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Whole Brain Teaching in a Second Grade Classroom

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Abstract

This study addresses the topic of whole brain teaching (WBT). The researcher sought to understand if WBT changed student achievement or student attitudes about math. The researcher also sought to understand students' perceptions of WBT. The main purpose of this study was for the author to understand if WBT would help students better engage in and understand mathematics. The author collected data through student surveys, teacher and student interviews, personal research journals, and math assessment scores. The researcher used the constant comparative method to analyze the participants' perceptions of WBT during mathematics instruction. Descriptive statistics were used to understand if WBT affected academic achievement. The data indicated that there were several misconceptions about WBT, but that the perceptions were overall positive. The research also found that WBT does in-fact change student attitudes about and achievement in math. This information may help teachers effectively implement WBT strategies into their own classrooms.

Whole Brain Teaching in a Second Grade Classroom

In the classroom there is a moderate level of noise. Students are sitting on the carpet, but they are talking and gesturing to one another. If an outsider were to peek into the classroom, he or she would see students excitedly talking with one another, fully engaged in conversations. Listen closer and the outsider would soon discover that the students are not only talking, but they are teaching one another how to solve a double-digit subtraction problem. The teacher then calls out "class, class," and the students respond with "yes, yes." All eyes are on the teacher as she asks, "Alright who would like to share? How did you teach your partner how to solve this problem?" Little hands shoot excitedly into the air, ready to share, eager to participate, and excited to communicate what they have learned.

Students in schools today are frequently stimulated in their environments at home and school. This consistent stimulation is due to a variety of factors in students' environments such as planned activities, technology, and other forms of entertainment (Aziz-Ur-Rehman, Malik, Hussain, Iqbal, & Rauf, 2012). These factors have led to an increase in students' need for continued activity. As this need for activity and stimulation has increased, students' ability to sit still, be quiet, or focus in on one lesson has dwindled to almost nothing. As a result of these factors, students often do not respond to conventional teaching and learning (Aziz-Ur-Rehman et al., 2012). Conventional teaching methods typically involve passive students whose only goal is to gain knowledge of a subject and then recite that knowledge back to the educator (Aziz-Ur-Rehman et al., 2012). It is important that students are actively involved in their learning, and many brain-based strategies provide educators with a way to engage students more fully in the learning process (Ozden & Gultekin, 2008). In response to conventional teaching and learning, a new teaching strategy called Whole Brain Teaching (WBT) has emerged in many schools around

the country with the purpose of more fully engaging students in the classroom (Biffle, 2013).

Purpose

This study was conducted at Smith Elementary (all names are pseudonyms), a Title 1 school, located in Archer, Texas, home to approximately 120,000 people. The school is one of fourteen elementary schools in the Archer Independent School District. Ten of the fourteen elementary schools in this school district, as per the U.S. Department of Education, are Title 1 schools. Smith serves around 550 students in grades kindergarten through fifth. The student body of Smith Elementary is represented by 48% Hispanic, 33% White, 14% African American, 1% Asian, 0.5% American Indian, 0.5% Pacific Islander, and 3% two or more races. About 77% of the Smith Elementary population is classified as economically disadvantaged, 5% are English Language Learners, and 11% are identified as special education students. The school has a mobility rate of 19%. The average class size ranges between 17 and 24 students. At the time of this study, I was a clinical teacher and teacher researcher in a second-grade classroom at Smith Elementary school as a part of a yearlong internship for the master's program at my university.

The purpose of this study was to explore what happened when whole brain teaching practices were incorporated into a second-grade classroom. This study sought to understand how WBT affected student achievement in math and how whole brain teaching changed student attitudes in regard to math. The study also sought to understand students' perceptions of WBT. Specifically, this study aimed to answer the following questions:

- What happens when whole brain teaching is implemented in a second-grade classroom during math instruction?
    - Sub-question: How does the practice of whole brain teaching change overall student achievement in math?

- Sub-question: How do students' attitudes toward math change when whole brain teaching practices are implemented?
- Sub-Question: What are students' perceptions of whole brain teaching? How do they feel about the strategies used in whole brain teaching? Why?

The main research question pertained to the potential benefits of implementing WBT during mathematics instruction. The sub-questions looked to address specific areas of achievement, attitudes about math, and perceptions of WBT. This study mainly sought to develop an understanding of how the use of WBT would help students to better engage in and understand mathematics instruction. Prior to this study, WBT was not a part of our everyday mathematics instruction. In order to answer these research questions, February 4, 2019, I implemented the whole brain teaching strategies into our math instruction. Each day these strategies were used during math instruction (8:00-9:15 a.m.) until the research period ended on March 1, 2019.

Literature Review

Whole Brain Teaching is a grassroots education reform movement started in 1999 by three teachers: Chris Biffle, Jay Vanderfin, and Chris Rekstad (Biffle, 2013). It is a strategy that was created by teachers in response to the conventional way of teaching and learning that was often very passive and inactive for students (Aziz-Ur-Rehman et al., 2012). The strategy of WBT engages students through the use of seven teaching techniques (the big seven), designed with the purpose of improving classroom management and student involvement (Biffle, 2013). The seven teaching techniques include the following: class-yes, the five classroom rules, teach-okay, the scoreboard, hands and eyes, switch, and mirror (Handayani, 2017). Biffle (2013) quickly discovered, through the use of those seven strategies, WBT was successful because it more fully engaged his students. With the help of several other educators, Biffle (2013) found that when

students were “emotionally involved in lessons that required seeing, saying hearing, and physically moving… in a remarkable number of cases, our challenging kids couldn’t be challenging because their entire brains were too busy learning” (Biffle, 2013, p. 8).

Several studies have examined the implementation of WBT and its effect on student engagement in the classroom. Torio and Cabrillas-Torio (2016), in their study on using WBT in the Philippines, found that WBT increased students’ motivation to learn physics. The students in the study were more motivated to learn the concepts presented by the teacher because they were more engaged in the lessons that were taught. The authors further explained that this model of WBT, “promotes a classroom environment conducive to class participation” (Torio & Cabrillas-Torio, 2016, p. 67). Silverstein (2013), whose study examined the experiences of teachers using WBT, found that teachers described their lessons as “more engaging” and that this strategy allowed them to quickly evaluate if their students understood the concept or not. Finding similar results, Sontillano (2018) explained when encountering WBT in the classroom students become focused for the duration of the lesson.

Academic achievement, like student engagement, is another theme present in the research. In several studies that looked at the use of brain-based strategies (WBT being a type of brain based learning), researchers saw an increase in the academic achievement of students (Aziz-Ur-Rehman et al., 2012; Hord et al., 2016; Ozden & Gultekin, 2008). In a study conducted by Aziz-Ur-Rehman, Malik, Hussain, Iqubal, and Rauf (2012), the researchers found that the experimental group of students performed much better academically than the students in the control group. Sontillano (2018), whose study dealt with implementing WBT specifically, found that WBT can increase students’ achievement in algebra. The author further explained that this increase in achievement could be due to the fact that multiple areas of the brain are activated

when WBT techniques are used throughout the lesson (Sontillano, 2018).

The themes of engagement and achievement found in many studies can be attributed to the fact that WBT is rooted in brain research. When students are involved in WBT lessons, their brains become engaged in multiple ways. According to Biffle (2013), brain and learning research have shown that when students teach one another they not only use multiple areas of their brain, but they also learn the information better. Through specific interactive lessons, students are able to activate five different areas of their brains: the "visual cortex (seeing gestures), motor cortex (making gestures), Broca's area (verbalizing a lesson), Wernicke's area (hearing a lesson), and the limbic system (giving emotional content to a lesson)" (Biffle, 2013, pp. 22–23). Another area of brain research that is a key factor in the success of WBT is what neuroscientists call "mirror neurons." Mirror neurons are networks that can be found in the premotor area of the brain (Sprenger, 2008). These neurons are so important because when we watch someone else perform a task or do something, the mirror neurons fire in the same way that they would fire if we were doing the action ourselves (Sprenger, 2008). According to Sprenger (2008), when a child watches an adult perform a task, then networks in the brain begin firing. Since a big part of WBT is the students mirroring the teacher's words and gestures, students are able to activate those neurons in their brain, allowing them to retain the information better than if they learned the information through traditional teaching methods.

Whole brain teaching is not only rooted in brain research, it is also rooted in Vygotsky's Social Learning Theory. Vygotsky believed that social interaction is a vital part of the learning and development of children (Tompkins, 2014). The two basic parts of Social Learning Theory include - the more knowledgeable other (MKO) and the zone of proximal development (ZPD). The MKO is a person, usually a teacher or professor, who contains a higher level of education or

knowledge than the person being taught (Biffle, 2013). The ZPD is the zone, or space between, a students' ability to learn content/solve a problem with help and his or her ability independent of assistance (Vygotsky, 1978). The ZPD represents the optimal time for instruction to occur (Vygotsky, 1978). These two aspects of Vygotsky's theory tie directly into the strategy of WBT. In the Teach-Okay model of WBT one student teaches another student what they have just learned from the educator (Biffle, 2013). Teachers in essence are training their students to become MKO's, and the MKO with the use of WBT strategies create "peer-based learning in which the zone of proximal development gap can be closed" (Biffle, 2013, p. 180). By training students to be the MKO the students are able to become more responsible and take ownership of their learning as they teach the concepts to one another (Biffle, 2013).

The topic of whole brain teaching is still relatively new in the education world. As a result, the research available is mostly geared toward brain-based learning and not WBT specifically. The other research available, even if it deals with WBT, is found in countries other than the U.S. or they deal with teacher perceptions of WBT. The purpose of this study is to look at what happens when whole brain teaching is incorporated into a second-grade classroom during math instruction. The research will explore if WBT changes students' perceptions or achievement in math. This study will add to the current body of research because few studies have examined the use of WBT strategies in an elementary classroom from the United States. More research on this topic is warranted to see if this strategy is a valuable one to use in the classroom.

Methods

This was a mixed-methods action research study. Data was collected from surveys, individual interviews, daily journals, and math assessment scores. This study was conducted in

one second grade classroom at Smith Elementary School. There were 18 students in this second-grade class. There were seven girls and eleven boys. The class demographic was composed of seven Hispanic students, six African American Students, and four Caucasian students. Two students were completing their second year of second grade. Four students were pulled daily for extra reading instruction as per their response to intervention (RTI). Two students were pulled out twice a week for speech interventions as per their individualized education program (IEP). Six students were pulled out daily from reading and math for small group instruction as per their IEP. One student who did not get pulled out, but needed small group interventions and instruction, was pulled aside during independent work and was assisted by the teacher as per his IEP for math, reading, science, and social studies. Two of the students were English Language Learners.

Participant Selection

The participants of this study included a single classroom of second-grade students and one classroom teacher. An informational letter and an attached consent form were sent home to the parents or guardians of every student in the class. The students who received parent permission to participate in the study completed an assent form while at school. An informational letter and an attached consent form were also provided to the mentor teacher. I provided a copy of my consent letters for each of the participants to keep.

Of the eighteen students in the class, seventeen students received parent permission and assented to the study. These seventeen students were given the math attitude survey. I chose a sample of students to interview based on their responses to the math attitudes survey. I selected two students who indicated that they really liked math, two students who said they don’t like math, and two students who had neutral feelings towards math to participate in the interviews.

This method of intentionally selecting interviewees is described by (Patton, 2002) as purposive sampling, which is a method of selecting participants who will best contribute to the achievement of the research objectives. My interviews were conducted one-on-one with the six students and one classroom teacher.

Data Collection

Data collection occurred over four weeks in February of 2019. Seventeen students who received consent and assented to participate in the study were given a math attitudes survey. The survey was given once prior to the implementation of WBT (pre-survey), and the survey was also given once at the end of the research period (post-survey). This survey consisted of twelve questions relating to students' attitudes in regard to math. Students responded to nine of the questions using a Likert scale. Three of the survey questions were open-ended.

Students' perceptions of WBT and math were assessed through one-on-one interviews that lasted approximately 10-15 minutes with each of the six students. I also conducted one fifteen-minute interview with my cooperating teacher to gain the teacher's perspective on integrating WBT into mathematics instruction. The interviews were semi-structured, meaning that open-ended questions were asked and the participants had the freedom to discuss related issues they found important (Hendricks, 2017).

Furthermore, students' responses to WBT were assessed through the use of the daily journal entries I made throughout the course of the study. During these journals I focused on student engagement, feelings about math/WBT, and interesting things that occurred when WBT was in session. The students were also assessed at the end of each week. These assessments were specific to the content that was taught each week, and reflected what the students had learned. The math assessment scores from four weeks prior to the implementation of WBT and the math

assessment scores from the four weeks during the implementation of WBT were collected.

Data Analysis

Data was analyzed using the constant comparative method, with initial coding followed by creating hierarchies of categories and supporting codes (Hubbard & Power, 2003). The constant comparative method allowed me to uncover themes that emerged within my data. To further analyze these themes, I initially coded the first twenty percent of my data using level 1 codes. This allowed me to develop a list of fifteen to twenty main codes that I then used to code the remainder of my data (Tracy, 2013). These level 1 codes were categories or ideas that were commonly found among the data. From there, I created hierarchies and level 2 codes in order to better organize the data and identify major themes (Tracy, 2013). The level 2 codes were the major themes that underlined all the other codes. Utilizing these level 2 codes, I deepened my understanding of my data by reflecting on the codes and their significance in a series of short memos. In these memos, I worked to articulate and understand how the level 2 codes represented my findings and what they meant to my study. A codebook (see Appendix A) was utilized to further explain every code I used in the analysis of my data (Tracy, 2013). The themes that emerged from the coding of the data determined the additional data I collected. The quantitative data was analyzed using descriptive statistics. The data from the students' survey responses were put into two tables in order to see frequency counts in the data (Hendricks, 2017). A bar graph of the math test scores was also created in order to better compare the results from before and after whole brain teaching was implemented into the classroom (Hendricks, 2017).

Findings

The findings are organized based on the major themes that emerged from the data: perceptions of whole brain teaching and its strategies, attitudes about math, student achievement

in math, and whole brain teaching helps learning. First, I discuss the perceptions students and one teacher in a second-grade class had in relation to whole brain teaching and its strategies. Second, I discuss students' attitudes about math and how they changed after the implementation of whole brain teaching. Third, I explain how overall student achievement in math changed after whole brain teaching practices were used during mathematics instruction. Fourth, I highlight how whole brain teaching has helped students' learning.

Perceptions of Whole Brain Teaching and its Strategies

As soon as I began collecting data it became clear to me that my participants shared common positive perceptions about whole brain teaching and its strategies. A common belief shared in all six of my student interviews was that they liked whole brain teaching because it was more fun than regular teaching. Many of the students stated that whole brain teaching was "fun," it helped them to "learn new things," and that they liked having a chance to "talk to each other" during the lesson. Golly expressed her view on whole brain teaching after class one day. She told me that she believed, "whole brain teaching, it's funner. It helps me to learn better sometimes, but sometimes it's easier, sometimes it's the same, and sometimes it's harder. But it's definitely funner!"

It is interesting to note that students perceived whole brain teaching to be more fun than regular teaching; however, when the students were questioned further about whole brain teaching many of them had misconceptions about what it meant to use whole brain teaching in the classroom. Several of the students interviewed thought that whole brain teaching and math were the same thing. In my interview with Terry, I asked him to tell me about whole brain teaching. Terry responded by saying that whole brain teaching, "well it really just like math… but kinda isn't… it's like adding and subtracting but it's a different symbol." When talking with Martin, he

said that whole brain teaching is when you use your background knowledge- "[It's when you] teach kids… what … what you already know… like your background knowledge."

Although several of the participants may have had misconceptions about what whole brain teaching was, when prompted, the students were able to discuss the different whole brain teaching strategies and what they liked about them. In the whole brain teaching model designed by Biffle (2013), there are seven teaching strategies. For the purposes of this research study, I focused on implementing three of his strategies: teach-okay, hands and eyes, and mirror. When talking with my students about the whole brain teaching strategies their feelings were overwhelmingly positive. Several students said that they liked using the whole brain teaching strategies because the strategies helped them to understand the concepts better. Martin expressed this perception saying that he liked the teach-okay strategy because "other people tell you what it means so that can help you." Rosabell, Beth, and Golly expressed that they really liked being teachers, and it made them happy.

This was also a perception I noted in several of my journals throughout the implementation of whole brain teaching. In several journals I mentioned that the students seemed to really like whole brain teaching and the strategies we were using. In one of my reflections I wrote that "when using the whole brain teaching strategies, it just makes learning more fun because they are very interactive. I think that the students are really enjoying the opportunity to talk with one another in a more structured and intentional way."

Ms. Marks also held the belief that using whole brain teaching was enjoyable not only for the students but for the teacher as well. She commented several times that the students seemed to be more engaged in the lessons because they were enjoying them more than before whole brain teaching. In our interview she explained this feeling saying,

> I just… I think its more fun. It's more fun for the kids so when the kids are having more fun, I would just… instead of me saying… blah, blah, blah… its more fun to sing or clap it out or uhhhh… you know it would just be more fun for me too. And [the students] would probably get the concepts better. So that makes it easier on me, and not as much work when they get it quicker.

Many students believed that whole brain teaching was more fun and that they liked it better than regular instruction. Although some of the students held misconceptions about what whole brain teaching was, they were still aware that something in my instruction had changed and the "thing" that had changed (WBT) was more fun than regular teaching. Not only did students find whole brain teaching to be a positive experience, but my cooperating teacher and I also held positive perceptions about using WBT strategies during instruction. So, in answer to the question- what are students' perceptions of whole brain teaching and its strategies- I would say that they were positive.

Attitudes About Math

At the beginning of the year, before implementing whole brain teaching into math instruction, I noticed that several students held negative perceptions in regard to math. When it was time for math to start several students would take a long time coming to the carpet, other students would cause disruptions during lessons or hide their work in their desks, and a few students would even cry because they didn't want to do the work. I wondered if implementing whole brain teaching practices into math instruction would change students' attitudes about math. In order to gage how students were feeling about math, they were given a math attitude survey prior to the implementation of whole brain teaching and after the implementation of whole brain teaching. All seventeen participants were given the survey (see Appendix B). The

results of the pre-survey are shown in Table 1, and the results of the post-survey are shown in Table 2.

Table 1

Pre-Survey Results

Likert Scale Questions	I Love It 	I Like It 	Unsure 	Don't Like It 	I Hate It 
I like learning math.	35%	29%	12%	18%	6%
I get excited when the teacher says it's time for math to start.	12%	35%	29%	12%	12%
I like to come up with new ways to solve math problems.	35%	47%	6%	6%	6%
Learning new things in math is fun for me.	47%	18%	18%	6%	12%
I am good at math.	29%	35%	29%	6%	0%
During math I like it when my teacher calls on me to answer questions.	65%	24%	6%	6%	0%
Math is important.	59%	35%	6%	0%	0%
I use math almost every day.	29%	18%	29%	12%	12%
I always try my best in math.	71%	18%	6%	0%	6%

Table 2

Post-Survey Results

Likert Scale Questions	I Love It 	I Like It 	Unsure 	Don't Like It 	I Hate It 
I like learning math.	47%	18%	24%	6%	6%
I get excited when the teacher says it's time for math to start.	29%	24%	24%	12%	12%
I like to come up with new	59%	18%	12%	6%	6%

ways to solve math problems.					
Learning new things in math is fun for me.	47%	29%	6%	6%	12%
I am good at math.	41%	29%	24%	6%	0%
During math I like it when my teacher calls on me to answer questions.	82%	12%	0%	6%	0%
Math is important.	65%	24%	6%	0%	6%
I use math almost every day.	41%	29%	12%	6%	12%
I always try my best in math.	65%	18%	6%	6%	6%

In both Table 1 and Table 2 I highlighted the most frequently chosen answer choice for each question. Looking at the data I was able to quickly see that the majority of students felt more positively about math after doing whole brain teaching, than before its implementation. On the pre-survey there was a varying degree of answers for each of the questions, whereas on the post-survey "I love-it" was the most frequently chosen answer.

Not only did the students answer each of the questions in a more positive way on the post survey, but many of the students also had a more positive total score on the post-survey than on the pre-survey. In order to determine a change in attitudes about math, the answer choices on the Likert scale questions were given a numerical value from one to five. Five being the most positive answer choice and one being the most negative answer choice. The students' total scores were then determined by adding up the points they received for each question (love=5, like it=4, unsure=3, don't like it=2, and hate it=1). The highest possible score (most positive score) the students could have received was a 45. The lowest possible score (most negative score) the students could have received was a 9. The results are shown in Table 3.

Table 3

Positivity Scores

Student	Pre-Survey	Post-Survey
Rosabell	35	44
Beth	36	41
Jordan	37	29
Brittany	36	45
JJ	43	45
Sarah	31	40
George	30	41
Sam	31	32
Nelly	37	36
Charlie	37	37
Amy	30	33
Martin	37	39
Nathan	25	16
Terry	42	43
Golly	36	36
Josh	36	39
Paul	35	29

Looking at the results from Table 3, the highlighted scores indicate the students who answered more positively on the post-survey than on the pre-survey. Sixty-five percent of the participants scored more positively on the post-survey than on the pre-survey, indicating that students' attitudes about math do change when whole brain teaching is used in the classroom. Not only do their attitudes about math change, but they also become positive after whole brain teaching was implemented.

Students' change in attitudes about math was also brought up consistently in all six of my student interviews. During the interviews almost every participant expressed that their feeling about math had changed after whole brain teaching was implemented into the classroom. When asked if her feelings about math had changed at all since, we started using whole brain teaching, Golly expressed her feelings changed "a little bit." When I questioned her further about how her feelings had changed, she stated that she liked math "like a little better."

Ms. Marks also noticed the students' attitudes about math had begun to change. In our interview Ms. Marks mentioned a specific student who she believed had a change in attitudes

about math. In our interview she stated that, “Sam said he didn’t like math and then he filled out a questionnaire of things that he was good at and his thing was math. So, we have a concrete example of where he said he didn’t [like math] before whole brain teaching and now, he’s really good at math and he really likes it… so yeah!”

Student Achievement in Math

A lot of education is driven by achievement and test scores. In order to make a compelling argument about why whole brain teaching is a good strategy to use in the classroom for today’s teachers, I thought it would be important to address how the use whole brain teaching affected student achievement. In order to determine if overall student achievement in math changed after the implementation of whole brain teaching, students’ math assessment scores were collected. I collected students’ assessment scores in math for four weeks prior to the implementation of whole brain teaching and for four weeks during the implementation of whole brain teaching. After collecting my students’ scores, I calculated the percentages of students who scored between 100-81, 80-61, 60-41, and 40-0. Figure 1 shows the results of the collected data.

Figure 1. Percentage of math test scores before and during WBT.

Looking at the graph, I quickly realized that student achievement actually decreased rather than increased when whole brain teaching was implemented. In other words, the students did worse on the assessments during whole brain teaching than they did prior to its implementation. The number of students who scored between 100-81% decreased by almost half. The number of students who scored between 80-61% increased but only slightly. The number of students who scored between 60-40% (the failing range) almost doubled. In regard to overall student achievement, this data communicates that the number of students who failed math assessments during whole brain teaching increased and the number of students who passed assessments during whole brain teaching decreased.

Even though the students did worse after the implementation of whole brain teaching, I would argue that this is not an accurate reflection of achievement during whole brain teaching. One of the assessments given during the whole brain teaching period was a six weeks assessment. On the six weeks assessment, the students were tested on concepts they had learned for six weeks prior to the test, as well as over concepts that they had learned at the beginning of the year. This test was much longer than our normal math assessments (26 questions rather than 10-12). This test also covered concepts that were taught before whole brain teaching was used. On this particular assessment, one student scored a 100, and the next highest grade after that was a 73. These scores tell me that this test was exceptionally hard because several students who normally receive higher grades (A's and B's) failed the assessment. Taking all of this information into account, I would argue that the grades from the six weeks assessment caused the passing percentage to go down, and skewed the results shown in Figure 1.

I am, however, a little biased. As a teacher-researcher, I want to find strategies that are

beneficial to the students in my class. Looking back at the results, the outcome was discouraging because the results painted a picture of reduction rather than achievement growth. Not only were the results discouraging, they were also surprising! The daily grades and formative assessments each week of WBT indicated that the students met mastery of each learning objective. The data may show that whole brain teaching causes overall achievement to decrease; however, I do not think that this is the whole story based on what was observed in the classroom. In order to more fully determine whether achievement is affected by WBT, further study of this topic is warranted. In the case of this study, it would be interesting to see if the results would change had the six weeks assessment not counted in the overall data.

Perpetual Evidence of Learning Gains

Although overall student achievement scores did not turn out the way that I thought they would, there is still evidence to suggest that whole brain teaching is beneficial and can help students learn. Throughout my interviews, surveys, and journals, two recurring themes stood out. 1) Whole brain teaching helps students learn by engaging them in the lessons through active listening. 2) Whole brain teaching also helps students to remember concepts longer and understand them better than traditional teaching.

Early on in my research, I noticed that students had become more engaged during my lessons. Several of the whole brain teaching strategies require students to become active listeners in the classroom because they often have to repeat what the teacher has said, or teach a concept to a fellow student. In one of my journal entries about whole brain teaching I commented on this idea- “another thing that came up today during the lesson was the idea of active listening. I made it clear to the students that if they did not listen closely during the lesson that they would not be able to teach one another when the time came. In order to teach your neighbor or your partner

something you have learned you have to be listening closely to the teacher." This was an idea that presented itself again and again in my journals throughout the implementation of whole brain teaching. It was an idea that my cooperating teacher also noticed and commented on in my interview with her. Ms. Marks expressed her ideas about engagement saying, "a lot that has changed from just sitting and watching the teacher to listening, knowing that they are going to be required to teach, so they are more aware that their turn's next. So, I think it's all just more captivating in general. All parts of it." So, whole brain teaching is more engaging, it captivates students, and it draws them into the lesson.

When reflecting on my experiences with WBT, it became abundantly clear to me that whole brain teaching appears to help students to remember and understand different concepts better than traditional teaching. One of the parts of whole brain teaching is the repetition of different ideas/concepts being taught. When you are doing something over and over, you are likely to remember it better because you are exposed to it several times. When interviewing my students, all six students reported that whole brain teaching helps them to remember things better when the lesson was over. My cooperating teacher also talked about this very idea when she stated that, "they understand it better and there's something catchy that they can return to when they are at their desk. Instead of just learning something and then they go back to their desk, and it seems like it just all goes away. They have a rhythm, a pattern, or something they can repeat in their head to help them remember."

After considering all the data collected, it became clear to me that whole brain teaching had improved learning. I think that through the use of different whole brain teaching strategies, students were challenged to get involved in the lessons and listen attentively for when it will be their turn to teach. Although the math assessment data did not provide the results I expected,

student and teacher perceptual data suggested that whole brain teaching helped the students to learn.

Implications for Teachers

Conducting this research has led to many implications about using whole brain teaching practices that can be applied to my own classroom, as well as other teachers' classrooms. The data showed that the students and teachers had positive perceptions about whole brain teaching, and that it motivated the students to be more engaged in the lessons taught during math. It also revealed that students' attitudes about math can become more positive when using whole brain teaching strategies in the classroom. Although overall student achievement decreased and some misconceptions regarding whole brain teaching were uncovered, there is still strong perceptual data that WBT helped the students learn.

When planning how I was going to implement whole brain teaching, I didn't realize the amount of intentional planning it would take each week of the study. This is something that surprised me, and I think that it is something teachers should know if they are interested in implementing whole brain teaching in their classroom. First, you have to introduce the whole brain teaching strategies to your students. The students have to learn the strategies and know when you will want them to use those strategies. Second, not only do you have plan your regular lessons, but you also have to intentionally plan how and when you are going to use the various whole brain teaching strategies each day. I realized very quickly that if I did not intentionally plan how I was going to incorporate whole brain teaching into each lesson, then it was very easily left out or forgotten. So, for teachers who want to try this strategy out, I would say that you have to be willing to put in the time and effort to intentionally plan the implementation of whole brain teaching.

The biggest take away for me from this study was the knowledge that although student achievement may not have increased, these strategies are beneficial because they help to change students' attitudes about math. I discovered through the use of whole brain teaching, students felt more positively about math. I think that this is an important discovery because many kids today suffer from math anxiety or have negative feelings regarding math (Luttenberger, Wimmer, & Paechter, 2018) - this includes several of the students in my class. As a teacher I want to find ways to motivate my students to want to learn, but if students come into your classroom with negative perceptions about a certain subject, it makes that job much harder. The students who did not like or want to participate in math, when whole brain teaching was implemented, were more open to participation and became more positive in their feelings towards math. For one student in particular math even became his favorite subject. Teachers who have students like these - students who are not motivated in certain subject areas - may benefit from the use of whole brain teaching in their classrooms.

In future research on whole brain teaching, I would like to revisit the research question- How does the practice of whole brain teaching change overall student achievement in math? This was a question that I think could benefit from more experimental research with a control group and an experimental group. If one group of students were able to receive instruction using whole brain teaching and another group of students were to receive instruction using traditional methods, then a researcher would be able to make a more compelling argument about if whole brain teaching does in fact change student achievement.

Final Thoughts

In bringing my study to a close, I spent a great deal of time reflecting on my experiences with whole brain teaching. I believe these strategies to be incredibly valuable in engaging

students, as well as promoting positive perceptions of whatever subject is being taught. In the future, I hope to continue to integrate these strategies into all subject areas. Students love to be engaged and challenged in their learning, and we as educators need to provide a way for students to get more involved. I believe that whole brain teaching can be the avenue to help accomplish this goal.

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Appendix A

Codebook

Color	Code Name	Level	Definition	Example
	Attitudes About Math	2	Referring to any feelings in regard to math/math instruction.	"It's sometimes hard to do but it gets easier."
	Negative Attitudes About Math	1	Referring to any negative feelings in regard to math/math instruction.	"I feel about a math test is mad because they are hard."
	Neutral Attitudes About Math	1	Referring to any neutral feelings in regard to math/math instruction.	"Yeah. Sometimes I like… I'm like yay math! But sometimes I'm like awwwwww."
	Positive Attitudes About Math	1	Referring to any positive feelings in regard to math/math instruction.	"excited and happy and excited… and I really wanna learn more about it…"
	Change of Feelings About Math	1	Instances where students' feelings/attitudes about math changed after whole brain teaching was implemented.	• "Bridges- Have your feelings about math changed at all since we started using WBT? • Golly- a little bit. • Bridges- How has it changed? • Golly- Like a little better. Like because its funner."
	Math is Important	1	When students/teachers expressed that math is important, or needs to be learned.	"because we need tuh know how to count, we need to learn how to know stuff, and if we didn't have math, no one would know anything."
	WBT Helps Learning	2	Any mention of how whole brain teaching specifically helps learning or understanding in the classroom.	• "Bridges- do you think that whole brain teaching has helped you understand math better? • Martin- yes! • Bridges- Why? • Martin- because whole brain teaching helps you learn and if that wasn't a thing then I wouldn't even know anything about math."
	WBT Increases Memory	1	Instances of students remembering concepts that have been taught or comments made by students about how whole brain teaching helps increase their memory.	"…some of the problems are hard… and in whole brain… so I remember whole brain teaching and it helps."
	Increased Engagement	1	Moments of increased student engagement during mathematics instruction.	"yeah… definitely! Instead of just sitting there and looking and listening, they're more involved. They get to use their arms, hands, they get to talk they get to spend time with friends. Umm… there's a lot that has changed from just sitting and watching the teacher to listening, knowing that they are going to be required to teach, so they are more aware, that their turn's next. So, I think it's all just more captivating in general. All parts of it."
	Active Listening	1	Moments of intentional listening performed by students during mathematics instruction.	"I think that they are better because kids are more engaged in the lessons because they know that they are going to have to teach their partner"
	Student Behavior	1	Any instance where student behavior was referred to- both positive and negative.	"I also noticed that I did not have to correct or refocus off task behavior during my lesson today. It will be interesting to see if this continues to be the case, or if it is just because we are going something new"
	WBT is Fun	1	References to the enjoyment of whole brain teaching by both teachers and students.	"ummm that it's fun. You learn stuff, and that… ummm… you get smarter."
	Perception of WBT	2	Thoughts or feelings in regard to whole brain teaching- what it is, positives, and negatives.	"Sometimes I like the teach-okay and sometimes I don't"

	Positives of WBT	1	References to good things about whole brain teaching/what students like about it.	"well the thing I like the gest is… you know the saying is when you teach you learn it… you can't teach somebody else unless you know it. So, when the kids turn and teach. I think that's the best part of it because they get to be the teacher and that's really fun."
	Don't Like About WBT	1	References to negative things about whole brain teaching/what students don't like about it.	• "Bridges- so what do you not like about WBT? • Martin- Ummm… sometimes it could be hard. • Bridges- Why? • Martin- Because we learn hard stuff, it's not always easy."
	What is WBT	1	Information about whole brain teaching- what it is and how its used in the classroom.	"that you… like you … you do hands and eyes and then say hands and eyes and then we just put our hands in our laps and we focus, and we have to pay attention to you or the person that's up there. And you say teach, and then we clap our hands back and then we say okay and we teach our partner. And when we teacher our partner, you say that we will raise our hands and we say our answers… and the other thing was… uhhhh… you, we all say the poem and then like we say the other one…"
	Misconceptions	1	When students expressed inaccurate information about whole brain teaching or misunderstandings of how it's used.	• "Bridges- what is your favorite part of whole brain teaching that we have done so far? • Golly- that like… the… the division… when we learned division. • Bridges- when we learned the division definition, or the poem, or what about division? • Golly- when we did the paper."
	WBT Strategies	2	Types of strategies used in whole brain teaching.	"today was my third day of teaching personal financial literacy and I have continued to use the whole brain teaching strategies that we used this week and last week."
	Hands and Eyes	1	Instances where the hands and eyes strategy were used or described.	"today we are going to be learning a new part of whole brain teaching called hands and eyes. When I say hands and eyes what I want each of you to do is put your hands in your lap as fast as you can and then look up at me like you can't wait to find out what I have to say!"
	Teach-Okay/Students Teaching	1	Instances where the teach-okay/students teaching strategy was used or described.	"when we do teach-okay, I am going to teach you something and then you are going to become the teachers and teach your partner."
	Mirror	1	Instances where the mirror strategy was used or described.	"today we are going to learn a new strategy called the mirror! When we use the mirror strategy a couple of things will happen. First, I will say mirror. When I say mirror, you will respond with mirror and then put your hands up ready to copy whatever I am about to do. Let's practice this now!"
	Using Gestures	1	Instances where gestures where used or described.	"when saying this line students put wo thumbs up until they got to the word multiply. When they said multiply, they made an 'X' with their arms."
	Math Instruction	1	Referring to anything that was being taught in math.	"division is splitting something into equal parts or groups."
	Math at Home	1	Referring to how students use math when they are at home.	"no… because we go to school because we do math… so … so … so when we leave… we have… we are supposed to have fun time for awhile and relax our brain."

Appendix B

Name: _____ Date: _____

Math Attitude Survey

1. **I like learning math.**

2. **I get excited when the teacher says it is time for math to start.**

3. **I like to come up with new ways to solve math problems.**

4. **Learning new things in math is fun for me.**

5. **I am good at math.**

6. **During math I like it when my teacher calls on me to answer questions.**

7. **Math is important.**

8. **I use math almost every day.**

9. **I always try my best in math.**

10.How do you feel about learning something new in math?

_____
_____
_____
_____

11.How do you feel about taking a math test?

_____
_____
_____
_____

12.Why do you think you need to learn math?

_____
_____
_____
_____