experiences (e.g. asking questions, problem solving, projects) (Ratey, 2008).

5. *Emotions are critical to patterning.* Emotions are involved in every thought process (Immordino-Yang & Damasio, 2007; Newquist, 2004; Sousa, 2006) therefore; feelings around a certain topic determine the depth of understanding and mastery (Caine & Caine, 1994). Teachers should present information to students in a way that encourages a positive emotional connection to the material.
6. *The brain/mind processes parts and wholes simultaneously*. The brain has the ability to integrate steps of a task when given the skill as a whole (Fuster, 2008). In other words, the brain can work backwards to develop strategies for completion when faced with the task as a whole. This principle can be integrated through projects, scenarios, and big ideas (Smith & Girod, 2003).
7. *Learning involves both focused attention and peripheral perception.* Attention is needed in order for learning to occur (Almarode & Almarode, 2008), which is dictated by stimulus selection (Ratey, 2008). Furthermore, learning also occurs through background stimuli, as shown in mirror-neural research on children displaying behaviors acquired from non-direct environmental triggers (Feeney, Howard, & Howard, 2002; Rizzolatti & Fabbri-Destro, 2008). Teachers should find ways to keep students engaged in learning, as well as, create a physical environment that indirectly conveys the message of the content being taught.

8. *Learning is both conscious and unconscious.* Besides intentional learning, the mind also has the ability to process information unintentionally, or through "cognitive unconscious" (Lakoff & Johnson, 1999). This process promotes metacognition, or awareness of learning, which encourages a higher order of thinking (Curwen et al., 2010). Teachers can promote higher-levels of thinking in students by incorporating reflection of learning and questioning results.
9. *There are at least two types of memory.* Science has discovered that the brain has both short and long-term memories (Fuster, 2006; Schacter, 1996). Teachers can use activities that encourage natural thinking (e.g. projects, problem solving), and organize activities that address different learning styles to encourage higher retention and meaning of the content.
10. *Learning is developmental.* Learning occurs in stages, and helps the brain develop new neural pathways (Sousa, 2006). For example, a novice develops into an expert as new experiences "hook" onto already existing knowledge (Barkley, 2010). Teachers can use scaffolding (Van de Pol, Volman, & Beishuizen, 2010) to encourage a progressive learning approach, as well as, incorporate reflection into activities to strengthen the connection between existing knowledge and new information.
11. *Complex learning is enhanced by challenge and inhibited by threat associated with helplessness and/or fatigue.* The brain slows in its ability to process information during times of stress (Barkley, 2010; Roberts, 2002), through the process called primitive response, or preparing the body to respond to fear

without having to think about it. Teachers can focus on student-centered, hands-on activities that foster positive peer-social interactions, and ensure that students succeed throughout the learning process (Ratey, 2008).

12. *Each brain is uniquely organized.* Each brain is made up of a mix of unique genetics and experiences (Gardner, 1983; Jenson, 2008a). Teachers can address the unique differences of the students by applying theories of learning styles (i.e. Gardner's Multiple Intelligences) into activity design and delivery.

The Caines' principles factor in multiple approaches to student learning that are similar to other learning approaches, including the constructivist theory of teaching and learning. At first glance, brain-based learning styles and constructivist learning approaches appear as separate domains in the educational literature (Kahveci & Ay, 2008); however, they share several common themes and methods as they relate to the learning process. The constructivist learning theory, and its overlapping principles to brain-based learning, is discussed in the following sub-section.

Constructivist Learning Theory

Constructivism is a theory of learning that explains how people construct their own learning based on personal experiences (Yager, 2000). Instead of students being passive receivers of information, constructivist learning theory suggests that students construct their own knowledge based on previous experiences, skills, and interaction with their environment (Chenyu, 2011). In a constructivist approach to learning, the student individually learns in a social environment where the teacher provides experiences and opportunities geared towards a certain direction of knowledge (Kahveci & Ay, 2008).

Yew (2010, p.11) discusses some teaching techniques that can help students better construct their own knowledge throughout the learning process, and include;

1. Encourage and accept student autonomy, initiation, and leadership.
2. Gear lesson activities around student thinking, and adapt instructional strategies around student responses.
3. Ask students to elaborate on their responses.
4. Allow time to process after posing a question.
5. Encourage students to interact with both the teacher and peers while processing information.
6. Ask enduring, open-ended questions.
7. Encourage students to reflect on discussed material and predict future results.
8. Ask students to express their ideas before examining their understanding of concepts.
9. Allow for student input when developing understanding around misconceptions.

The constructivist theory of learning has many implications for brain-based learning theory, and some experts suggest that constructivist learning models are brain compatible (Gülpinar, 2005; Kahveci & Ay, 2008). Kahveci and Ay (2008) outlined 5 overlapping principles between brain-based and constructivist learning approaches that are illustrated in Figure 2.

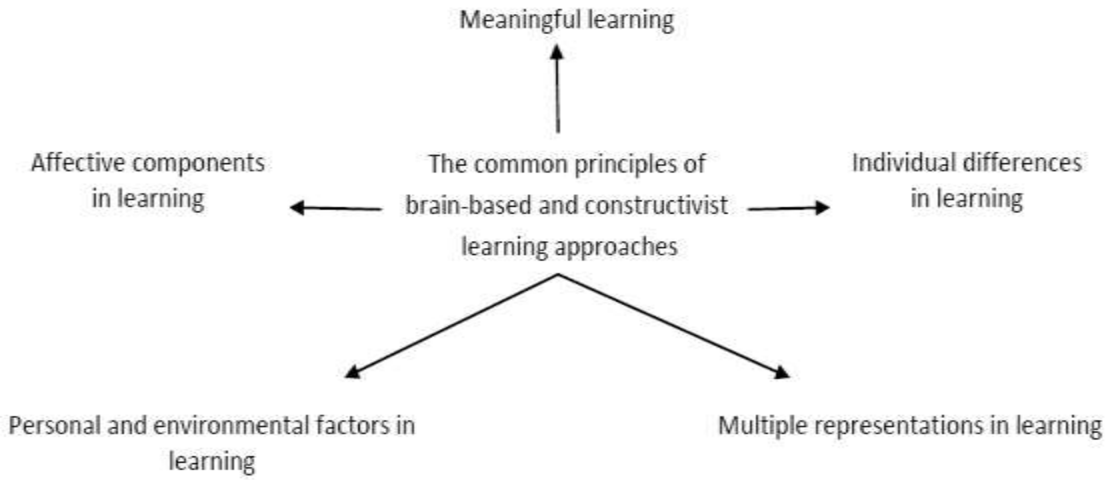

Figure 2. Overlapping principles between brain-based and constructivist learning approaches (Kahveci & Ay, 2008).

These overlapping implications include the encouragement of students to engage in meaningful learning, and to construct understanding based on previous knowledge (Barkley, (2010). Kahveci and Ay (2008) argue that brain-based approaches actually provide an explanation for many constructivist learning principles, and that the brain-based learning theory "tends to explain the methods used for teaching in a cause-effect relationship" (p. 127) of constructivist learning principles. Some of these brain-based applications to learning are discussed in the following section.

Translating Brain-Based Research into Classroom Application

Many researchers and educators are constantly attempting to make connections between brain research and classroom practice. However, there still appears to be a gap between what researchers and theorists are suggesting in regards to best-practice teaching strategies and what educators are doing in the classroom (Carnine, 1997; Gravani, 2008; Robertson & Bond, 2005). This section outlines what Bondy and Brownell (2004) call the "research-to-practice gap" that continues to occur despite many advances in educational research. Furthermore, suggestions of some major brain-based learning theorists, as they relate to classroom applications, are also discussed.

The Gap between Academic Research and Application in the Classroom

Despite the benefits of actively engaging students in the learning process (Marks, 2000; Roderick & Engle, 2001; Weiss & Pasley, 2004), many educators are continuing to use passive, or teacher-centered, practices in their classrooms (Goodlad, 2004; McDermott, Mordell, & Stoltzfus, 2001; Yair, 2000). Even with well-grounded educational theories, there is still a gap between research findings and teacher application (Carnine, 1997; Gravani, 2008; Robertson & Bond, 2005). Teachers frequently attribute this gap to a) unfamiliarity with research-based instructional strategies, b) lack of training for implementing those strategies, and c) lack of support when trying to implement new practices in the classroom (Huberman & Miles, 1984; Williams & Coles, 2007).

A national survey conducted by Indiana State University, reaching more than 81,000 students, found that students want more interactive classes and prefer activities that involve interaction with teachers and peers (Yazzie-Mintz, 2010). The study also reported boredom, loss of interest, irrelevant courses, and bad relationships with teachers as the top reasons for truancy or dropping out of school. Researchers have repeatedly found that students respond better to hands-on lessons and show increased achievement results from student-centered activities (Dunn & Dunn, 1992; Favre, 2007; Fine, 2003). Fabry (2010) found that implementing research-based instructional strategies in the classroom improved students' motivation to learn and strengthened the teacher-student connection.

The gap between researchers and teacher application may be due to a low research-engagement by teachers (Bondy & Brownell, 2004). Research engagement is the ability to seek out and implement evidence-based suggestions into the classroom (Williams & Coles, 2007).

According to Chafouleas and Riley-Tillman (2005), researchers often fail to translate research results into application for practitioners to use in their classrooms. Richards and Skolits (2009) found that in order for teachers to use research-based strategies, they must understand the theory behind the research, observe the strategy being used, relate the strategy to their current teaching practices, and receive support when first using the new strategy.

One way to address this research to practice gap is to translate the research findings into practical application for teachers. Two of the more influential theorists who have bridged the research with classroom teaching strategies are Eric Jenson (2005) and David Sousa (2006). Their translations of brain research into classroom practices are widely used and are outlined in the next sub-section.

Interpretations of Brain-Based Research into Classroom Practice

Taking findings from neuroscience and translating them into pedagogical practices can be challenging due to the unique dynamics of the classroom (Goodlad, 2004). If a teacher already feels ill-equipped to dealing with the wide range of cognitive diversity within a single classroom, they are less likely to have the confidence to initiate a new research-based method (Nash & Norwich, 2010). To encourage teachers to incorporate practices based on research findings, theorists and educational researchers should be able to present findings in ready-to-use formatted strategies. In his book, *Teaching with the Brain in Mind*, Eric Jenson (2005) lists 6 ready-to-use basic instructional strategies recruited from neuroscience on input sensory that may increase learner engagement. They include;

1. *Engaging Spatial-Episodic Memory.* Find ways to tie material to specific events, situations, or experiences. This allows for easier long-term memory recollection. For example, while discussing the Renaissance period, have students participate in time-appropriate activities (e.g. juggle, wear silly hats).
2. *Change the location of learning.* Help stimulate brain activity and attention by moving the lesson to another location. For example, allow students to sit in the hallway while in reading groups, or take the class outside during discussion.
3. *Guest Speakers.* Invite guest speakers to discuss themes of the lesson. This gives another perspective to the content which may help students retain the material.
4. *Use props, costumes, and special music.* Using props or "novelty" materials can give visual links to students.
5. *Change seating or grouping.* Change who students work with by switching groups or seating arrangement regularly.
6. *Create special events or themes to anchor the learning.* Present material in a workshop or celebratory manner.

Jenson's (2005) suggestions are fairly basic, allowing for integration into many classroom settings. In order to better inform teachers of how brain-based learning themes can work to their classrooms, it may be beneficial to align these ideas with the multiple components of lesson planning. In his book, *How the Brain Learns,* David Sousa (2006) discusses some of the more common themes that educators can apply to different lesson components. These themes and their applications to the classroom are outlined in Table 2.

Table 2

Brain-Based Themes Applied to the Classroom

Brain-Based Learning Themes	**Classroom Applications**	**Lesson Components**
1. Learning engages the entire person (cognitive, affective, and psychomotor domains) (Gardner, 1983; Ratey, 2008).	Make personal connections to material for students and allow them time to interpret information.	*Learning Objective*: students should know exactly what is expected of them.
The human brain seeks patterns in its search for meaning (Gilhooly et al., 2007; Marks, 2000).	Group information through common threads of student experiences (i.e. asking questions, problem solving, projects, etc…).	*Anticipatory Set*: use activities that capture student attention through familiar concepts or themes.
2. Emotions are an integral part of learning, retention, and recall (Newquist, 2004; Pekrun et al., 2009).	Present information to students in a way that encourages a positive emotional connection to the material.	*Purpose*: the information needs to have meaning to the students.

Table 2 (Continued)

Brain-Based Themes Applied to the Classroom

3. Past experience always affects new learning (Kagan, 1992; Thoonen et al., 2011).	Use scaffolding to encourage a progressive learning approach.	*Connection*: incorporate personal reflection into activities.
4. The brain's working memory has a limited capacity (Barros et al., 2009; Pellegrini, 2005; Sanes & Lichtman, 2001).	Teach in short segments or “chunk” materials into no more then 15-20 minutes, followed by a break.	*Block*: present material in logical sets of content that allows for processing time.
5. Lecture usually results in the lowest degree of retention (Downer et al., 2007).	Avoid long lecturing segments. Teachers should mix up delivery methods (i.e. hands-on, visuals, etc…) to address all learning styles.	*Activities*: present materials using multiple features (i.e. visual aids, small groups, movement).
Rehearsal is essential for retention (Bandura, 1977; Deeming & Johnson, 2009).	Present material in an overlapping manor to expose themes several times.	*Independent Practice*: allowing time for students to personally rehearse materials is essential to learning.

Table 2 (Continued)

Brain-Based Themes Applied to the Classroom

6. The brain is a parallel processor performing many functions simultaneously (Sulaiman et al., 201; Vennema et al., 1999).	Allow students to engage their peers and environment during the learning process to stimulate different parts of the brain.	*Physical Environment*: set up the classroom with items related to the content.
7. Practice does not make perfect. Instead perfect practice makes perfect (Bandura, 1977; Deeming & Johnson, 2009).	Allow students time to practice materials that suit their learning styles.	*Guided Practice*: demonstrate what students should learn, and allow time to practice.
8. Each brain is unique (Gardner, 1983; Jenson, 2005; Ratey, 2008).	Address the unique differences of the students by applying theories of learning styles (i.e. Gardner's Multiple Intelligences) into activity design and delivery.	*Delivery*: provide options for students to access information.

These common themes are general enough to minimize the impact of classroom constraints (e.g. limited space, class sizes, different cognitive abilities) and allow for adaptive activities to be incorporated into many learning environments. Teachers need to experience success and see changes in their own students' learning in order to accept a strategy (Fabry, 2010). Denton (2010) found that when teachers implemented brain-based strategies into the learning environment and saw student success increase, they were more likely to continue utilizing those strategies in future lessons. Helping teachers better understand the connection between the environment that they provide, and students' academic success, may lead to more effective teaching practices (Fitzsimmons & Lanphar, 2011).   To further address the impact that teacher-controlled environmental influences has on academic performance, research in this area is reviewed in the subsequent section.

Environmental Influences on Academic Performance

The environmental climate within the classroom greatly impacts the learning process (Roberts, 2002), and unfortunately is often unexamined and downplayed (Fitzsimmons & Lanphar, 2011). The environmental climate of a classroom includes the relationship between the students and the teacher, as well as, the relationship between the students themselves (Avant, Gazelle, & Faldowski, 2011). These relationships or experiences evoke emotions, motivations, and physiological responses; all of which influence academic success (Barkley, 2010). This section reviews the impact that the classroom environment has on students' emotions, motivation to learn, and physiological responses. Finally, the impact that classroom seating and physical activity breaks has on academic achievement will be discussed.

Emotions and the Learning Climate

Hadfield (1924) and Brill (1946) compared students' academic achievement with their emotional state. Both studies found that excitement, motivation to learn, and anxiety greatly impacted academic achievement. More recently, researchers are using technology to determine learning efficiency based on emotional reactions. For example, a student's stress level can be determined by monitoring changes in their physiological conditions. Fechir et al. (2009) and Kobayashi et al. (2003) studied the impact that mental stimulation had on skin humidity and sweating. Both studies maintain that there is a strong positive correlation between levels of emotional sweating and levels of task difficulty. Assuming that physiological conditions can determine stress levels based on the difficulty of a task (Fechir et al., 2009; Kobayashi et al., 2003), then educators and researchers can begin to determine a student's stress level during academic tasks. It is crucial to understand stress levels of students due to its impact on brain functioning. Researchers have found that stressful events (e.g. poor-performance, detachment from the class) cause the brain to release a chemical (i.e. cortisol) that clouds the brain's decision-making abilities (Newquist, 2004; Sousa, 2006).

When teachers foster a positive learning environment, the brain is more suited for learning. During positive situations (e.g. academic success, social acceptance), the body releases a feel-good chemical (i.e. endorphins) in the blood, which leads to improved brain function (Newquist, 2004; Ratey, 2008; Sousa, 2006). Furthermore, when students are emotionally connected to information, they are more likely to retain what was learned (Barkley, 2010; Fitzsimmons & Lanphar, 2011). Researchers have been discovering ways to help teachers minimize the negative impacts of students' emotions on learning.

Neuroscience research supports several strategies that encourage positive emotional connectedness to learning. First, focusing on student-centered activities have been shown to cultivate positive peer-social interactions (Flook et al., 2005; Ratey, 2008). Downer et al., (2007) conducted observations on 955 third-grade students and found that the children were more engaged within small group 'analysis-inference' (i.e. critical thinking) instruction as compared to large group lecture-based instruction. This high level of engagement fosters positive social interactions that has been linked to increased levels of self-esteem (Kirkcaldy, Shephard, & Siefen, 2002), and school connectedness, both critical influences on academic achievement (Johnson & Johnson, 1989; Rosen et al., 2008). Johnson and Johnson (1989) and Rosen et al. (2008) found that academic achievement was higher during cooperative activities, or "positive social interdependence" (Johnson et al., p.5), when compared to independent or competitive activities.

Another concept supported by brain-based research on emotional connectedness to learning involves physical activity. Physical activity opportunities have been shown to improve student self-esteem and reduce anxiety and depression (Ekeland et al., 2005; Flook et al., 2005; Kirkcaldy et al., 2002), which are linked to academic performance (Akey, 2006). Doucette (2004) found that adolescents who participated in short bouts of physical activity reported improvements in their level of self-efficacy and well-being. Physical activity is also reported to help balance brain chemicals that elevate self-esteem (Tkachuk & Martin, 1999), and improve neural activity in several areas of the brain responsible for emotions (Davis et al., 2007). Incorporating teaching and learning strategies that foster positive emotional experiences that are linked to academic achievement may sequentially lead to students' increased motivation to learn (Cokley et al., 2001; Flook et al., 2005; Watters & Ginns, 2000). The influences and importance of motivation on the learning process is explored in the next section.

Motivation and Learning

Psychologist Julian Rotter (1945) suggested that people are motivated by the results of their behaviors, and these results dictate repeat behaviors or not. Motivation has been described as "an internal state that arouses, directs, and sustains human behavior" (Glynn, Aultman, & Owens, 2005, p. 150). The human behavior element that drives motivation assists in the regulation of student behaviors (Cokley et al., 2001). When students are motivated to learn, they are more attentive, engaged, and receptive to information (Flook et al., 2005). For example, if the results of a behavior are well received by peers, the motivation of that student to repeat the behavior is high. Extrinsic motivators (i.e. rewards or punishments) represented in the classroom can also greatly impact student behavior (Watters & Ginns, 2000). Cokley et al. (2001) believe that students with low motivation to succeed perceive that their behaviors are not attributing to success. When students are unmotivated, they often believe that their behaviors are out of their own control (Brophy, 2010).

Thoonen, Sleegers, Peetsma, and Oort (2011) looked to see if teaching methods could impact student motivation to succeed. Questionnaires were used to measure students' intrinsic motivation, academic self-efficacy, school investment, and performance avoidance. They also measured teachers' self-efficacy and teaching practices. The results showed that students' motivation levels were positively impacted when the teacher used cooperative learning methods (e.g. small-group work, interdependent assignments). The results also suggest that teachers' beliefs in their own ability impact both their teaching practices and students' motivation to learn (Thoonen et al., 2011). Students with high intrinsic motivation are self-propelled to engage in learning and are in control of their own behaviors (Deci & Ryan, 2002). This process of intrinsic motivation as a driving force to learn is referred to as the Self-Determination Theory (SDT).

Self-Determination Theory, or being intrinsically motivated to learn (Reeve, Deci, & Ryan, 2004), believes that when students' need for competence and relatedness are met, they are more motivated to learn (Brooks & Young, 2011). Feeling competent stems from perceived opportunities of having influence on a situation or feeling effective (Deci & Ryan, 2002), both of which are part of the cooperative learning approach. Classrooms that foster a sense of connectedness can address student desires to care for or be cared by others, or "to be socially connected" (Brooks & Young, 2011, p. 49). This connectedness can lead to increased positive self-image and ultimately positive physiological responses (e.g. low anxiety, relaxed) to learning (Flook et al., 2005).

Physiological Responses and Learning

The physiological state of a student plays a crucial role on their behavior (Shephard & Siefen, 2002), which in turn, can affect their academic performance (Doucette, 2004). Students who suffer from low self-esteem, anxiety, or depression tend to suffer academically (Kirkcaldy et al., 2002); leading to even more psychological concerns such as learned helplessness (Sutherland & Singh, 2004). Emotional responses to information and experiences not only determine the ability to retain information (LaBerge & Samuels, 1974), but can also determine the type of response a student has to the learning environment (Kolb & Whishaw, 2003). For example, if a student has anxiety or feels unsafe, the ability of that student to learn will be difficult, if not impossible (Denton, 2010). One way to decrease anxiety and increase a sense of belonging for students is to encourage positive social interactions amongst students (Flook et al., 2005).

Flook et al. (2005) studied the impact that social anxiety had on predicting academic performance in fourth and fifth grade students. They found that students who reported having a low peer acceptance also had low levels of self-esteem and poor academic performance. Furthermore, there is also a strong relationship between low self-esteem and higher levels of delinquent behaviors in both males and females (Fergusson & Horwood, 2002). Donnellan et al (2005) conducted three studies across nationalities (United States and New Zealand) to determine if self-esteem levels predicted externalizing problems (e.g. delinquency, and aggression) in school-aged children. After analyzing responses from the students, teachers, and parents, they found a strong relationship between lower levels of self-esteem and higher instances of delinquent behaviors. Lastly, students who suffer from low self-esteem and depression have a higher prevalence of engaging in health-risk behaviors such as substance abuse, sexual risk behaviors, and violence (Valois, MacDonald, Bretous, Fischer, & Drane, 2002). These health-risk behaviors are consistently associated to academic failure and often affect student attendance, grades, and ability to focus in class (Dewey, 2000). Students who are in good physical health are less likely to suffer from depression, low self-esteem, and other negative mental consequences (Kirkcaldy et al., 2002).

Tanida et al. (2004) looked at the relationship between the completion of a difficult arithmetic task and prefrontal cortex activity (i.e. the part of the brain responsible for decision making and planning difficult cognitive behaviors). The study used infrared spectroscopy (i.e. scanning for changes in body chemicals) to determine if there was a connection between increased heart rate and cerebral blood oxygenation changes in the prefrontal cortex during a difficult mental task. The study concluded that as the heart rate increased during a difficult and stressful cognitive task, the amount of blood flow to the prefrontal cortex also increased. This relationship suggests that in the event of stress, brain chemistry changes and makes learning function more difficult (Tanida et al., 2004). Lastly, numerous studies on mental stress and blood pressure (Fechir et al., 2009; Haris et al., 2000; Shapiro et al., 2000; Sloan et al., 1991) conclude that as mental stress (e.g. mental arithmetic) increased, so did both systolic and diastolic blood pressure. These studies suggest that stress level impacts a student's ability to work efficiently (Matuliauskaite & Zemeckyte, 2011).

Researchers have found that as mental stress increases, productivity and task engagement decreases (Fechir et al., 2009; Harris et al,. 2000; Sloan et al., 1991). Furthermore, when a student is angry or frustrated their achievement potential decreases (Daniels et al., 2009; Pekrun et al., 2009; Schutz & Pekmn, 2007). Pekrun et al. (2009) studied the link between achievement goals (e.g. performance approach, mastery) with achievement outcomes (e.g. boredom, anger, joy). By using exam-specific assessments of both performance goals and achievement emotions to predict academic performance, the study found that both the goals and emotions of the participants predicated performance achievement (Pekrun et al., 2009). Matuliauskaite and Zemeckyte (2011) posit that there are direct links between physiological responses, emotions, and academic performance, which is illustrated in Figure 3.

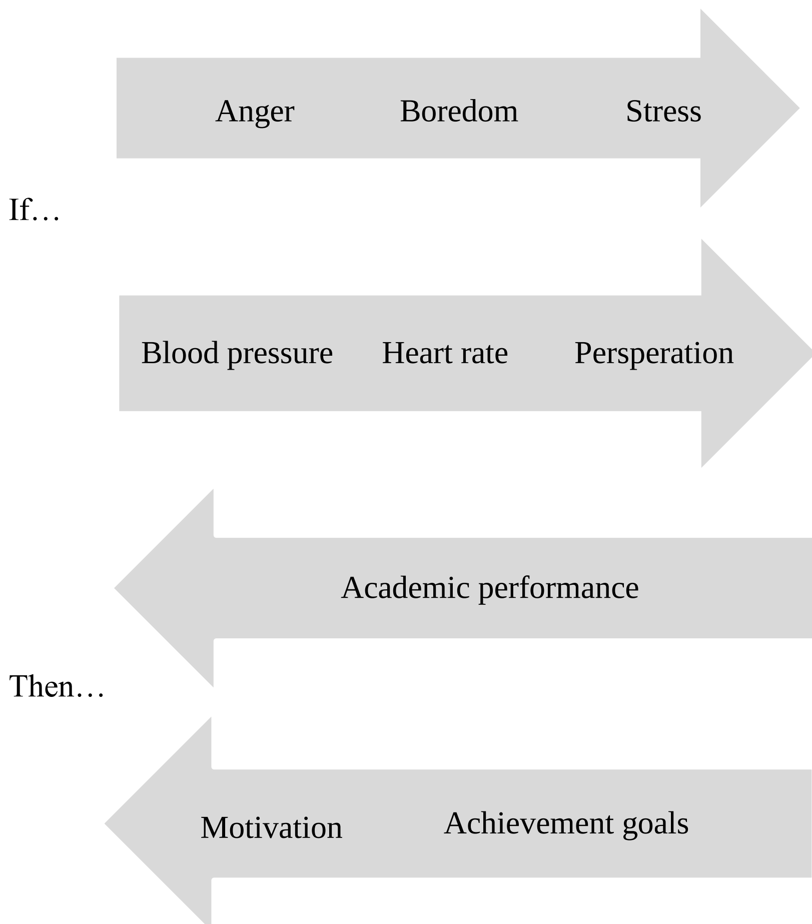

Figure 3. Interrelation between students’ emotions, physiological response, and academic performance (Matuliauskaite & Zemeckyte, 2011).

Matuliauskaite and Zemeckyte (2011) work demonstrates the interaction that occurs between emotional responses to learning, the body’s response to those emotions, and the impact that those reactions have on learning. If educators understand the importance of fostering positive emotional responses in their students, they can increase academic performance, and motivation to learn (Daniels et al., 2009; Matuliauskaite & Zemeckyte, 2011; Pekrun et al., 2009).

Encouraging positive responses to learning can be a difficult task for teachers due to the experiences that students bring with them to the classroom (Harris et al., 2000). However, there are several actions that can be done within the classroom that can assist teachers in providing a positive learning climate. One of those actions is being cautiously aware of the impact that the physical arrangement of the classroom has on learning. Classroom seating is an often overlooked, teacher-controlled, environmental factor that can influence student learning experiences (Wannarka & Ruhl, 2008), and is discussed in the next sub-section.

The Impact of Classroom Seating on Learning

Where a student sits in the classroom is shown to impact several components of learning (Fernandes, Jinyan, & Rinaldo, 2011). For instance, classroom seating affects student learning conditions (e.g. availability to resources, distance from the teacher) (Budge, 2000), which in turn impacts their engagement and participation (Wannarka & Ruhl, 2008). A student's level of participation and engagement has a direct impact on their academic achievement (Douglas & Gifford, 2001; Flynn et al., 2009; Stronge, 2007). Burda and Brooks (1996) found that students who sat closer to the front of the class demonstrated higher levels of motivation, as well as, higher results on achievement tests. In addition, individual personalities and motivation to learn may dictate where a student chooses to sit (Edwards, 2000). For example, a passive or unmotivated student may sit in the back of the room (Fernandes et al., 2011), which is likely to decrease their participation (Stronge, 2007), and teacher-student and student-student interaction (Marx, Fuhrer, & Hartig, 2000).

Unlike certain components that impact the learning environment (e.g. student personalities, social dynamics), classroom seating is a factor that the teacher can control (Wannarka & Ruhl, 2008).

Therefore, “it is important for teachers to have the knowledge necessary to make informed decisions about whether rows, clusters, semicircles or some other arrangement will best meet the instructional needs of their students” (Wannarka & Ruhl, 2008, p.89).

Wannarka and Ruhl (2008) made several conclusions in relation to seating arrangements with 7-11 year old student. The following findings were found in the research;

1. On-task behavior (e.g. compliance with teacher instructions, eye contact with materials) during individual seatwork for students is higher when students are seated in rows (Axelrod, Hall, & Tams, 1979; Hastings & Schweiso, 1995; Wheldall & Lam, 1987).
2. Work productivity is higher when students are seated in rows (Bennett & Blundell, 1983; Yeomans, 1989).
3. Students ask their teachers significantly more questions when they are seated in a semi-circle as compared to straight rows (Marx et al., 2000).
4. The quality and productivity of interactive group work decreases when students are sitting in rows (Marx et.al, 2000; Rosenfeld, Lambert, & Black, 1985).
5. Students classified as having a behavior disorder show less disruptive behaviors when seated in rows (Friend, 2005; Handwerk & Marshall, 1998; Salend, 1998).

Trends in the research suggest that seating arrangements should be dictated by the nature of the task. For example, if a teacher wants students to complete independent work, than their performance will be best in straight rows where talking to peers and distractions are limited (Friend, 2005). Conversely, if teachers are interested in brainstorming, collaboration, and discussion, than students should be seated in small group clusters (Wannarka & Ruhl, 2008). Besides looking at seating arrangements, brain-based research also focuses on the impact that physical movement has on student achievement (Jensen, 2008a; Mahar et al., 2006; Ratey, 2008) and is investigated in the next sub-section.

The Impact that Classroom Physical Activity has on Learning

Neuroscience research suggest that students who sit for longer than twenty minutes experience a decrease in brain activity required for learning to occur (Blaydes, 2000; Mahar et al., 2006). On the other hand, physical movement increases the release of "feel good" brain chemicals (i.e. endorphins) that are responsible for focus and concentration; which allows for improved on-task behaviors (Ratey, 2008). The brain needs a constant supply of oxygen for optimal learning to occur (Sanes & Lichtman, 2001), and sitting slows the rate of oxygen rich blood flow in the body (Levin et al., 2008). However, standing increases blood flow and oxygen to the brain by approximately 5% (Krock & Hartung, 1992), and physical movement, such as walking, can increase blood flow to the brain as much as 20% (Delp et al., 2008). When teachers understand these factors influencing brain function, they can optimize the cognitive performance of their students by integrating physical movement into the classroom (Jensen, 2008a; Ratey, 2008).

The brain requires “downtime” to process, organize, and strengthen learning (Sanes & Lichtman, 2001). Research on memory and attention suggest that information recall is improved when learning is distributed rather than concentrated (Barros, Silver, & Stein, 2009; Pellegrini, 2005). Coupled with breaks, physical activity increases the brain’s ability to process information more effectively by clearing toxins (Delp et al., 2008), providing a refreshing feeling, and improving focus (Medina, 2008). Lastly, research in neuroscience has shown that exercise can increase students’ attention systems (Mahar et al., 2006; Ratey, 2008), which include improved function the sensory systems, working memory, hippocampus, and reticular activation system (Almarode & Almarode, 2008). Mahar et al. (2006) found that students who received a short exercise break throughout the school day had higher levels of academic engagement, lower off-task behaviors, and higher retention of the information being taught.

The structure of physical activity also provides social situations that may lead to improvements in a student’s self-image (Kirkcaldy et al., 2002). Providing students with opportunities to build social skills encourages them to develop self-confidence and instills a sense of belonging (Pellegrini, 2005). Students who learn to cooperate, share, and abide by rules of both individual and group physical activities are more likely to feel more connected to their school and want to challenge themselves (Ekeland et al., 2005). In addition, students who self-discover and test their physical skills often improve their self-image and assurance in their abilities to succeed (Flook et al., 2005). With gaining the social benefits of self-worth and belonging, physically active adolescents are also less likely to attempt suicide, adopt risk-taking behaviors, or become pregnant; all of which are associated with lower academic outcomes (Valois et al., 2002).

One program that utilizes the research in physical activity to address the above mentioned benefits in student learning is Brain Gym.

This program utilizes findings that suggest student achievement can be improved through specific physical activity movements and routines spread throughout the school day (Blaydes, 2000; Mahar et al., 2006).

Brain Gym® as a model for physical activity integration. A commercial brain-based program that is used in over 80 countries, Brain Gym is based on advances in neuroscience and kinesthetic education (Spaulding, Mostert, & Beam, 2010). The program includes 26 exercises that are designed to improve the brain's ability to function, especially during learning activities (Dennison, 2006). The creator of Brain Gym, Dr. Paul Dennison, claims that these specific movements mechanically activate both hemispheres of the brain through cross-lateral movements, and balance-requiring movements (Spaulding et al., 2010). These movements "activate the brain via the motor and sensory cortexes, stimulate the vestibular system for equilibrium, and decrease the fight or flight mechanism" (Dennison, 2006, p.8).

One study conducted by Freeman (2000) reported that using Brain Gym daily can yield significant results in student academic performance. Freeman conducted a 10 week long study where third, fourth, and fifth grade students were placed in either the experimental group or control group. The experimental group participated in 15 minutes of Brain Gym activities each day while the control group did not. Freeman also provided in-depth trainings to the students' teachers in using Brain Gym. The results showed that the experimental group showed at least 20 percentile point improvements on the Stanford Achievement Test (SAT) in 55% of the third-grade students, 6% of the fourth grade students, and 89% of the fifth-grade students. The control group did not have any students with at least a 20 percentile point improvements on the SAT exam. Freeman (2000) reported that the fourth grade students in the experimental group only received the Brain Gym break sporadically, as compared to daily for the third and fifth graders; which demonstrated the importance of frequency and consistency. This study indicates that Brain Gym can be an effective intervention at improving student achievement when incorporated into the classroom schedule.

Gilberto (2002) conducted a study where he had an experimental group of Latino elementary students participate in select brain gym exercises during the school day. He also had a control group of Latino students in the same district who did not participate in the movements. He found that students who participated in the brain exercises for 20 minutes a day showed increases in reading (9.85% greater) and math (16.05% greater) when compared to the control group of students.

In her book, Dr. Cara Hannaford (2005) outlines her work with fifth grade special education students, and the results they had using Brain Gym exercises. She reported that all of her students in the class showed a minimal gain of one-year in reading comprehension scores, and several students made gains of nearly two-years in overall academic growth while participating in Brain Gym interventions (Hannaford, 2005). Furthermore, a little more than half of her students demonstrated a minimal of a one-year gain in math test scores. Lastly, she reported improvements in both the students' ability to stay on-task, and their levels of self-esteem. Hannaford stressed that the gains made while using Brain Gym were much greater than what is considered typical academic progression in special education students.

Nussbaum (2010) looked at using Brain Gym as a tier-one Response to Intervention (RtI) and also as a class-wide general education intervention with elementary students. The sample included both students who were academically at-risk and students in general education. She was trying to identify if Brain Gym exercises could be used as an academic performance, as well as, a behavioral intervention tool for primary school children. After the 8-month long study, the study concluded several findings. For the students at-risk, it was found that after receiving Brain-Gym exercises as a tier-one intervention they demonstrated significant improvements in both reading and math results (Nussbaum, 2010). Likewise, for the general student population, when Brain-Gym was used as a classroom management strategy, they showed significant reductions in maladaptive behaviors (e.g., aggression, hyperactivity, inattention, depression, and anxiety), and increases in adaptive behaviors (e.g., social skills, functional communication, and adaptability).

The ability to improve student achievement and foster desired behaviors should be a major focus of educators. However, utilizing research-based strategies is often clouded by teachers' personal beliefs on learning (Rosenfeld & Rosenfeld, 2008). Teachers' beliefs on how learning occurs and the direct impact it has on academic achievement are investigated in the next section.

Teachers' Beliefs as Predictors of Student Achievement

The importance of understanding how teachers' beliefs and knowledge of the learning process impact student performance is grounded in years of research (Hong, Hartzell, & Greene, 2009; Jordan, Lindsay, & Stanovich, 1997; Nespor, 1987). When teachers have a conscious awareness of the impact that their beliefs has on learning, they are more likely to adopt more effective teaching methods (Denton, 2010). This section explores the impact that teachers' beliefs have on the learning process. This section also looks at the impact that research-based professional development trainings have on shaping appropriate teaching practices.

The Impact of Teachers' Beliefs on Learning

How teachers view the learning process greatly impacts student success (Rosenfeld & Rosenfeld, 2008). Effective teaching is a) acting on the belief that all students can learn (National Board for Professional Teaching Standards, 2007), b) addressing diverse learner needs (Darling-Hammond, 2000), and c) believing that the teacher can intervene to help a student improve. Jordan et al. (1997) define effective teaching as a set of beliefs that are reflected in inclusive classrooms which lead to effective teacher practice, and improved student performance and self-esteem.

Teachers' beliefs are often formed when they are students themselves (Kagan, 1992). Assuming that Kagan is correct that these beliefs are formed early on, they are often ingrained with emotional and vivid personal experiences (Nespor, 1987). Many teachers have adopted their beliefs and practices from their own teachers (Stuart & Thurlow, 2000), through what Lortie (1975) called 'apprenticeship of observation.' Hong et al. (2009) found that teachers' personal beliefs greatly impacted the learning structure of the classroom, and this learning structure had some influence on the level of creative thinking opportunities for students. Teachers rarely reflect on these embedded beliefs, and often do not realize the importance of challenging their beliefs about teaching and learning (Stuart & Thurlow, 2000). Besides a student's own attributes (e.g. cognitive function), teachers' beliefs are one of the most influential factors that impact student performance and developed talent (Hong & Milgram, 2008).

Years of research have linked teachers' instructional practices to student performance (Foorman et al., 2006; Nespor, 1987; Taylor et al., 2000). In particular, brain-based instructional practices (e.g. small-group work, cross-curricular activities) are linked to higher student outcomes (Foorman et al., 2006). Furthermore, teachers with classroom management beliefs that encourage students to self-regulate their behaviors have more engaged and motivated learners (Bogner, Raphael, & Pressley, 2002; Dolezal, Welsh, Pressley, & Vincent, 2003).

Melodie and Sherman Rosenfeld (2008) studied teachers' personalities, and concluded that there are two types of teachers. The first type show 'interventionist beliefs', or feel they can help a struggling learner through intervention. The second type show 'pathognomonic beliefs,' or blame the student for academic struggles (Rosenfeld & Rosenfeld, 2008). Teachers who base learning on interventionist beliefs contribute to increased academic achievement and self-esteem in students (Connor et al., 2005; Darling-Hammond, 2000; Rosenfeld & Rosenfeld, 2008). Understanding the impact that teachers' beliefs have on student learning is crucial for developing effective professional training opportunities (Rosenfeld & Rosenfeld, 2008). The impact that professional develop trainings can have on teachers' beliefs and ultimately their teaching practices is reviewed in the following sub-section.

The Impact of Professional Development Trainings on Teachers' Beliefs and Practices

Teachers' knowledge of learning and classroom interventions can greatly impact student success (Sousa, 2007). According to Denton (2010) “brain based education is important because it educates us to the benefits of the correlation between neuroscience and the corroboration between other disciplines” (p.18). When teachers have an understanding of how neurons, dendrites, and synapses all work together to communicate, they can have a better understanding of what it takes to complete academic tasks (Berninger & Richards, 2002). Research has offered ways to improve teachers’ understanding of the learning process through offering trainings on how the brain functions and learns best (Denton, 2010; Shaywitz, 2003).

Shaywitz (2003) extensive work with dyslexic patients demonstrates the impact that teachers’ knowledge has on student achievement. Teachers were offered extensive trainings on brain function; in particular the parts of the brain responsible for dyslexia and other reading disabilities. The study found that when teachers were familiar with certain brain function deficits, they were better equipped to provide effective intervention strategies which lead to improved reading scores in those students with reading disabilities (Shaywitz, 2003).

Denton (2010) examined the impact that brain-based research sessions had on classroom interventions for struggling readers. Teachers participated in ongoing trainings that provided; a systematic look at how the brain learns; allowed them to better understand terminology related to the brain and reading; and provided them with easy to implement reading interventions. The results showed a positive relationship between the brain-based training sessions and the implementation of effective reading strategies. Furthermore, teachers acknowledged that after the training sessions, they viewed their teaching differently and their attitudes towards brain-based learning had improved (Denton, 2010).

Finding ways for teachers to better meet the needs of students is essential to improving education (Ratey, 2008). Jenson (2005) argues that teachers should be experts on how the brain functions. As shown in the research (Denton, 2010; Shaywitz, 2003), providing teachers with professional development opportunities on brain-function and teaching strategies that support the learning process are effective ways at improving students' educational experiences.

Summary

Teachers should have an understanding of how learning occurs in order to provide an optimal experience for student development. Brain-based Learning Theory provides this knowledge, as well as, makes suggestions for incorporating best practice applications for the classroom. Jensen (2000) believes that "if educators don't know why they do what they do, their actions are less purposeful and professional" (p. 76). If teachers can be more consciously aware of the impact that their decisions have on learning, they can better address the diverse needs of their students. The first step to providing teachers with effective trainings is to determine their current level of knowledge of the learning process. The purpose of this study is to determine teachers' knowledge and beliefs about the learning process using brain-based learning theory as the foundation for what is considered best-practice. Chapter 3 reviews the methodology behind how this study will attempt to address the purpose stated above.

CHAPTER 3

METHODOLOGY

The purpose of this study was to determine public school teachers' knowledge, beliefs, and practice of brain-based learning strategies in western Pennsylvania schools. Specifically, this study looked at K-12 public school teachers' knowledge of brain-based learning theories, K-12 public school teachers' professional experiences and perceptions of brain-based learning, and K-12 public school teachers' implementation of brain-based learning strategies in each of their classrooms. This chapter describes the study participants, research design, survey procedures, and the instrument that was used.

The participants included in this study consisted of K -12 public school teachers within three selected school districts in western Pennsylvania. The Brain-Based Learning Survey Questionnaire (BBLSQ), developed by Shelly Klinek (2009), was used as the data collecting instrument of this study. The BBLSQ is made up of 3 sections, consisting of 50 questions. For the purpose of this study, the survey was administered using an online survey tool (i.e. Qualtrics), and will be distributed through participants' e-mail accounts.

Method of Obtaining Data

A slightly modified version of Dr. Klinek's (2009) Brain-Based Learning Survey Questionnaire (BBLSQ) was used as the data collecting instrument for this study (see Appendix A). The first section of the questionnaire includes five demographic items including: gender; age (e.g., younger than 30, 30-39, 40-49, 50-59, 60 or older); are you a current public school teacher? what grade level do you primarily teach? (i.e. elementary [K-5], middle grades [6-8], high school [9- 12], K-12), and; how many years have you been teaching fulltime? (e.g. less than 5, 5-10, 11-15, 16-20, more than 20). The remaining two sections of the survey focus on competency/brain-based learning indicators and Brain Gym indicator statements (Klinek, 2009).

The second part includes 36 rating scale questions used to describe participants' knowledge, beliefs, and practices of brain-based learning on a strongly agree to strongly disagree scale. This section of the BBLSQ is divided into 3 sub-categories: (1) knowledge-14 items, (2) beliefs-13 items, and (3) practices-9 items. The following is a sample question from this section, "I have sufficient understanding of how the brain learns."

The last part of the instrument includes open-ended questions and items about Brain Gym, a program designed to overcome learning challenges through specific physical movements (Dennison, 2006).

Out of the 50 questions on the original BBLSQ, questions 3, 4, 5, 15, 16, 25, and 31 were slightly modified from the original target population (higher education faculty) to better address the subjects in this study (primary and secondary educators). The specific changes are outlined in Table 3 below.

Table 3

Modifications Made to Original Brain-Based Learning Survey Questionnaire (BBLSQ)

Item #	**Original BBLSQ Questions**	**Modified BBLSQ Questions**
3	Are you in the College or School of Education Faculty?	Are you a current public school teacher?
4	How many years have you been teaching in Higher Education?	How many years have you been teaching in public schools?
5	Highest Degree Earned?	What grade level do you primarily teach?
15	Our University has encouraged workshops, conferences, or in-service training on the topic of the newest strategies in classroom teaching.	Our District has encouraged workshops, conferences, or in-service training on the topic of the newest strategies in classroom teaching.
16	Different learning approaches are a waste of time in a University setting.	Different learning approaches are a waste of time in a K-12 setting.
25	I feel all college of education faculty should know how to implement brain-based learning	I feel all K-12 teachers should know how to implement brain- based learning.
31	I use new and updated information in all my education classes.	I use new and updated information in all my (deleted education) classes.

Reliability of the Instrument

During the pilot study conducted by Dr. Klinek (2009), Reliability was determined by calculating the split-half reliability coefficient. This was completed by dividing the odd and even numbered questions into two separate categories. A reliability correlation was calculated for each half of the two sets. Because the split-half reliability technique only represents the reliability of half a test (Mertler & Charles, 2010), a Spearman-Brown correction formula was computed to determine the reliability of the entire questionnaire (Klinek, 2009).

The Brain-Based Learning Survey component of the BBLSQ was divided into three different scales, including knowledge (14 items); beliefs (13 items), and practice (9 items). Each scale had items that were reversed-keyed to prevent a particular response set bias known as acquiescence, or agreement with a statement no matter what it says (Fink & Kosecoff, 1998). Because the instrument consists of three different sub-scales, a reliability coefficient was determined for each scale using Cronbach's Alpha to determine internal consistency reliability. The internal consistency of each scale on the original BBLSQ were as follows; Knowledge Scale, α= .79, Belief Scale, α=.86, and the Practice Scale, α=.64 (Klinek, 2009). The reliability of the practice scale is considered questionable; however, any result greater than .5 is considered acceptable (Mertler & Charles, 2010).

Validity of the Instrument

Content validity of the BBLSQ was determined through a review from an expert panel (Klinek, 2009). Validity of test content can be established from the judgment of experts in a particular content field (Mertler & Charles, 2010). During the development of this instrument, it was reviewed by seven experts in the fields of physical therapy, occupational therapy, and education. The primary task of the panel was to determine how well the items represented what the researcher was trying to find. Revisions to the original BBLSQ were made based on the panel's recommendations (Klinek, 2009).

Procedures

The multiple components of this study are presented in this section. The major components discussed include the method of how the subjects were selected and the sample size of the study. Finally, this section describes the data collection process and the procedures used to analyze the data in order to answer the research questions presented in Chapter 1.

Method of Subject Selection

The selection of school districts for this study was based on convenience (i.e. location) to the researcher, and included three different districts that covered two counties in western Pennsylvania. K -12 teachers of the selected school districts were contacted via their school e-mail account, with the access to their email accounts being granted by each district's respective Superintendent. This procedure is outlined in the data collection section of this chapter. The population was a non-probability convenience sample, where participants were invited to participate in a survey as long as they were current public school teachers during the two week duration of the study.

Sample Size, Selection, and Study Sites

The sample included K -12 public school teachers within the selected school districts in western Pennsylvania. All current K -12 teachers were eligible to participate in the study because they are directly involved in the learning process of students. The target population of volunteers consisted of approximately 450 members which is the total number of K-12 teachers in the three selected school districts. The survey was administered electronically using a product called Qualtrics, an online survey software program that allows researchers to develop and administer web-based surveys (Phillips, Guss, & McGarry, 2011). The program provided a private link to the BBLSQ questionnaire that participants accessed through their school email accounts. The Qualtrics software ensured that participants met the study requirements (i.e. current K-12 teacher) and that they only responded to the survey once. Lastly, the Qualtrics software assisted in analyzing questionnaire results for statistical information related to the study research questions.

Data Collection Procedures

Phase One

Initial contact for the study occurred through emailing each district's Superintendent (see Appendix B). A detailed overview of the proposed study was sent, as well as, a response form indicating site approval or disapproval of the study within his or her district. Follow-up phone calls were used for superintendents who did not respond after one week of being emailed.

Phase Two

After the number of willing school districts was verified, an email with the description of the study was sent to the all of the Superintendents, which was then forwarded to all K-12 teachers in each district (see Appendix C). Sending participants a request to complete the questionnaire through their district's superintendent served two purposes. For one, participation was being promoted by someone with-in the district, as opposed to an unknown outside source. Second, sending the invitation this way ensured that the Superintendents did not have to disclose a district email list, which was a concern of several Superintendents. The email included an overview of the project; a statement indicating that participation in the study was completely voluntary; and a copy of the Superintendent's site approval letter. Lastly, an invitation to participate in the study was sent in the form of a link to the Qualtric's website, where the online questionnaire was administered.

Phase Three

The survey itself was executed in multiple steps. After the participants received the email, those who chose to participate clicked on the survey's URL. Second, after they were redirected to the Qualtric's survey site, they were prompted to read the brief instructions for completing the survey. Third, the participants completed the survey by answering all fifty questions. Forth, after answering the questions, participants were asked if they want included in a drawing to win a Kindle Fire, because offering an incentive may have increased the likely-hood of subject participation (Zangeneh et al., 2008). Lastly, after deciding whether or not to be entered in the drawing, the participants clicked on the "submit" button, which entered their results into the Qualtric's database.

Participants were only permitted to complete the survey one time, which was automatically monitored through the Qualtric software. The participants were sent a second and final reminder one week after the initial invitation to remind them that they could still participate in the study.

Data Analysis

The survey results were analyzed using SPSS (Statistical Package for the Social Sciences) software (Levesque, 2007). Multiple analysis procedures were used to answer the research questions presented in Chapter 1. Descriptive statistics were used to explain the data results through measures of central tendency (Mertler & Charles, 2010). Independent t-tests were used to determine any differences found between gender and the three scale scores (knowledge, beliefs, and practice). Spearman Rank-Order correlations were computed between years of teaching experience and each of the three scale scores. Spearman correlations were appropriate because years of teaching were measured on an ordinal scale (Klinek, 2009). A One-Way Analysis of Variance (ANOVA) was used to determine if there were any differences between grade level being taught and the three scale scores. Lastly, internal consistency of each scale was computed using Cronbach's alpha reliability. All three scales showed reliability above the .5 level, which is considered acceptable (Mertler & Charles, 2010). The internal consistencies are presented in Table 4 below.

Table 4

Internal Consistency for the BBLSQ Survey Scales

Scale	**N**	**Number of Items**	**Reliability**
Knowledge	216	14	.75
Belief	216	13	.83
Practice	219	9	.69

Summary

The purpose of this chapter was to identify the components of the research study. This chapter outlined what methods were used to collect the data, as well as, the selected sample of participants that were tested. Furthermore, this chapter outlined the different phases of the data collection portion of this study. Lastly, this chapter discussed how the results of the study were analyzed in order to appropriately answer the research questions presented in Chapter 1.

CHAPTER 4

RESULTS OF DATA ANALYSIS

The knowledge, beliefs, and practices of K-12 teachers regarding brain-based learning strategies were established by gathering self-reporting data on an online survey questionnaire. This study investigated these variables through the following five research questions:

1. What is the extent of knowledge K-12 public school teachers have about the indicators of brain-based learning and Brain Gym?
2. To what extent do K-12 public school teachers rate the value of brain-based learning and Brain Gym?
3. To what extent do K-12 public school teachers report implementing brain-based learning indicators in their classrooms?
4. What is the relationship between K-12 public school teachers' level of knowledge of brain-based learning and indicators of Brain Gym and their beliefs about brain-based learning?
5. What is the relationship between gender, years of teaching experience, grade level being taught, and teachers' knowledge, perceptions, and implementation related to brain-based learning?

This chapter presents the survey results as it pertains to the research questions of this study.

Description of the Sample

The data on K-12 teachers' knowledge, beliefs, and implementations of brain-based learning were collected through the use of an online survey. Teachers within three public school districts in western Pennsylvania received a link to participate in the survey through their school districts' email system. This study was conducted electronically using Qualtrics, an online survey software program. During the two week duration of the study, the survey generated 256 responses, or 57% of the roughly 450 teachers who were asked to participate. Out of the initial responses, four participants did not meet the study criteria (i.e. is a current public school teacher), and 15 respondents dropped-out for unknown reasons.

As shown in Table 5, the majority of participants were females (72.7%) with 186 participating. There were 70 males (27.3%) who also participated in the study. Most of the participants were in the 50-59 (36.3%) or the 40-49 (25%) age range. Out of all of the participants, 40% have been teaching for more than 20 years, followed by 20.3% teaching for 5- 10 years. Most of the participants were elementary (40.2%) teachers or secondary (28.9%) teachers.

Table 5

Demographic Characteristics of Participants

		Frequency	Percentage
Gender	Male	70	27.3
	Female	186	72.7
Age	younger than 30	41	16.0
	30-39	48	18.8
	40-49	64	25.0
	50-59	93	36.3
	60 or older	10	3.9
Years Teaching	less than 5 years	28	10.9
	5-10	52	20.3
	11-15	34	13.3
	16-20	34	13.3
	more than 20 years	103	40.2
Teaching Level	Elementary (K-5)	103	40.2
	Middle Grades (6-8)	59	23.0
	High School (9-12)	74	28.9
	K-12	15	5.9

Analysis of the Variables

The variables that were analyzed in this study include K-12 public school teachers' knowledge of brain-based learning and Brain Gym; their beliefs about brain-based learning strategies and Brain Gym; and their reported level of practicing brain-based learning strategies in the classroom. These variables were measured based on specific items of the survey questionnaire (Klinek, 2009).

Teachers' Knowledge of Brain-Based Learning and Indicators of Brain Gym

The first research question examined the extent of knowledge K-12 public school teachers had about the indicators of brain-based learning and Brain Gym. To answer this question, frequencies and percentages were determined for the 14 items that represented knowledge of brain-based learning and indicators of Brain Gym. As Table 6 shows, only 16 (6.3%) out of the 226 teachers indicated that they strongly agree that they have sufficient understanding of how the brain learns. Furthermore, 98 (38.3%) agreed, 68 (26.6%) neither agreed nor disagreed with the statement, 53 (20.7%) disagreed, and only 1 (.4%) strongly disagreed. A large proportion of respondents either strongly agreed (11.3%), or agreed (45.3%) that they need to be more adequately trained in the area of how the brain learns best. Moreover, 64 (25%) participants neither agreed nor disagreed, 24 (9.4%) disagreed, and only 3 (1.2%) teachers strongly disagreed that they need to be more adequately trained in the area of how the brain learns best.

Table 6

Frequencies and Percentages for Brain-Based Learning Knowledge Questions with Agreement Ratings

	Strongly Disagree	Disagree	Neither	Agree	Agree Strongly
I have sufficient understanding of how the brain learns.	1 (.4)	53 (20.7)	68 (26.6)	98 (38.3)	16 (6.3)
I am comfortable with the use of various learning strategies as part of my teaching.	2 (.8)	4 (1.6)	11 (4.3)	153 (59.8)	66 (25.8)
I am knowledgeable about the use of providing frequent, non-judgmental feedback.	--	6 (2.3)	18 (7)	154 (60.2)	58 (22.7)
I feel the need to be more adequately trained in the area of how the brain learns best.	3 (1.2)	24 (9.4)	64 (25)	116 (45.3)	29 (11.3)
I evaluate in a way that accounts for the fact that all students learn differently.	1 (.4)	18 (7)	28 (10.9)	137 (53.5)	52 (20.3)

The one question that represents participants' knowledge of indicators of Brain Gym is presented in Table 7. 111 (43.3%) teachers agreed that they need to be more adequately trained in relaxation, movement, and crossing the midline activities for enhanced learning in the classroom. In addition, 29 (11.3%) strongly agreed, 55 (21.5%) neither agreed nor disagreed, 15 (5.9%) disagreed, and only 6 (2.3%) teachers strongly disagreed that they need to be more adequately trained in relaxation, movement, and crossing the midline activities to enhance learning in the classroom.

Table 7

Frequencies and Percentages for Brain Gym Knowledge Questions with Agreement Ratings

	Strongly Disagree	Disagree	Neither	Agree	Agree Strongly
I feel the need to be more adequately trained in relaxation, movement, and crossing the midline activities and strategies for my classroom to enhance learning.	6 (2.3)	15 (5.9)	55 (21.5)	111 (43.4)	29 (11.3)

Table 8 presents on how often teachers indicate they seek knowledge of brain-based learning approaches and how often they indicate pre-exposing their students to content. Out of all of the responses, 109 (42.6%) participants indicated that they occasionally pre-expose their students to content and context of a topic. 18 (7%) reported always, 57 (22.3%) often, 39 (15.2%) rarely, and 4 (1.6%) teachers reported that they never pre-expose content at least one week before introducing it. Participants were also asked how often they attended workshops or conferences that dealt with the topic of a certain type of learning strategy. On this question, 5 (2%) teachers reported always, 36 (13.7%) often, 114 (44.5%) occasionally, 57 (22.3%), and 16 (6.3%) never attended worthwhile workshops or conferences dealing with learning styles.

Table 8

Frequencies and Percentages for Brain-Based Learning Knowledge Questions with Ratings for How Often

	Never	Rarely	Occasional	Often	Always
I pre-expose my students to content and context of a topic at least one week before introducing it.	4 (1.6)	39 (15.2)	109 (42.6)	57 (22.3)	18 (7)
I have attended worthwhile workshops or conferences which dealt with the topic of a certain type of learning strategy.	16 (6.3)	57 (22.3)	114 (44.5)	35 (13.7)	5 (2)
I have sought the advice of colleagues concerning the implementation of a certain type of learning strategy.	7 (2.7)	28 (10.9)	119 (46.5)	61 (23.8)	12 (4.7)
I support real-life, Immersion-style, multi-path learning over traditional learning.	4 (1.6)	28 (10.9)	85 (33.2)	87 (34)	23 (9)
Our district has encouraged workshops, conferences, or in-service training on the topic of the newest strategies in classroom teaching.	11 (4.3)	39 (15.2)	103 (40.2)	59 (23)	15 (5.9)

Table 9 presents the two items that indicate knowledge of Brain Gym with ratings for how often. These items include teachers' use of some form of movement in the classroom, and how often they attend workshops that dealt with the topic of relaxation, movement, and crossing the midline activities. The results include 114 (44.5%) teachers indicating that they often encourage or use some form of movement in the classroom. Furthermore, only 1 (.4%) teacher reported that they never use or encourage movement in the classroom. In regards to attending workshops or conferences, 99 (38.7%) rarely, 42 (16.4%) never, 36 (13.3%) often, 36 (14.1%) occasionally, 5 (2%) always attend workshops or conferences on the topic of relaxation, movement, and crossing the midline activities and strategies to enhance learning in the classroom.

Table 9

Frequencies and Percentages for Knowledge of Brain Gym Indicators with Ratings for How Often

	Never	Rarely	Occasional	Often	Always
I use or encourage some form of movement in my classroom to help with focus, attention, or learning readiness.	1 (.4)	19 (7.4)	40 (15.6)	114 (44.5)	42 (16.4)
I have attended worthwhile workshops or conferences which dealt with the topic of relaxation, movement, and crossing the midline activities and strategies for my classroom to enhance learning.	42 (16.4)	99 (38.7)	36 (14.1)	34 (13.3)	5 (2)

Table 10 represents the descriptive statistics for knowledge of brain-based learning indicators. Included in this table are the mean scores out of a 5 point scale. A large portion of teachers indicated that they are comfortable with the use of various learning strategies as part of their classroom teaching. The mean score was 4.17 with little variance (SD= .67) among respondents. Furthermore, teachers only reported a moderate level of agreement with the statement of having sufficient understanding of

Table 10

Brain-Based Learning Descriptive Statistics for the Knowledge Scale

	N	Range	Mean	SD
I have sufficient understanding of how the brain learns.	236	4	3.32	.911
I am comfortable with the use of various learning strategies as part of my classroom teaching.	236	4	4.17	.665
I am knowledgeable about the use of providing frequent, non-judgmental feedback as a useful tool.	236	3	4.12	.641
I evaluate in a way that accounts for the fact that students learn differently.	236	4	3.94	.825
I pre-expose my students to content and context of a topic at least one week before introducing it.	227	4	3.20	.879
I have attended worthwhile workshops or conferences which dealt with the topic of how students learn	227	4	2.81	.861
I have sought the advice of colleagues concerning the implementation of a certain type of learning strategy.	227	4	3.19	.833
I support the use of real-life, immersion-style multi-path learning over traditional learning in my classroom.	227	4	3.43	.896
I feel the need to be more adequately trained in the area of how the brain learns best.	236	4	2.61	.876

how the brain learns. The mean score for this question was 3.32, with somewhat low variance (SD= .911). Table 11 presents the descriptive statistics for the knowledge questions on the indicators of Brain Gym. The question with the highest mean score involved the use of movement in the classroom to help students with focus, attention, and learning. That question's mean score was 3.82 and had little variance (SD =.863). Teachers also agreed, on average, that drinking water is a very important aspect that enhances learning. The mean score on that item was 3.71 with little variance (SD = .848) as well.

Table 11

Indicators of Brain Gym Descriptive Statistics for the Knowledge Scale

	N	Range	Mean	SD
I use or encourage some form of movement in my classroom to help with focus, attention, or learning readiness.	216	4	3.82	.863
I encourage my students to use some form of cross lateral movements or crossing the mid-line for concentration or thinking skills.	216	4	3.10	.865
I view movement, relaxation, and cross lateral stretching a valid form of readiness for learning.	216	4	3.53	.777
I feel that drinking water is a very important aspect that enhances learning.	216	4	3.71	.848
I feel the need to be more adequately trained in relaxation, movement, and crossing the mid-line activities and strategies for my classroom to enhance learning.	216	4	3.66	.896
I feel that movement, relaxation, and cross lateral stretching should play an important role in classroom learning.	216	4	3.49	.772
I have attended workshops or in-services which dealt with the topic of relaxation, movement, and crossing the midline activities and strategies for my classroom to enhance learning.	216	4	2.36	1.038

Looking at research question one in regards to the extent of knowledge teachers' had of brain-based learning and indicators of Brain Gym, the results were promising. The average mean score for the participants on the Knowledge Scale was 46.6 out of a possible 70, or 67% correct. The results indicate that teachers in this study have a moderately high knowledge base of brain-based learning and indicators of Brain Gym.

Teachers' Beliefs of Brain-Based Learning and Indicators of Brain Gym

The second research question looked at teachers' beliefs about brain-based learning and indicators of Brain-Gym. To answer this question, frequencies and percentages were determined for the 13 items that represented beliefs about brain-based learning and indicators of Brain Gym. Table 12 presents frequencies and percentages of the items that measured participants' beliefs.

Table 12

Frequencies and Percentages for Brain-Based Learning Belief Questions with Agreement Ratings

	Strongly Disagree	Disagree	Neither	Agree	Agree Strongly
Different learning approaches are a waste of time in a K-12 setting.	130 (50.8)	79 (30.8)	10 (3.9)	2 (.8)	--
The purpose of my classroom is to create a supportive, challenging, and a complex environment where questions are encouraged.	--	--	5 (2)	106 (41.4)	110 (43)
I view how students will learn best, more important than, what I should teach.	3 (1.2)	30 (11.7)	91 (35.5)	77 (30.1)	20 (7.8)
I feel that how one learns plays an important role in classroom learning.	--	1 (.4)	9 (3.5)	140 (54.7)	71 (27.7)
I would be more willing to initiate various learning strategies if there were more time to do so.	--	1 (.4)	19 (7.4)	124 (48.4)	77 (30.1)
Brain-based learning is a fad in education which will pass as many other so-called “reforms” have done.	6 (2.3)	14 (5.5)	86 (33.6)	87 (34)	28 (10.9)
I believe I already do brain-based learning in my classroom.	1 (.4)	18 (7)	91 (35.5)	100 (39.1)	11 (4.3)
I would be more willing to initiate brain-based learning if I knew more about it.	--	4 (1.6)	59 (23)	142 (55.5)	16 (6.3)
Brain-based learning is a very positive way to learn.	--	1 (.4)	71 (27.7)	122 (47.7)	27 (10.5)
I feel all K-12 teachers should know how to implement brain-based learning.	--	3 (1.2)	65 (25.4)	123 (48)	30 (11.7)

No teachers reported to strongly agree with the statement, “Different learning approaches are a waste of time in a K-12 setting.” Only 2 (.8%) agreed, 10 (3.9%) neither agreed nor disagreed, 79 (30.8%) disagreed, and half (50.8%) or 130 participants, strongly disagreed that different learning approaches are a waste of time in a K-12 setting. On the item that looked at the purpose of the classroom, an impressive 84.4% of participants either agreed or strongly agreed with the statement, indicating that a large portion of participants believe that the purpose of the classroom is to create a supportive, challenging, and complex environment. Furthermore, over half (55.5%), or 142 participants agreed with the statement “I would be more willing to initiate brain-based learning if I knew more about it.” In addition, 16 (6.3%) strongly agreed, 59 (23%) neither agreed nor disagreed, 4 (1.6%) disagreed, and no one strongly disagreed with that same statement. Table 13 presents participants’ beliefs towards indicators of Brain Gym.

Table 13

Frequencies and Percentages for Brain Gym Belief Questions with Agreement Ratings

	Strongly Disagree	Disagree	Neither	Agree	Agree Strongly
I feel that movement, relaxation, and cross lateral stretching should play an important role in classroom learning.	5 (2.0)	8 (3.1)	93 (36.3)	96 (37.5)	14 (5.5)
I feel that drinking water is a very important aspect that enhances learning.	2 (.8)	12 (4.7)	70 (27.3)	95 (37.1)	37 (14.5)
I view movement, relaxation, and cross lateral stretching a valid form of readiness for learning.	4 (1.6)	7 (2.7)	95 (37.1)	91 (35.5)	19 (7.4)

On the item stating that movement, relaxation, and stretching are valid forms of learning readiness, 19 (7.4%) strongly agreed, 91 (35.5%) agreed, 95 (35.5%) neither agreed nor disagreed, 7 (2.7%) disagreed, and only 4 (1.6%) strongly disagreed with that statement.

Table 14 presents the descriptive statistics for participants' beliefs of brain based learning. The item stating that different learning approaches are a waste of time in the K-12 setting generated a very low mean score of .475, indicating that most teachers strongly disagreed with this statement. The variance (SD =.629) for this item was also low. Furthermore, the item stating "how one learns plays an important role in classroom learning" generated an average mean score of 4.27, and had little variance (SD = .555) between the responses.

Table 14

Descriptive Statistics for Belief of the Brain Based Learning Questions

	N	Range	Mean	SD
Different learning approaches are a waste of time in the K-12 setting.	221	3	.475	.629
The purpose in my classroom is to create a supportive, challenging, and complex environment where questions are encouraged.	221	2	4.48	.544
I view how students will learn best, more important than, what I should teach.	221	4	3.37	.877
I feel that how one learns, plays an important role in classroom learning.	221	3	4.27	.555
I would be more willing to initiate various learning strategies if there were more time to do so.	221	3	4.25	.625
Brain-based learning is a fad in education which will pass as many other so-called “reforms” have done.	221	4	1.47	.892
I believe I already do brain-based learning in my classroom.	221	4	3.46	.735
I would be more willing to initiate brain-based learning if I knew more about it.	221	3	3.77	.600
Brain-based learning is a very positive way to learn.	221	3	3.79	.648
I feel all K-12 teachers should know how to implement brain- based learning.	221	3	3.81	.672

Research question two reported positive results from the participants' beliefs towards brain-based learning and indicators of Brain Gym. The average mean score for the participants on the Belief Scale was 50 out of a possible 65, or 77% correct. The results indicate that teachers in this study have strong positive beliefs towards brain-based learning and indicators of Brain Gym.

Teachers' Reported Implementation of Brain-Based Learning in the Classroom

The third research question examined teachers' use of brain-based learning practices and indicators of Brain Gym in their classrooms. To answer this question, frequencies and percentages were determined for the 9 items that represented practices about brain-based learning and indicators of Brain Gym. Table 15 presents the teachers' reported results of those practice items. On the item suggesting it is not important to practice various learning strategies in the classroom, only 11 (4.3%) participants strongly agreed with that statement. On the same item, 26 (10.2%) agreed, 5 (2%) neither agreed nor disagreed, 76 (29.7%) disagreed, and 102 (39.8%) strongly disagreed with the statement. Furthermore, nearly half (45.7%) of the participants agreed with the statement, "it is important to demonstrate and show educators new ways of teaching." Moreover, 49 (19.1%) participants strongly agreed, 50 (19.5%) neither agreed nor disagreed, 3 (1.2%) disagreed, and no participants strongly disagreed with that statement. Table 16 presents teachers' reported practices of how often they implement brain-based learning strategies in the classroom.

Table 15

Frequencies and Percentages for Practice Questions with Agreement Ratings

	Strongly Disagree	Disagree	Neither	Agree	Agree Strongly
It is not important to practice various learning strategies in my classroom.	102 (39.8)	76 (29.7)	5 (2)	26 (10.2)	11 (4.3)
I should teach all my students the meaning and purpose of various styles of learning.	2 (.8)	21 (8.2)	57 (22.3)	115 (44.9)	25 (9.8)
I have been successful; therefore I will not change my teaching strategy.	--	6 (2.3)	58 (22.7)	122 (47.7)	34 (13.3)
It is important to demonstrate and show educators new ways of teaching.	--	3 (1.2)	50 (19.5)	117 (45.7)	49 (19.1)

Table 16

Frequencies and Percentages for Practice Questions with Ratings for How Often

	Never	Rarely	Sometimes	Often	Very Often
I am willing to change my teaching style.	--	2 (.8)	75 (29.3)	113 (44.1)	29 (11.3)
I utilize some form of brain-based learning strategy on a weekly basis.	1 (.4)	8 (3.1)	60 (23.4)	104 (40.6)	46 (18)
I use new and updated information in all my education classes.	--	4 (1.6)	78 (30.5)	111 (43.4)	26 (10.2)
I use the newest technology in my classroom.	4 (1.6)	20 (7.8)	88 (34.4)	67 (26.2)	40 (15.6)
I currently attend educational conferences and workshops about the latest trends in education.	15 (5.9)	68 (26.6)	92 (35.9)	32 (12.5)	12 (4.7)

In regards to the item looking at changing their teaching style, nearly half (44.1%) or 113 participants reported that they are willing to change their teaching style often. 29 (11.3%) participants indicated very often, 75 (29.3%) indicated sometimes, 2 (.8%) indicated rarely, and no participants indicated that they would never change their teaching style. Furthermore, 104 (40.6%) participants indicated that they often utilize some form of brain-based learning strategy on a weekly basis. On the same item, 46 (18%) participants indicated very often, 60 (23.4%) indicated sometimes, 8 (3.1%) indicated rarely, and only 1(.4%) participant indicated that they do not utilize some form of brain-based learning strategy on a weekly basis. On the item that asked how often participants use new and updated information in the classroom, 111 (43.4%) teachers reported that this occurs often in their classrooms. No teachers reported that they never use new or updated information, 4 (1.6%) reported rarely, 78 (30.5%) reported sometimes, and 26 (10.2%) participants reported that they use updated information very often.

In order to examine the average scores of reported practices, the mean scores for each item was determined. Table 17 presents the average scores of the items that measured teachers' implementation of brain-based learning strategies in the classroom. The majority of participants reported that it is important to demonstrate and show educators new ways of teaching. The mean for this item was 3.97 with low variance (SD =.713) between responses. Furthermore, the majority of participants reported some level of utilizing brain-based learning strategies in their classroom on a weekly basis. This item generated a mean score of 3.85 with little variance (SD = .807) amongst respondents.

Looking at research question three in regards to teachers' reported use of brain-based learning strategies, the results were positive. The average mean score on the Practice Scale was 32 out of a possible 45, or 74% correct. The results indicate that teachers in this study report a high rate of implementing brain-based learning practices in their classrooms.

Table 17

Descriptive Statistics for Practice Questions

	N	Range	Mean	SD
It is not important to practice various learning strategies in my classroom.	220	4	.946	1.189
I have been successful; therefore I will not change my teaching strategy.	220	3	1.16	.709
I should teach all my students the meaning and purpose of various styles of learning.	220	4	3.64	.841
It is important to demonstrate and show educators new ways of teaching.	219	3	3.97	.713
I am willing to change my teaching style.	219	3	3.77	.679
I utilize some form of brain-based learning strategy on a weekly basis.	219	4	3.85	.807
I use new and updated information in all my education classes.	219	3	3.73	.689
I use the newest technology in my classroom.	219	4	3.54	.954
I currently attend educational conferences and workshops about the latest trends in education.	219	4	2.81	.958

Relationships between Scale Scores

The forth research question looked at the relationship between participants' knowledge of brain-based learning and indicators of Brain Gym with their beliefs of these topics. This research question was answered by examining the correlation between the Knowledge Scale scores with the Belief Scale score results. The scale scores were computed by averaging across all the items of each score. Table 18 presents the descriptive statistics for each of three scale scores.

Table 18

Descriptive Statistics for Each Scale Score

	N	Range	Mean	SD
Knowledge Scale	216	32	46.6	5.89
Belief Scale	216	32	50	5.32
Practices Scale	219	20	33.2	4.12

In regards to the relationships between the scale scores, Pearson correlations were computed. Table 19 presents those correlations. The results indicate that there was a significantly strong correlation ($r = .57$, $p <.01$) between the Knowledge and Belief Scales. This suggests that participants who have high levels of knowledge of brain based learning also hold positive beliefs towards those strategies. The strongest correlation ($r = .60$, $p <.01$) was between the Belief Scale and the Practice Scale, indicating a strong positive relationship between participants' beliefs and practices. There was also a positive correlation between the Knowledge and Practice Scales ($r = .41$, $p <.01$).

Table 19

Correlations between the Three Scale Scores

	Knowledge	Belief	Practices
Knowledge	--		
Belief	r = .57	--	
Practices	r = .41	r = .60	--

Note. *Correlations were significant at the .01 level (2-tailed).*

In answering research question four, it was determined that there were significant correlations between all of the three scales. The strongest correlation (r = .60) was between the teachers' beliefs towards brain-based learning and their use of brain-based learning strategies, which supports the literature on the impact of teachers' beliefs on their instructional practices (Denton, 2010; Jordan et al., 1997).

Comparisons between Gender, Teaching Experience, Grade Level, and Scale Scores

The fifth research question looked at the relationship between participants' gender, years of teaching experience, grade level being taught, and their responses to the three survey scales. This research question was answered in several ways by examining participants' demographic statistics with the scale scores.

Looking at the relationship between participants' gender and their responses to each of the scale scores, independent t-tests were computed. Table 20 presents the relationship that exists by showing the mean scores for each of the scale scores based on gender. The results revealed that females scored significantly higher on all three scales when compared to males. These results indicate that females having more knowledge, stronger beliefs, and reported implementing more brain-based practices than males.

Table 20

Comparison of Male and Female Mean Scale Scores

	Males (n =58) M (SD)	**Females** (n=158) M (SD)	*t (219)*	*p*
Knowledge	45.19 (5.39)	47.08 (6)	-2.1	.037
Beliefs	47.36 (5.73)	50.96 (4.84)	-4.6	< .001
Practices	30.86 (3.64)	34.04 (3.96)	-5.36	< .001

Note. *Correlations were significant at the .05 level (2-tailed).*

The part of research question five that looked at participants' years of teaching experience and the scale scores was determined by computing Spearman's Rank-Order Correlations. This test was appropriate because years of teaching were on a nominal scale. As presented in Table 21, there were no significant relationships (p <.01) between participants' years of teaching experience and scores on the three survey scales. These results suggest that years of teaching experience is not a strong indicator of determining teachers' knowledge of learning strategies.

Table 21

Comparison between Years of Teaching and Scale Scores

	Years of Teaching	
	Spearman's rho	*p*
Knowledge	.006	.932
Beliefs	.099	.147
Practices	-.041	.544

Note. *No Correlations were significant at the .05 level (2-tailed).*

The last part of research question 5 looked at the relationship between teachers' instructional grade level and their scale scores. A One-way ANOVA test was computed to determine if the differences between these groups were significant. Table 22 presents the correlations between the grade levels and the three scale scores.

Table 22

Comparison between Teachers' Instructional Grade Level and Scale Scores

	Elementary K-5 (n= 87) M (SD)	**Middle 6-8** (n=49) M (SD)	**Secondary 9-12** (n=66) M (SD)	**K-12** (n=14) M (SD)	F (3,212)	p
Knowledge	47.8 (5.92)	46.31 (4.65)	44.35 (6.01)	50.29 (5.55)	6.79	< .001
Beliefs	51.61 (3.97)	49.47 (4.85)	47.38 (6.01)	54.14 (4.99)	12.78	< .001
Practices	34.31 (3.66)	33.34 (4.19)	31.22 (3.89)	34.93 (4.48)	8.95	< .001

Note. *The differences between mean scores are significant at the 0.05 level.*

The results indicate that there is a significant difference between teachers' instructional grade level and their scales scores. In order to determine where the significance between the groups existed, A Post Hoc (Tukey HSD) test was computed. The results of those tests are presented in Table 23. Secondary teachers' differences in mean scores were lower on all three scales when compared to the other three (elementary, middle, and K-12) instructional groups. For example, the K-12 teachers had a higher mean difference of 5.94 ($p < .01$), on the Knowledge Scale, a mean difference of 6.76 ($p < .001$) on the Belief Scale, and a mean difference of 3.7 ($p < .001$) on the Practice Scale when compared to the secondary teachers. Another notable comparison was that the K-12 teacher group had the highest mean scores on all three scales when compared to the other three groups. No other grade level had higher mean differences when compared to the K-12 teachers.

Table 23

Post Hoc Test for Differences between Grade Levels Taught and Mean Scale Scores

		Knowledge	**Belief**	**Practice**
		Mean Difference (p)	Mean Difference (p)	Mean Difference (p)
Elementary (K-5)	Middle Grades (6-8)	1.5 (.451)	2.14 (.075)	.97 (.49)
	High School (9-12)	3.46* (.001)	4.23* (.000)	3.09* (.000)
	K-12	--	--	--
Middle Grades (6-8)	Elementary (K-5)	--	--	--
	High School (9-12)	1.96 (.261)	2.09 (.114)	2.11* (.22)
	K-12	--	--	--
High School (9-12)	Elementary (K-5)	--	--	--
	Middle Grades (6-8)	--	--	--
	K-12	--	--	--
K-12	Elementary (K-5)	2.48 (.427)	2.53 (.284)	.614 (.95)
	Middle Grades (6-8)	3.98 (.097)	4.67* (.011)	1.59 (.54)
	High School (9-12)	5.94* (.003)	6.76* (.000)	3.7* (.008)

Note. ** The mean difference is significant at the 0.05 level.*

In answering research question five, it was determined that certain demographic characteristics were correlated with participants' responses on the three survey scales. for instance, gender was a strong variable for determining scores on the survey. In particular, females scored significantly higher on the survey then did the males. Furthermore, the participants' instructional grade level was strongly correlated to survey scores. More specifically, there was a strong negative correlation between participants' grade level and their scale scores, with the Secondary (9-12th grade) teachers scoring the lowest on all three scales. The only demographic characteristic that was not considered a significant variable to survey responses was years of teaching experience.

Summary

This chapter presented an analysis of the data gathered from the survey questionnaire. The results were used to answer the research questions that made up this study. More specifically, the five research questions were answered with the following results; 1) teachers had moderately high (67%) knowledge of brain-based learning, 2) teachers had strong positive beliefs (77%) towards brain-based learning, 3) teachers reported (74%) implementing brain-based learning strategies at a high level, 4) there was a strong correlation (r = .60) between teachers beliefs and their practices, and 5) participants' gender and instructional grade level were strongly correlated to knowledge, beliefs, and practices of the participants in this study. Chapter 5 includes the discussion, conclusions, and recommendations that resulted from this research.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study reported teachers' level of knowledge about brain-based learning strategies and indicators of Brain Gym. There were 256 public school teachers with in western Pennsylvania who reported their knowledge, beliefs, and implementations of brain-based learning strategies in the classroom. Analysis were conducted to determine the significance of these three scales, and to see if teachers' knowledge impacted their beliefs and practices. Furthermore, demographic variables (i.e. gender, years teaching, grade level taught, and age) were compared to determine if any patterns existed between the scale scores.

Chapter 1 outlined the purpose of this study including the theoretical framework and the problems found in instructional strategies and the learning process. Chapter 2 reviewed the foundations for brain-based learning theory and its implications on the learning process. Furthermore, the current literature surrounding the topic of classroom learning and how teachers' knowledge and beliefs impact teaching strategies and student outcomes were also reviewed. Chapter 3 outlined the study's procedures including participant selection, and how their knowledge, beliefs and practices would be collected. Chapter 4 presented the results of the study responses by answering the five research questions presented in Chapter 1. Chapter 5 summarizes the study results presented in Chapter 4, provides suggestions for school districts, and makes recommendations for further research studies.

Summary of Research Findings

This study examined five research questions that relate to teachers' understanding of brain-based learning strategies. By answering the survey questions, teachers' reported knowledge, beliefs, and implementations of those strategies were determined. The summaries of findings are presented under each of the following research questions.

Research Question 1. The first research question looked at the participants' reported knowledge of brain-based learning strategies and indicators of Brain Gym. This question was answered by measuring their mean scores on the Knowledge Scale. The mean score for participants on the Knowledge Scale was 46.6, or roughly 67% of the highest possible score of 70. This score suggests that participants have a slightly higher than average knowledge level on this topic. However, the results of the Knowledge Scale also show that only 16 (6.8%) respondents strongly agreed that they have sufficient understanding of how the brain learns. Furthermore, 145 (57%) teachers agreed or strongly agreed that they need to be more adequately trained in the area of how the brain learns best. These results reflect the work of a similar study (Klinek, 2009) that also reported that higher education faculty (55%) felt the need to be more adequately trained on how the brain learns best. These results suggest that the majority of teachers believe they lack knowledge of how the brain learns and that they may benefit from professional develop training on the topic of the brain and learning. In a previous study, Denton (2010) found that when teachers participated in brain-based learning training sessions, they viewed their teaching differently, and utilized more effective teaching strategies. This was indicated by increased student reading scores, as well as, teachers' attitudes towards learning (Denton, 2010).

Furthermore, when looking at teachers' knowledge of indicators of Brain Gym, 54.6% of participants indicated that they either agree or strongly agree that they need to be more adequately trained in relaxation, movement, and crossing the midline activities and strategies to enhance learning. Mahar et al. (2006) found that when teachers incorporated physical activities in the classroom, students' on-task behaviors during academic instruction increased. This on-task behavior is directly related to academic performance (Downer, Rimm-Kaufman, & Pianta, 2007; Grissom, 2005; Ratey, 2008). Having over half of the teachers report interest in receiving more training in this area was not anticipated to be so high. These results exceeded this researcher's expectations.

Research Question 2. In looking at the second research question, participants' beliefs about the value of brain-based learning and indicators of Brain Gym were measured. Results indicate that teachers have a positive strong attitude towards brain-based learning strategies. This was reflected by the results of the Belief Scale, which generated a mean score of 50 or 77% of the highest possible score of 65.

Teachers' attitude towards learning can greatly impact student achievement (Rosenfeld & Rosenfeld, 2008). In this study, teachers strongly believed that the purpose in the classroom is to create a supportive, challenging, and complex environment where questions are encouraged. This is reflected by a high mean score of 4.5 out of 5, or 90%, on this survey question. The results also suggest several other findings about teachers' beliefs of the learning process. For example, results suggest that teachers view how students learn more important than what they are teaching. This is indicated by a mean score of 3.37 out of 5, or 67.4% out of the highest possible score. Furthermore, teachers reported that they would be more willing to initiate brain-based learning if they knew more about it. These results reflect the literature that suggests there is a research-to-practice gap (Gravani, 2008) in education. As discussed in Chapter 2, teachers report not trying new instructional strategies to unfamiliarity with research-based instructional strategies (Williams & Coles, 2007). On a similar survey item, teachers felt strongly that all K-12 teachers should know how to implement brain-based learning strategies.

The overall results on the Belief Scale items indicate that teachers' have positive attitudes towards the learning process. This is important because teachers' beliefs on learning are one of the most influential factors that impact student performance and achievement (Hong & Milgram, 2008; Rosenfeld & Rosenfeld, 2008; Thoonen et al., 2011).   When teachers have a positive attitude towards learning, they have more engaged and motivated learners (Bogner, Raphael, & Pressley, 2002; Dolezal, Welsh, Pressley, & Vincent, 2003).

Research Question 3. The third research question looked at teachers reported usage of brain-based learning strategies in their classrooms. The average mean score on the Practice Scale of 33.2 out of 45, or 74%, reflects that teachers report implementing brain-based learning strategies in their classroom at a moderately high rate. 84.7% indicated that they are willing to change their teaching style at least sometimes. Furthermore, 84.1% reported that they use new and updated information in all of their classes at least sometimes. These results support the research that suggests teachers are willing to try new approaches that they see as being effective with students (Denton, 2010; Shaywitz, 2003).

Research Question 4. Research question 4 looked at the relationship between teachers' level of knowledge of brain-based learning with their beliefs about brain-based learning. It has been suggested that teachers' beliefs about learning often match their instructional practices (Artzt, & Armour-Thomas, 1999; Tsai, 2006). Furthermore, adding research-based knowledge to these beliefs can lead to improvements in the classroom environment and ultimately the learning process (Denton, 2010; Richards & Skolits, 2009). In addition, teachers' personal beliefs have been found to greatly impact the learning environment of the classroom, as well as, creative thinking opportunities for students (Hong et al., 2009).

This study found that there was a strong positive correlation ($r = .57$, $p < .001$) between teachers' knowledge of brain-based learning and their beliefs about these strategies. This suggests that teachers' knowledge of the learning process may be directly related to their beliefs. Furthermore, there was also a strong positive correlation between the teachers' beliefs and their practices. This strong positive correlation ($r = .60$, $p < .001$) suggests that teachers' beliefs about learning may impact their classroom practices, which supports the research (Artzt, & Armour-Thomas, 1999; Denton, 2010; Hong et al., 2009; Richards & Skolits, 2009; Tsai, 2006). .

Research Question 5. The last research question looked at the relationship between teachers' demographic characteristics and their scores on the three scales. The different demographic areas that were focused on included the teachers' gender, how many years they have been teaching, and what grade level they taught.

In regards to gender, the results indicate that there were significant relationships between gender and the mean scores on all of the three survey scales. These results indicate that females reported having more knowledge, stronger beliefs, and implementing more practices than males. Furthermore, a similar study (Klinek, 2009) that looked at gender differences of knowledge, beliefs, and practices of higher education faculty also found females to have significantly higher results in all three areas. These similar results reflect the research that suggest males and females process information and approach problem solving differently (Jenson, 2000; Kimura, 2004). When comparing the sample size of this study for gender, it was noted that there were nearly three times as many female (72.7%) respondents than males (27.3%); which is reflective of the national averages for male (24%) and female (76%) teachers (Keigher, 2010).

When comparing years of teaching experience with the three scale scores, there were no significant correlations found at any level. These results suggest that years of teaching is not a significant factor for teachers' understanding, beliefs, or practices of brain-based learning strategies. Again, in comparing a similar study conducted by Klinek (2009) that looked at years of teaching experience of college-level instructors with their knowledge, beliefs, and practices also found no strong relationship between any of the scale scores and years of teaching.

The last part of research question five looked at the instructional level of the teachers and their scale scores. The results indicate a strong relationship between instructional level and the scale scores. For example, the K-12 teachers had the highest mean scores on all three scales when compared to the other three grade level categories. In regards to the significance of the K-12 teachers' scores, there was a significantly higher mean score between the Middle level teachers (mean difference = 4.67, $p < .05$) on the Belief Scale. The K-12 teachers also had significantly higher ($p < .05$) mean scores over the secondary teachers on all three of the scale scores; including higher mean differences on the Knowledge (3.46), Belief (4.23), and Practice (3.09) Scales. One assumption that could be made to support these findings is that in order for K-12 teachers to be successful instructing such a wide range of grade levels, they may have a better appreciation for the different learning styles, which is a major component of Brain-Based Learning (Jensen, 2008).

Another noteworthy observation was when looking at the secondary teachers' mean scale scores. They scored the lowest out of all four teaching levels on all three of the scale scores. For instance, the elementary teachers had significantly higher ($p <.05$) mean differences than the secondary teachers on all three of the scale scores. Lastly, the middle level teachers had a significantly higher ($p <.05$) mean difference on the Practice Scale (2.11), as compared to the secondary teachers.

The secondary teachers' low scores could be attributed to several reasons. One reason is that secondary teachers have the most pressure to improve achievement scores (Thornburg & Mungai, 2011). This often leads to constant school reform and increased resistance from secondary teachers to explore new teaching strategies (Brown & Nagel, 2004), such as Brain-Based Learning.

This idea that secondary teachers are more resistant to school reform is further supported by the responses that were generated on certain items on the survey questionnaire. For example, the secondary teachers in this study agreed the most with the item suggesting that "brain-based learning is a fad in education which will pass as many other so-called 'reforms' have done." The secondary teachers had significantly higher mean scores ($p < .05$) on that item when compared to the elementary and K-12 teachers. Furthermore, secondary teachers had significantly higher mean scores ($p <.05$) on the item "different learning approaches are a waste of time in a K-12 setting", when compared to the elementary, middle, and K-12 teachers. Again, these results support the idea that secondary teachers are more resistant to educational reform and different learning approaches (Brown & Nagel, 2004).

Another possible explanation for such low scores from the secondary teachers may be that secondary schools possess unique characteristics that are less common in elementary and middle schools; including larger school size, departmentalized teaching, and increased emphasis on formal evaluation (Bru et al., 2010). These traits have been found to make it more difficult for secondary teachers to form close connections with their students, and may lead them to focus less on learning strategies and more on classroom management (Eccles & Roeser, 1999). Further research is needed to determine if these beliefs are the result of increased pressure from teaching to high-stakes testing (Thornburg & Mungai, 2011) or other environmental factors.

Educational Implications

When teachers have knowledge of the learning process, they can deliver high quality instruction to students (Denton, 2010; Jenson, 2008). Understanding what teachers know and what their beliefs are about learning can help determine what type of training and support teachers may need to better address the learner. Teachers who are familiar with how the brain works (i.e. Brain-Based Learning Theory), are better equipped to provide teaching strategies that help students improve academic achievements (Denton, 2010; Shaywitz, 2003). Finding ways for teachers to better meet the needs of students is essential to improving education (Ratey, 2008).

There is much that can be done to help teachers improve their knowledge of the learning process. Professional development trainings can be effective for offering teachers intervention strategies to improve the classroom learning process (Denton, 2010; Shaywitz, 2003). For example, Denton (2010) found that the more teachers knew about learning and the brain, the more likely they were to implement effective teaching strategies. Furthermore, after utilizing intervention strategies gathered from the training sessions, teachers reported that their beliefs about teaching and learning improved significantly (Denton, 2010).

This study provided an overview of teachers' knowledge, beliefs, and practices of brain-based learning strategies. It was determined that the majority (56.6%) of teachers felt the need to be more adequately trained in the area of how the brain learns best. Additionally, only 16 (6.3%) out of the 226 teachers strongly agreed that they have sufficient understanding of how the brain learns. It was also determined that over half (61.8%) are willing to initiate brain-based learning if they knew more about it. This information is important when determining professional develop opportunities for teachers and looking for ways to improve the learning experience. Furthermore, over half (64.8%) of the teachers believe that it is important to demonstrate and show educators new ways of teaching. This may result in teachers being more confident in their ability to address different learning styles and help them utilize effective intervention strategies that improve student success as indicated in the research (Denton, 2010; Shaywitz, 2003).

Theoretical Implications

The results of this study support the theoretical framework discussed in Chapter 2 in multiple ways. For instance, the teachers responded to items in a way that supports Gardner's Multiple Intelligence, which is a major component of Brain-Based Learning

Theory. Furthermore, the teachers' responses on the survey support the use of positive peer group activities, incorporating movement into the classroom, and implement strategies to improve student focus and attention; all of which support the Brain-Based Learning Theory. This section reports the positive connection between the theoretical foundation and the results of the study.

Multiple Intelligence Theory believes that students should be taught to their specific modes of learning, and that teachers should be aware of their teaching styles and should have an understanding of the different learning styles found in the classroom (Gardner, 1983). This study found that 81% of respondents believe it is important to practice various learning strategies while teaching. Furthermore, the majority (67%) of teachers in this study believe it is important to take an inventory or scale to determine what their dominant teaching style is. Likewise, the majority (64%) of teachers in this study believe it is important to give an inventory or scale to their students to determine what their learning styles are. Moreover, the participants (76.2%) also support to some degree real-life, immersion-style, multi-path learning over traditional learning.

Evident by the responses in this study, the participants appear to value the importance of having student attention and focus in order for learning to occur. For instance, the participants (87%) rated focus and attention as the main reason that they use or teach learning readiness skills. Furthermore, the teachers (75%) in this study rated strategies for focus and attention as the most beneficial activity for student learning. These results support the work of Bandura (1977), in that the teachers recognize the importance of having student attention in order for learning to occur. The teachers' responses also support the work of Renate and Geoffrey Caine (1994), in that they believe that learning involves focused attention, which is one of the 12 Brain/Mind Learning Principles that the Caines' have developed.

To further support the theoretical framework of this the study, the participants ranked physical movement as an important factor to learning, which is a cornerstone to the Brain-Based Learning Theory (Jenson, 2008). Most of the participants (76.5%) reported using or encouraging some form of movement in their classroom to help students learn. Furthermore, they (71%) reported that they incorporate art, manipulatives, visuals, and music in my lessons. These findings support the belief that students perform well when teachers incorporate movement into classroom lessons (Mahar et al., 2006; Ratey, 2008).

Recommendations for Practice

How teachers engage their students greatly impacts learning outcomes. When teachers are aware of different learning styles, and address those differences, students will be more engaged in learning (Gardener, 1983). Teachers need to have knowledge of effective teaching strategies in order to be able to implement them. For example, this study determined that nearly every teacher (216 out of 226) believed that the purpose of the classroom was to provide a supportive, challenging, and complex environment for their students. However, the majority (78.5%) of teachers admitted that they would be more willing to initiate various learning strategies if there were more time to do so. It is recommended from these results that teachers receive training and support on how to incorporate effective learning strategies in a way that minimizes time constraints as an issue. If teachers' believe that utilizing different learning strategies takes too much time, than they will be less likely to incorporate new strategies (Rosenfeld & Rosenfeld, 2008).

However, when teachers are instructed on effective teaching strategies that results in improved student engagement, their beliefs about those different learning strategies improves (Denton, 2010).

With advances in neuroscience, it is widely received that movement can improve the brains' efficiency to learn. Research has shown that incorporating physical activity into the school day can help improve student achievement (Mahar et al., 2006), as well as, on-task behaviors (Hannaford, 2005). This study found that most teachers (87%) view student focus and attention as the most important factor to learning, and most (75%) believe that movement activities work best as strategies for improving those factors. These results indicate that teachers view movement as being beneficial to student learning; and those teachers understand the importance that student attention and focus has on learning. Moreover, 76.5% of the teachers reported that they at least occasionally use or encourage some form of movement to help with focus, attention, or learning readiness in their classrooms.

Though these results present a positive image of the teaching practices of the participants, there is an apparent need for further training on teaching strategies. For instance, over half (54.6%) of the teachers agreed that they need to be more adequately trained in relaxation, movement, and crossing the midline activities to enhance learning. Furthermore, over half (55%) teachers reported that they have rarely or never attended workshops or trainings that dealt with relaxation, movement, or crossing the midline activities. It is recommended that teachers be provided with different approaches and techniques for incorporating physical activity movements as learning readiness skills that can assist in student focus and attention. As indicated by this study, teachers believe that these practices are important to learning, which suggests that they are more willing to incorporate new techniques as represented in the research (Denton, 2010; Tsai, 2006).

In order for teachers to take into account the complex learning differences between students they need to address the different learning styles found within today's classrooms. This study determined that teachers (82.4%) believe that how a student learns plays an important role in the learning process. Furthermore, teachers (64%) reported that it is important to give students an inventory or scale to determine their learning style. Teachers (67%) also reported that it is important for them to take an inventory or scale to determine their dominant teaching style. It is recommended that teachers receive training on effective instructional practices that meet the diverse learning needs of the students. It is also recommended that teachers receive tools to use to assess their teaching strategies and ways to interpret the results in a way that improvements in those strategies are applicable and make sense to the teachers. It is important for teachers to have support for implementing new strategies and techniques; as this is a strong indicator for determining if a teacher will use a new technique or not (Williams, & Coles, 2007).

It was also determined that there were strong relationships between what grade level the participants taught and their reported knowledge, beliefs, and practices of brain-based learning. For instance, the K-12 teachers scored the highest on all three of the survey scales. Though there were only 15 (5.9%) K-12 participants, there were several significant mean differences, as indicated in Table 23 in Chapter 4. It was also determined that the secondary teachers scored the lowest on all three survey scales when compared to the other three grade levels. These results may indicate that there are differences on what teachers know, believe, and practice in relation to the grade level that they teach. Further research is needed to determine why significant differences exist between the different teaching levels and their knowledge, beliefs, and practices of brain-based learning.

Recommendations for Future Research

The current study generated interesting findings around teachers' beliefs on learning and their teaching practices. Results from participants found that 43% believe that they already do brain-based learning in their classroom. Furthermore, 61.8% reported that they would be more willing to initiate brain-based learning if they knew more about it. It would be interesting to see if the teachers who reported using brain-based learning strategies would also report having higher student engagement, less classroom management issues, and higher student performance; all of which are results from implementing brain-based learning strategies in the classroom (Kirkcaldy, Shephard, & Siefen, 2002; Mahar et al., 2006; Tantillo et al., 2002).

In regards to demographic information, several interesting results were found. For instance, female teachers scored significantly higher on all three of the survey scales when compared to males. Though females reported having more knowledge, stronger beliefs, and implementing more practices than males, further research is needed to determine factors that attribute to these results.

When looking at the grade level that teachers taught, several trends were found. The K-12 teachers had significantly higher results on all three scales when compared to the other three teaching categories. Furthermore, the secondary teachers had the lowest scores on all three scales, including certain items that reflect on those scores. Secondary teachers had the strongest beliefs that a) brain-based learning is a fad, b) that different learning approaches are a waste of time in the K-12 setting, and c) that what they teach is more important than how students will learn best. They also scored the lowest when rating a) the purpose of my classroom is to create a supportive, challenging, and a complex environment where questions are encouraged, b) I would be more willing to initiate brain-based learning if I knew more about it, and c) I believe I already utilize brain-based learning in my classroom. Further research could answer why there is such a discrepancy between teachers' grade level and their views on learning and teaching. More specifically, why the secondary teachers are so resistant to educational reform and have such negative beliefs towards the teaching process. Further research may also look at what characteristics are found in teachers who instruct at all grade levels (K-12) that lead to having more knowledge, stronger positive beliefs, and using more effective teaching strategies than any other grade level (elementary, middle, and secondary). Characteristics that should be explored should include K-12 teacher education program curricula, personality traits of these specific teachers, and the impact that teaching such a wide spectrum of grade levels has on K-12 certified teachers' instructional beliefs and practices.

Conclusions

Improving the student learning experience starts with implementing effective teaching strategies (Hong & Milgram, 2008). Providing trainings for teachers on the learning process and on ways to implement effective teaching strategies is crucial. Past research suggests that teachers do not utilize effective teaching strategies because they are unfamiliar with these strategies, lack training for implementing them, and lack support when trying to implement new strategies (Carnine, 1997; Huberman & Miles, 1984; Williams, & Coles, 2007). This study lends support to the belief that teachers are interested in new instructional strategies and that they are willing to incorporate new strategies. These conclusions were made from the following results of this study which suggest teachers:

1. Would be willing to initiate brain-based learning if they knew more about it (75.4%).
2. Are willing to change their current teaching style (75.4%).
3. Believe all teachers should know how to implement brain- based learning (76.2%).
4. Report the need to be more adequately trained in the area of how the brain learns best (52%).
5. Believe it is important to demonstrate and show educators new ways of teaching (79.4%).

If teachers believe a new strategy is too difficult to implement, they are less likely to attempt it (Williams, & Coles, 2007). However, if a teacher experiences success from using a new teaching strategy, they are more willing to continue implementing that strategy (Shaywitz, 2003).

The conclusions drawn from this study provide a positive view on teachers' knowledge, beliefs, and practices of brain-based learning. Though some of the items generated lower than anticipated scores, the overall results indicate that teachers are interested in how students learn best. This interest in seeking effective teaching strategies should be met with support and encouragement from school administrators. Teachers should be experts on the brain (Jenson, 2005), and be trained as such. When effective teaching strategies are used, students are being taught to their preferred learning styles, teachers are confident in their methods and abilities, and the overall school climate is improved.

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APPENDICES

Appendix A

Brain-Based Learning Survey Questionnaire (BBLSQ)

1. What is your gender?	____Male ____Female
2. What is your age?	____ younger than 30 ____ 30-39 ____ 40-49 ____ 50-59 ____ 60 or older
3. Are you a current public school teacher? (Not on any type of leave, including; medical, personal, educational, disciplinary, sabbatical, etc…)	____ Yes ____ No
If you answered No, to Question #3, please stop and do not continue 4. How many years have you been teaching full-time?	____ Less than 5 ____ 5-10 ____ 11-15 ____ 16-20 ____ More than 20 years
5. What grade level do you primarily teach?	____ Elementary (K-5) ____ Middle Grades (6-8) ____ High School (9- 12)

	____ K-12

Please read the following definitions before completing the questions which follow: Brain-Based Learning is a learning approach that is more aligned with how the brain naturally learns best. Brain-Based Learning is a way of thinking about the learning process. It is learning with the brain in mind. Brain-Based Learning is providing for differences in learning. Encouraging students to learn with music, mind maps, role plays, journals, model building, movement, community projects, theater, art, etc. (Jensen, 2000). Brain Gym is a series of twenty-six simple movements to enhance the experience of whole-brain learning (Dennison & Dennison, 1989). Indicators of Brain Gym are relaxation techniques, cross lateral movements, stretching techniques, and drinking plenty of water.
Please indicate **1-Strongly Disagree** **2-Disagree** **3-Neither Agree or Disagree** **4-Agree** **5-Strongly Agree** **(Knowledge of Brain-Based Learning)**
6. I have sufficient understanding of how the brain learns.
7. I am comfortable with the use of various learning strategies as part of my classroom

teaching.
8. I am knowledgeable about the use of providing frequent, non-judgmental feedback as a useful tool.
9. I feel the need to be more adequately trained in the area of how the brain learns best.
10. When evaluating students, I evaluate in a way that accounts for the fact that students learn differently.
Please indicate **Never** **Rarely** **Occasionally** **Often** **Always**
11. I pre-expose my students to content & context of a topic at least one week before introducing it.
12. I have attended worthwhile workshops or conferences which dealt with the topic of how students learn.
13. I have sought the advice of colleagues concerning the implementation of a certain type of learning strategy**.**
14. I support the use of real-life, immersion-style multi-path learning over traditional learning in my classroom.
15. Our District has encouraged workshops, conferences, or in-service trainings on the topic of the newest strategies in classroom teaching.

Please indicate **1-Strongly Disagree** **2-Disagree** **3-Neither Agree or Disagree** **4-Agree** **5-Strongly Agree**
16. Different learning approaches are a waste of time in the K-12 setting.
17. The purpose in my classroom is to create a supportive, challenging, and complex environment where questions are encouraged.
18. I view how students will learn best, more important than, what I should teach.
19. I feel that how one learns, plays an important role in classroom learning.
20. I would be more willing to initiate various learning strategies if there were more time to do so.
21. Brain-based learning is a fad in education which will pass as many other so-called "reforms" have done.
22. I believe I already do brain-based learning in my classroom.
23.I would be more willing to initiate brain-based learning if I knew more about it.
24. Brain-based learning is a very positive way to learn.
25. I feel all K-12 teachers should know how to implement brain- based learning.
Please indicate **1-Strongly Disagree** **2-Disagree** **3-Neither Agree or Disagree** **4-Agree**

5-Strongly Agree **(Practices of Brain-Based Learning)**
26. It is not important to practice various learning strategies in my classroom.
27. I should teach all my students the meaning and purpose of various styles of learning.
28. I have been successful; therefore I will not change my teaching strategy.
Please indicate **1-Never** **Rarely** **Occasionally** **Often** **5-Always**
29. I am willing to change my teaching style.
30. I utilize some form of brain-based learning strategy (e.g. students: drawings, charts, lists, dialogues, actions, demonstrations, debates, or maps) on a weekly basis.
31. I use new and updated information in all my education classes.
32. It is important to demonstrate and show educators new ways of teaching.
33. I use the newest technology in my classroom
34. I currently attend educational conferences and workshops about the latest trends in education.
Please indicate **1-Strongly Disagree** **2-Disagree** **3-Neither Agree or Disagree** **4-Agree** **5-Strongly Agree**

35. I feel the need to be more adequately trained in relaxation, movement, and crossing the midline activities and strategies to enhance learning.
36. I view movement, relaxation, and cross lateral stretching a valid form of Readiness for learning.
37. I feel that movement, relaxation, and cross lateral stretching should play an important role in classroom learning.
38. I feel that drinking water is a very important aspect that enhances learning.
39. I use or encourage some form of movement in my classroom to help with focus, attention, or learning readiness.
40. I encourage my students to use some form of cross lateral movements or Crossing the midline for concentration or thinking skills.
41. I have attended workshops or in-services which dealt with the topic of Relaxation, movement, and crossing the midline activities and strategies for my classroom to enhance learning.
Please check all that apply
42. What would you use or teach learning readiness skills for? ____ focus/attention ____ academics ____ relax/calm ____ readiness ____ creative thinking

43. What specific movement or activity do you feel most benefits student learning? (Please choose at least one answer) ____ Relaxation Techniques ____ Cross Lateral Movements ____ Water Breaks ____ Stretching Techniques ____ Strategies for Focus & Attention ____ Other (Please specify)______________________________
Please answer by filling in response
44. Have you ever heard of brain gym? ____ Yes ____ No If yes, please specify?
45. Have you ever taken courses, workshops, or in-service training about Brain Gym? If yes, please specify?
Please indicate **1-Strongly Disagree** **2-Disagree** **3-Neither Agree or Disagree** **4-Agree** **5-Strongly Agree**
46. Please indicate your level of agreement with the following statement: (Teaching

Style) – It is important to take an inventory or scale to determine what my teaching style is (e.g., right-brained, left-brained, middle-brained).
47. Please indicate your level of agreement with the following statement: (Teaching Style) - It is important to give an inventory or scale to all my students to determine what their learning style is (e.g., right-brained, left-brained, middle-brained).
48. Please indicate your level of agreement with the following statement: (Teaching Style) – I believe that both the left and right hemispheres of the brain need to be activated to enhance learning.
Please check all that apply
49. Which of the following best describes you? (Check all that apply) ______ I like to lecture. ______ I expect my students to listen quietly and take notes. ______ I need to have order in my day ______ I follow a precise schedule ______ I like using structured lessons. ______ I prefer giving assignments and activities such as research papers, debates, and book reports that are written. ______ I get annoyed when others are late.
50. Which of the following best describes you? (Check all that apply) ______ I like hands-on projects.

_______ I see the whole picture first. ______ I incorporate art, manipulatives, visuals, and music in my lessons. _______ I prefer a busy, active and noisy classroom environment.

Appendix B

Letter to Superintendents for Permission to Conduct Study

IUP E-mail

Dear Superintendent:

I am writing this letter to introduce you to a study that I will be conducting as part of the completion of my doctoral dissertation through Indiana University of Pennsylvania. I will be conducting a research study that will identify K-12 teachers' knowledge, beliefs, and practices of brain-based learning in their classrooms.

Their knowledge, beliefs, and practices will be determined by utilizing an internet survey that has been developed and hopefully will be completed by professionals in the field.

I am writing you to specifically request participation in my study. Study approval will be granted through Indiana University of Pennsylvania's Institutional Review Board.

Participants will only be contacted via email, with a maximum of 3 e-mails being sent. All e-mail addresses will be destroyed at the completion of the research study. Your confidentiality will be protected.

Results will be made available to your district for agreeing to participate. I feel that this information can be helpful when making decisions around curricular changes, as well as, choosing professional develop topics.

Thank you very much for your time and consideration.

Please e-mail back your decision using the attached Voluntary Consent Form (on official school district letterhead).

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Appendix C

Letter to K-12 Public School Teachers

Dear Teaching Professional,

I am currently working on my doctoral degree and I would appreciate your precious time and effort in assisting me in my study of brain-based learning. This study is in partial fulfillment of completion of my doctoral dissertation research which I am conducting through Indiana University of Pennsylvania.
Each participant will have the opportunity to be entered in a drawing for a chance to win a Kindle Fire.

This study will focus on the knowledge, perceptions, and practices related to brain-based learning in the classroom. I will use a survey that I would like you to complete about brain-based learning. The survey will take approximately 10 minutes to complete. Your participation in this survey will contribute to our knowledge of brain-based learning in the classroom.

Your participation in this study is completely voluntary. You are free to decide not to participate in this study. You may also withdraw at any time by simply closing your browser. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, all information will be collected anonymously and will have no bearing on your academic standing or services you receive from your District. Your responses will be considered only in combination with those from other participants. The information obtained in the study may be published in educational journals or presented at conferences. This project has been approved by the Indiana University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (Phone: 724/357-7730).

If you are a current public school teacher, and would like to participate in the study, please click on the following link:

https://iup.qualtrics.com/SE/?SID=SV_1Y2oQbDmluepfgM

Thank you very much for your time and consideration. To obtain more information about this project, please use the contact information below.

Sincerely,

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