

Regis University

ePublications at Regis University

Regis University Student Publications
(comprehensive collection)

Regis University Student Publications

Fall 2009

Techniques for Addressing Gender Cognitive Differences in the Elementary Classroom

Nichole R. Brooker
Regis University

Follow this and additional works at: <https://epublications.regis.edu/theses>



Part of the [Education Commons](#)

Recommended Citation

Brooker, Nichole R., "Techniques for Addressing Gender Cognitive Differences in the Elementary Classroom" (2009). *Regis University Student Publications (comprehensive collection)*. 59.
<https://epublications.regis.edu/theses/59>

This Thesis - Open Access is brought to you for free and open access by the Regis University Student Publications at ePublications at Regis University. It has been accepted for inclusion in Regis University Student Publications (comprehensive collection) by an authorized administrator of ePublications at Regis University. For more information, please contact epublications@regis.edu.

Regis University
College for Professional Studies Graduate Programs
Final Project/Thesis

Disclaimer

Use of the materials available in the Regis University Thesis Collection ("Collection") is limited and restricted to those users who agree to comply with the following terms of use. Regis University reserves the right to deny access to the Collection to any person who violates these terms of use or who seeks to or does alter, avoid or supersede the functional conditions, restrictions and limitations of the Collection.

The site may be used only for lawful purposes. The user is solely responsible for knowing and adhering to any and all applicable laws, rules, and regulations relating or pertaining to use of the Collection.

All content in this Collection is owned by and subject to the exclusive control of Regis University and the authors of the materials. It is available only for research purposes and may not be used in violation of copyright laws or for unlawful purposes. The materials may not be downloaded in whole or in part without permission of the copyright holder or as otherwise authorized in the "fair use" standards of the U.S. copyright laws and regulations.

Techniques for Addressing Gender Cognitive Differences in the Elementary Classroom

by

Nichole R. Brooker

A Research Project Presented in Partial Fulfillment
Of the Requirements for the Degree
Master of Education

REGIS UNIVERSITY

August, 2009

ABSTRACT

Techniques for Meeting Gender Cognitive Differences in the Elementary Classroom

From conception, the male and female brains develop differently. Due to these differences, current research shows methods of teaching should be examined and modified to accommodate both genders' learning needs. Educating teachers on the brain diversities between the genders is essential for opportunities in establishing a positive classroom atmosphere. In this project, the author has created an interactive workshop for new and experienced teachers to explore the vast differences between the male and female brain, and what those differences mean in the classroom. The interactive workshop will be a full day workshop where the teachers will be presented with facts on the brain differences and will develop ideas and techniques to better adapt teaching methods to serve both genders. The outcome of this study focuses on educating teachers on brain differences, strengthening their realization of the need for classroom accommodations for each gender, as well as to encourage them to modify their teaching practices.

TABLE OF CONTENTS

Chapter		Page
1. INTRODUCTION	.....	1
Statement of the Problem	.....	1
Purpose of the Project	.....	2
Chapter Summary	.....	2
2. REVIEW OF LITERATURE		
Neurological Differences Between Males and Females	.....	4
Processing Differences	.....	8
Chemical Differences	.....	10
Brain Characteristic Differences	.....	12
Educational Implications and Alternative Suggestions to Reach Every Student	.....	15
Chapter Summary	.....	19
3. METHOD	.....	21
Target Audience	.....	21
Organization of Project	.....	22
Peer Assessment Plan	.....	23
Chapter Summary	.....	23
4. RESULTS	.....	25
Introduction	.....	25
Interactive Workshop	.....	26
Icebreaker	.....	26
Questionnaire Answers for Review	.....	27
PowerPoint Presentation	.....	30
Small Group Collaboration	.....	47
Large Group Discussion	.....	48
Chapter Summary	.....	50
5. DISCUSSION	.....	51
Contribution of the Project	.....	51
Limitations	.....	52
Peer Assessment Results	.....	52
Recommendations for Further Development	.....	53
Project Summary	.....	53

REFERENCES	54
APPENDIX	57
A. Prior Knowledge Questionnaire	58

Chapter 1

INTRODUCTION

Research on human brain development has been conducted for hundreds of years but has become extremely prominent within the past 10 years. This research has been tremendously useful in the medical field to further conceptualize brain research, but in the elementary classroom, it is not often utilized as a teaching tool. The vast differences between male and female brain development lend to the diversity of the ways males and females learn and grow. For example, according to Gurian, Stevens and King (2008b), the female Language Processing Area utilizes both hemispheres of the brain, making them more susceptible to learning language sooner than males. With the findings in the field of brain research, elementary teachers could better accommodate the uniqueness of their students' abilities and discover the most appropriate methods to address each learning style. The issue regarding whether the left and right hemisphere determines a person's personality and natural abilities is currently being debated; but for the purpose of this project, that debate will not be addressed.

Statement of the Problem

The study of neuroscience shows that, at human conception, the brains of males and females develop in entirely different ways and, therefore, their learning styles vary. Elementary teachers often do not make adaptations to accommodate the brain differences in the methods and procedures they use to teach both genders. It is a global issue that the

achievement gap between boys and girls in school cause more behavior issues, learning disabilities, and lower grades for boys (Gurian & Stevens, 2005). If accommodations were made to better adapt a classroom atmosphere to its learners, students of both genders and all learning styles would benefit.

Purpose of the Project

The author sought to make the connection between brain development, gender differences, and classroom management in order to better prepare beginning as well as experienced elementary educators. The purpose of this project was to educate teachers on the immense developmental differences between the male and female brain and how these differences affect students in the classroom. The author developed an interactive workshop for beginning as well as experienced teachers to share: (a) the relevant research regarding gender brain differences, (b) the implications of those differences within a classroom, and (c) the teaching techniques to manage a classroom of students of both genders with their brain development as the driving force.

Chapter Summary

Research indicates a significant developmental differentiation between the male and female brain. The chemical composition differences as well as the processing distinction between the male and female brain cause discrepancies in the abilities and capabilities of each gender. These abilities vary and cause environmental and educational needs in the classroom that are often overlooked in the classroom.

In Chapter 2, the Review of Literature, the author presents an overview of: (a) neurological differences between males and females, (b) processing differences, (c)

chemical differences, (d) brain characteristic differences, and (e) educational implications and alternative suggestions to reach every student. The content of this review supports the need for more training and staff development at the elementary level with regard to the classroom implications regarding brain differences between genders.

Chapter 2

REVIEW OF LITERATURE

Most universities offer teacher education classes for aspiring teachers in the theories behind education, classroom management, lesson plan writing, and the history of education. All of these classes and subjects are relevant in their own right, but one subject that needs more attention is the difference between male and female brain development and what those differences mean to student learning. When a fetus forms, cognitive differences are evident in early stages that will create either a male or a female and will determine numerous differences between them. This information is important and extremely relevant to understanding why males and females develop the way that they do and learn in the way that they do. Females have traits that are extremely different than males, and with knowledge of brain research, teachers can tailor their instruction to fit a majority of the learning needs of their students.

Neurological Differences Between Males and Females

According to Gurian, Stevens, and King (2008b), the differences begin at conception when a Y chromosome is present or not present, determining the sex of the fetus. When a Y chromosome is present, a male system begins with a secretion of testosterone, resulting in a higher capacity for muscle mass as well as different calcium and iron ratios. Female offspring will also receive testosterone, but in a smaller amount due to the estrogen-type hormones being released in their blood stream. These chemical

differences affect brain development, and although they are not the only factors influencing how the brain will develop, they are the stepping-stones for brain growth (Wasserman, 2007). When researching the differences between male and female brains, it is important to note that neither brain is “better” but just unique in its strengths and weaknesses. Both fully developed brain types have the potential to learn, grow, be productive, and succeed, and the method used to teach should correspond with the research presented (Baron-Cohen, 2003).

Scientists, in order to determine brain functionality when males and females are requested to perform the same task, did research using Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), and Magnetic Resonance Imaging (MRI) (Costello, 2008). The differences in brain development are biological and can be medically supported, but the ways that males and females respond to these differences are generalizations and not absolute, as all humans have individual differences that make them unique. Research collected by Gurian, Stevens and King (2008a) is known in the field of gender brain research as it provides prime examples of differences between the brains of most females and most males. The brain stem sends messages back and forth, and the male brain has more fluid, so these messages can move more quickly than the female brain (Gurian et al., 2008a). The stem also controls the fight or flight response, causing males to respond more quickly when they feel threatened or emotionally charged.

The *corpus callosum* is the bridge that connects the nerves between the left and right hemispheres of the brain. A female’s corpus callosum tends to be larger and denser

than a male's, resulting in a more acute ability to multitask. Females can also usually verbalize their feelings more quickly than males, who often need time to process their emotions into words (Zaidel & Lacoboni, 2003).

According to Boeree (2002), the *limbic system* controls sensory and emotional memory, which is more acute in females, resulting in increased emotional memory for females as well as the ability to read emotional cues better than most males. The key emotion center in the limbic system is the cingulate gyrus (Boeree, 2002). This area is larger and more active in women and has more connections and transmissions in and through the brain. These connections are the reason that women have a natural tendency to make friends and nurture others, while males do not have the same drive to make connections with others. In the classroom, the limbic system may cause social discord for some males and some females, as they struggle to control their sensory and emotional connections.

The *hippocampus* is the area of the brain that allows one's working memory to convert its information into long-term or permanent memory. The hippocampus is important in retention and making connections during the learning process. This area of the brain tends to be larger in females, resulting in larger memory storage (Gurian et al., 2008a).

Males often show signs of increased impulsive responses relating to aggression. This could be connected to the fact that their *amygdala* tends to be larger. This small part of the brain processes the emotions of anger and fear. Blakemore, Berenbaum and Liben (2009) believe these emotions are connected to memories; therefore, when a memory is

recalled, emotions can be conjured as well. In the classroom, the amygdala's size and utility could become an issue for males if they cannot control their aggression when faced with a difficult situation.

The *cerebral cortex* is an area of the brain that is extremely important for recall, speaking, and thinking. A female's blood flow in this area can be up to 20% higher than a male's; therefore, the connections between neurons fire faster. This often leads to females being "faster on their feet." In contrast, males have more neurons in this area of the brain, but the speed of the connections is slower. Females have more neuropil, making the process for cell-to-cell communication easier and more efficient (Sabbatini, 1997). With a larger corpus collosum and an increased blood flow in the cerebral cortex, females tend to neurologically have an increased chance of raising their hand first and being called on to answer questions in the classroom, giving them an increased opportunity to prove their knowledge base.

When males physically move, they tend to learn more. This is due to their *cerebellum* being larger; it allows their brains to speak to their bodies faster and more often. The cerebellum is the "movement" area of the brain, firing impulses to the body to tell it to move. When the cerebellum speaks to the body, the male's movements are often in reaction to the brain's impulses to move and be active (Gurian et al., 2008a). This knowledge is the basis for the need for educators to change the way material is presented in their classrooms. If the cerebellum's need is to move, a classroom setting where students are expected to sit and listen all day will not increase the male students' ability to learn new material.

The *inferior parietal lobe* is the portion of the brain that integrates information generated from various parts of the body, such as the manipulation of objects, and number knowledge and relationships. After all factors are adjusted for, the inferior parietal lobe is larger in the male brain. Males tend to perform better in mathematical and spatial reasoning, in which the inferior parietal lobe is mainly responsible. This explains why females may often have more difficulty with math and engineering (Gabriel, 2001).

Processing Differences

According to Gurian et al. (2008b), not only is the development of the brain different between males and females, but there are also substantial differences in how each brain is used. The authors reported the following insight in regard to language processing areas, spatial relations, and human senses.

The female *language processing areas* utilizes both hemispheres of the brain, making them more capable of learning language sooner than males. The male portion of the brain that controls language acquisition is only found in the left hemisphere (Gurian et al., 2008a). This limits the amount of brain capacity that males use towards language as well as the number of words that they typically use in their vocabulary. Since language is the building block to all education, this could be the primary reason that females often are faster readers and better writers early in their education. Females have a greater density of nerves surrounding the part of the brain that processes language and comprehension. According to research conducted by Hardin (2000), at the Indiana University School of Medicine, females listen with both sides of their brain while males listen with only one. This helps explain why females can usually listen to and

comprehend up to seven different auditory inputs. This supports the fact that males often have trouble multitasking when there is more than one sound happening simultaneously. In the classroom, this can cause numerous issues for males, as they are often expected to concentrate while a number of auditory stimuli are present.

The differences between the male and female brain in the area of spatial relations is significant in gross motor skills, abstract reasoning, mathematics, and spatial reasoning (the mental manipulation of objects). Males are found to have more neural connections in the right hemisphere because of the increased amount of testosterone in their brains and bodies. The right hemisphere in a female's brain does not usually have the same number of neurons dedicated to spatial relations. Males often need more space in order to function and feel comfortable in their surroundings while learning, whereas females are able to sit for longer periods of time and concentrate. Science and technology are often easier for males, although this is not to say that females cannot do well in science and technology; often more encouragement is needed for them in these areas (James, 2007).

Human senses are an essential aspect of learning, reading, and writing. The senses in females are frequently more distinctive. Females often see, hear, and smell better and take in more information tactilely. This has large implications in the classroom, as females usually use more detail in their writing and conversation, while males tend to need more guidance with sensory descriptors in their writing. According to Baron-Cohen (2003), males and females actually taste things differently, with females gravitating toward sweet flavors while males are attracted to salty ones. This does not

usually have a large impact in a classroom, but the fact that the genders taste things differently supports the fact that the sexes are abundantly diverse.

Males and females actually see different things when looking at the same object or scene. Because of the increased number of cones in the eyeball of a female, they tend to see more colors than males do. Peripheral vision is another area where males have less of a range than females. This can be an issue in determining where to place students in the classroom for maximum learning potential (Baron-Cohen, 2003).

According to Sax (2005), females hear better than males, causing issues in the classroom. Boys are sometimes labeled as having attention deficit disorder (ADD) when they actually may just be having trouble hearing the teacher and their peers. Many classrooms are now equipped with a sound system to amplify the teacher's voice, but this leaves the peers' comments and additions to the lessons unheard by many of the students in the room, especially the males.

The sense of smell in females is far superior to males and can affect the placement of desks in a classroom. For example, if a female is sitting near a trashcan that has a banana peel in it, her concentration can be severely altered; whereas, if a male is placed in the same seat, he probably will not even notice the smell.

Chemical Differences

Although male and female brains are different in their development from conception, they do have many chemicals in common, but the volume and use for these chemicals is often different between genders. It is well known that the main hormone in the male brain is testosterone, and in a female's, it is estrogen. Many people are not

aware that these hormones are present in the opposite gender as well, just not in the same volume (Gurian & Stevens, 2005).

Males are generally more aggressive than females, and their testosterone levels fluctuate depending on whether they win or lose at sports and activities. Males testosterone levels are twice that of females, which leads to higher levels of aggression, self-assertion, competitiveness, and self-reliance. Think of a sporting event where opponents are of the same gender and how they treat one another during the competition. Males tend to show more hostility and antagonism, while females are more inclined to hug and congratulate one another (Gurian & Stevens, 2005).

Males secrete less serotonin, making them more impulsive as well as fidgety. Female moods are often calmed by high levels of serotonin, and the higher level of this hormone makes them more suitable for child care and conversation (Tyre, 2005). This could also explain why females tend to have more personal relationships with their teachers, giving them the ability to communicate more effectively.

When a female hears a child cry, the level of oxytocin that is released is much higher, giving them more of a sense of empathy and concern for others. This release also indicates that females are more likely to continue relationships with their peers and teachers long after advancing in age, in order to keep those ties. This can affect the way that students work in groups, as females will work to continue relationships while males will simply use the relationship for the purpose of the assignment and move on (Willis, 2008).

Estrogen is what controls the female hormones and determines the mood and sex drive. Estrogen also makes the female brain more alert and sensitive to stimuli. This hormone is present in men, but at a much lower amount, as testosterone is the chemical that affects their moods and sex drive (Larimore & Larimore, 2008). Being more alert in the classroom could lead to better attention and fewer behavioral issues for females while males struggle to stay on task.

Progesterone is another hormone that is specifically found in the female body and affects nurturing and an overall feeling of well-being and contentment. As with any hormone or chemical in the brain, too much or too little can alter the activity level or ability to perform different tasks (Larimore & Larimore, 2008). Dobson (2001) says, “if testosterone is the gasoline that powers the brain, serotonin slows the speed and helps one steer” (p. 25). The difference in the chemical composition between males and females helps to explain how each gender reacts to situations and how they accomplish different tasks.

Dopamine is a “feel good” neurotransmitter that can affect human behaviors such as pencil tapping, leg jiggling, and the inability to sit still. This chemical is present in both genders, but when males are excited about something and get their bodies moving in response, it is often more difficult for them to calm themselves than it is for females, due to the method by which dopamine is metabolized in the body (Sternberg, 2008).

Brain Characteristic Differences

Gurian (2002) has found that the resting female brain is as active as the activated male brain. In other words, the female brain is never sedentary. It is always working and

firing neurons and has a true learning advantage. According to Gurian et al. (2008a), the male brain does not use all of its capacity for problem solving and other needs. When males are working on a problem, they will often stay the course even when the course does not seem to be working, often leading them down the wrong path. Females will often reevaluate their methods to differentiate the most effective way to accomplish the task at hand.

In Larimore and Larimore (2008), it is discussed that, even though a male's brain is 10% larger than the average female's, the intelligence level does not necessarily correspond with size. "Women's brains appear to be more efficient than men's in the sense that an equal increase in volume produces a larger increase in processing capacity in women than in men" (p. 34). Male brains also have more gray matter, which is known as the "thinking matter," while females have a larger concentration of white matter, also known as the "processing matter." In combination with a larger corpus collosum, this indicates that females are more apt to have better communication between their hemispheres, therefore resulting in better overall communication skills (Larimore & Larimore, 2008). The female brain stops growing a year or two before a male's does, has a more active frontal lobe, and more mature ability to process language. According to Lenroot et al. (2007), the male and female brains develop in a completely different sequence, thus making the process of brain development an entirely different process between genders.

There are times when all of the systems in the brain are working properly and accurately, and at other times, there can be issues with timing and responses. According

to Levine (2002), neuro-developmental functions are “the various implements for learning and for applying what’s learned” (p. 10). A dysfunction in this area often includes the inability to assign proper muscles to particular tasks such as writing, reading, speaking, and thinking. There are an endless number of combinations that connect through the synapses or nerve linkages within the brain that can misfire or fail. These failures can lead to attention deficit, memory lapses, language issues, spatial awareness issues, and many other behavioral and cognitive concerns. Unfortunately, a neuro-developmental dysfunction goes undetected most of the time, leaving a diagnosis of lazy, unmotivated, or even that the student has a lower intelligence level (Levine, 2002).

Males are wired to react first and ask questions later (Larimore & Larimore, 2008). This can explain why a male student can become aggressive when things do not go their way. Stress is a factor in most human beings’ lives, and the way the human body and brain deal with stress is different, depending on one’s gender. Due to the brain connections that transport emotional responses, females tend to think before acting. Males often find it difficult to think things through before reacting to a situation. Stress about things at home or issues in the classroom can change the way a male concentrates, listens, and reacts to situations in the classroom.

Intuition is the state of being aware of or knowing something without having to discover or perceive it, and often, females have this ability more readily than males (Tileston, 2005). A female can “read” another person’s body language and intentions, while males do not often notice anything out of the ordinary about people. This contributes to the relationships that females will have with their teachers, as they

sometimes will get a “feeling” about a teacher or mentor and not have the ability to concentrate as strongly. Without this keen sense of intuition, males will usually listen with the same level of respect to all of their educators (King, 2001).

Simply put by Baren-Cohen (2003), “The female brain is predominantly hard-wired for empathy. The male brain is predominantly hard-wired for understanding and building systems” (p. 1). Empathy is the act of putting oneself in another’s shoes, feeling what they are feeling, and thinking the way they do (King, 2001). This behavior is more suited for females as they tend to be more in tune to others’ feelings and needs.

Educational Implications and Alternative Suggestions to Reach Every Student

There are numerous differences in neurological growth between males and females, yet, educators often are not aware of these vast differences and the consequences which can result from educating students with the same methods. If more teachers and education professionals were versed in the brain differences between males and females, their teaching styles would likely be altered to accommodate the differences in learning. This research is extremely relevant in the education profession and should be further studied and taught in the university setting (Sax, 2005). Often, at the university level, this research may be presented as part of a psychology course, but not often as part of a teacher education curriculum.

To create a stimulating classroom, a teacher needs to make a safe and generous environment for both genders (Gurian, Henley, & Trueman, 2001). It is important to change the classroom structure to create a learning space to cater to all students. Every grade level requires different, innovative, and creative methods in order to differentiate

learning for every student. What works for one grade level will not necessarily work for another grade, so flexibility and the ability to accommodate each student's needs are essential aspects of differentiating instruction for all students.

For hundreds of years, classrooms of all levels have catered to the female learner with paper and pencil work while sitting at a desk, with very little movement or variation in keeping everyone in the room engaged. This classroom setting caused an ongoing debate about single sex classrooms versus co-education. According to the staff at the National Association for Single Sex Public Education (2009), single sex classrooms create a learning environment that can fracture stereotypes for both genders, allow each gender to explore their areas of interest without ridicule or embarrassment from the opposite sex, and create an atmosphere to accommodate the individual needs of each gender; however, segregation of the sexes is not always appropriate for all students, as the world outside such a setting is not single sex or segregated, and both males and females need to acquire the ability to communicate and understand both genders.

Many different strategies can be used to help males and females reach their full potential in the classroom. One idea that Gurian et al. (2008) has is to teach males sewing and beadwork to help with fine motor skills. Tailoring instruction and strategies to age appropriate activities is essential for maximum productivity. According to Gurian et al. (2008b), if all educators taught to the strengths of males, females would learn just as well, conversely, students are taught in a way that is more conducive to the female learning style, which does not address male needs.

Males respond to movement and tend to learn when moving; therefore, moving around the room during learning time can benefit most learners. Movement does not have to mean a full game of kickball or football, but small movements can make a difference in getting the blood flowing and encouraging the brain to be more productive. Keeping things visual can spark brain connections that listening to a lecture cannot do. The use of graphic organizers is an efficient way to display knowledge of a particular subject. Another approach to reaching all students through instruction is to use more drawings and symbol making (Gurian et al., 2008a). One strategy is for students to draw what they already know about a subject and then explain their drawing to another student. Using their creativity, previous knowledge, and communication skills all in one simple lesson can further extend their knowledge level of a subject. “This exercise allows the visual-spatial learners to shine and challenges your more verbal learners, often your highly verbal females, to expand their own playbook-thinking and expressing differently than they are used to” (Gurian et al., 2008a, p. 49).

Technology is a popular topic in education. With smart boards and video cameras used daily in classrooms, it is imperative that technology be used to stimulate minds and motivate learners. Computers offer drawing and painting software for students to create and use hands-on methods to look at information differently. Applications like PowerPoint allow students to demonstrate their knowledge in a format that helps to take the focus off the presenter and onto the material. Technology can help the shy student who may be uncomfortable presenting. There are countless examples of technology uses

for the classroom that can assist all students in being creative, concise, explorative, innovative, and challenged (Haynie, 2008).

The term, *multiple intelligences*, was first identified and defined by Howard Gardner in 1983; as a result, most educators know there are different kinds of learners who respond better to different types of teaching (Gardner, 1983). One approach to teaching is kinesthetic, which allows the students to use their sense of touch in order to explore and learn their material. Males tend to need to use their sense of touch more in learning, as this keeps both hemispheres of the mind working and communicating. Gurian et al., (2008a) suggest putting more of the decisions regarding the methods of learning in the hands of the students because males tend to need to know the purpose of activities in which they are required to participate. Giving students a choice works because, according to Gurian et al. (2008b), all humans have a need to maintain some control. This control can be over what they eat for breakfast, or it can be over how they go about completing a task. Either way, giving students individual responsibility allows them to take ownership in their education and teaches them to be more self-reliant.

Teachers need to analyze topics for literacy in the classroom, since it can make the difference between a motivated writer and a student who has no interest in reading and writing. Males tend to favor topics like sports, monsters, intense weather, cars, and the military. Females tend to favor topics like fairies, animals, poems, feelings, and family. When a teacher gives a subject for creative writing that males have no interest in, immediately, they may become turned off to exploring literacy. If a teacher is sensitive to the interests of the students, this can improve the motivation of all students. It is

understood that choice is not always an option when teachers need to cover the state and national curriculum, but when possible, choice should be incorporated in the students' day (Brozo, 2006).

Social interaction between students is often the reason both males and females are motivated to attend school. Using social interaction, which is natural for most humans, is a great motivator and can offer a break for students to rejuvenate their brains (Gurian et al., 2008a). In literature circles, students read literature together and then discuss what they have read and learned. In Gurian et al. (2008a), they stated, "Students actively engaged in reading through making choices, discussing, and constructing meaning" (p. 91). Using a collaborative method of learning and discussion allows the students to be in control of the conversations instead of sitting and listening to a teacher talk. Study groups are another technique that emphasizes critical thinking, writing, and reading about a topic. This method also puts the control in the hands of the participants, as it allows for individual input, and it can lead to critical analysis of a given topic, with many minds working together and contributing.

Chapter Summary

Differentiating instruction is when, according to James (2007), "you change how you present information and what you ask students to do in response to their individual needs" (p. 221). It would be extremely improbable for every student in a classroom to have the same skills, strengths, and educational backgrounds. Research supports the need for educators to differentiate instruction and have the knowledge of different teaching methods to accommodate the dissimilar brain development. With the known differences

between the male and female brains, teaching to all students so that they have an equal opportunity to understand and retain the information is critical for success. Every student is different and has specific educational needs, but knowing that males and females are quite different in their brain development can give an educator a head start to understanding what changes they need to make in their instruction and classroom. Males and females are different in so many ways, including their brain development, chemical make up, developmental stages, and educational strengths and weaknesses. Knowledge of these differences is essential for all professionals who work in education, as these differences determine how students learn, process information, and retain what is taught to them. In Chapter 3, the method used to develop a workshop for educators is described.

Chapter 3

METHOD

The purpose of this project was to develop a workshop for teachers which describes how to integrate brain differences between the genders with practical classroom techniques. Hopefully, this workshop will serve as an opportunity for new and experienced teachers to explore the vast differences between the male and female brain and how those differences affect the classroom atmosphere. According to Gurian and Stevens (2005), kindergarten through 12th grade boys, worldwide, are fraught with more learning disabilities, discipline issues, inferior grades, and more behavioral disorders than girls. Unfortunately, classrooms are often organized with the female learner in mind, using paper and pencil, seatwork, and very little movement (Gurian et al., 2008b). A typical elementary classroom environment is designed for the female student, giving an educational advantage to the females in the classroom. The male brain has the ability to learn with more efficiency when put in motion, and if a classroom is structured with the male brain in mind, females can also benefit and learn as effectively (King & Gurian, 2006). The intended result of this project is to help raise awareness of (a) brain differences between genders, (b) the need for classroom modifications, and (c) ways to integrate the information into classrooms and curriculum.

Target Audience

The target audience for this workshop is new and experienced elementary teachers as well as administrators. This presentation could be delivered as an in-service for elementary teachers and/or as a teacher preparatory induction program. Teachers and

administrators with an interest in enhancing their teaching methods and better preparing their students, are the focus for this workshop. Any educator with an interest in gender brain differences and how they affect learning would benefit from this workshop, while administrators may benefit from the knowledge and training to guide teachers in creating a learning environment for both genders.

Organization of Project

This interactive workshop for teachers and administrators consists of four sections: (a) a teacher self-examination of gender brain differences, (b) a PowerPoint presentation of the pertinent brain research affecting the classroom learning, (c) small working groups for the development of classroom techniques and suggestions for reaching both genders, and (d) whole group discussion and collaboration of ideas.

Initially, each teacher will be asked to fill out a questionnaire (see Appendix A) regarding their knowledge of the brain differences between males and females to assess their familiarity of the subject. When the participants' questionnaires are completed, the answers will be shared by the participants so that they can identify what discrepancies and prior knowledge exist in the area of gender brain differences.

Next, a PowerPoint will be presented to the group with information on the differences between the male and female brain. The information given will be the basis for the next portion of the workshop.

At the conclusion of the PowerPoint presentation, the large group will be divided into smaller groups by the facilitator with various grade levels represented in each group. Each group will be asked to create a list of classroom techniques and suggestions to use

in the elementary classroom to better facilitate learning to both genders. This list will be discussed as a whole group with a reporter from each small group. From the whole group discussion, a master list of techniques and ideas will be compiled and the participants will be advised to create their own list to use in their classrooms. As a follow up suggestion, the administrator will be given a suggestion for their staff to develop a lesson plan implementing five to eight of the techniques on the list. The workshop, in its entirety, will take approximately one full day to complete.

Peer Assessment Plan

Assessment of the interactive workshop was obtained from four colleagues: (a) two second grade teachers, (b) one retired principal, and (c) one retired third grade teacher. Each colleague based their assessment on: (a) the relevancy of the project, (b) the perceived usefulness of the method of instruction, and (c) any needed modifications in implementation that existed. Their feedback is discussed in Chapter 5.

Chapter Summary

Although most professionals who work with children will tell you that boys and girls are extremely different, there is little training for teachers in teacher preparation programs to educate them on the vast biological differences between males and females from birth and how this affects teaching and learning. Through this project, the author provides information regarding the gender brain differences and their impact on learning. The workshop provides an opportunity for elementary educators to work together to create a list of activities and techniques to differentiate instruction and reach both genders

based upon the workshop presentation. The interactive workshop for teachers is presented in Chapter 4.

Chapter 4

RESULTS

Introduction

Education preparation courses at most universities do not usually include thorough coverage of the differences between the male and female brain and how they can affect students in the classroom. With the increased amount of research conducted on the subject of brain differences between genders, educators need to be informed about how the cognitive and developmental differences interact with the learning styles and abilities of their students. According to Gurian and Stevens (2005), boys are lacking in their education due to the frequency of behavioral issues and learning disabilities. Many of these issues can be addressed if their teachers understand the cognitive differences between males and females. Catering to both genders in the classroom can only improve the atmosphere and learning capabilities of all students.

The goal of this workshop is to provide new and experienced teachers and administrators an opportunity to become aware of the research on the differences between the male and female brain. Each participant is provided: (a) a questionnaire to determine their prior knowledge regarding the differences between the male and female brain, (b) a PowerPoint overview of the differences, and (c) the opportunity to compile a list of useful classroom modifications to address cognitive differences.

Interactive Workshop

As participants arrive, they will be asked to sign in and take a packet of information including: (a) the Prior Knowledge Questionnaire, (b) the PowerPoint presentation notes, and (c) a Classroom Modification Ideas form. On the whiteboard, at the front of the room, are the following instructions for the participants:

- Hello and welcome to The Male and Female Brain: What are the Differences?
- Please sign in and take a packet of information before finding a seat.
- Please take 10 minutes to fill out the questionnaire on your own, and we will go over them in a few minutes.

Welcome to an interactive workshop where you will be involved in the learning! You will have the opportunity to discover the differences between the male and female brain and how that affects learning and behavior in the classroom. In addition, you will leave this workshop with a list of classroom modifications that are easily executed to improve your classroom atmosphere. You will also have suggestions to use in your classroom to teach both genders to the best of their learning potential.

Icebreaker

In your packet, there is a note card with 5 learning styles listed. Please choose the one that best describes how you learn. Please stand next to the sign on the wall that corresponds with your choice. When everyone has chosen their learning style, we will discuss the differences among the group and how the different learning styles affect a classroom of learners. Participants may now return to their seats.

In that little demonstration, you saw how a classroom full of people can have different learning styles and require different teaching methods to learn at their highest potential. Every classroom has this issue, and when you consider the fact that the brain is so different and complex in its capacity for learning, gender brain differences add another variable to educating all students to their highest potential. We will now examine the questionnaire you filled out when you first came in and discover what discrepancies you may have in your prior knowledge regarding the differences between the male and female brain.

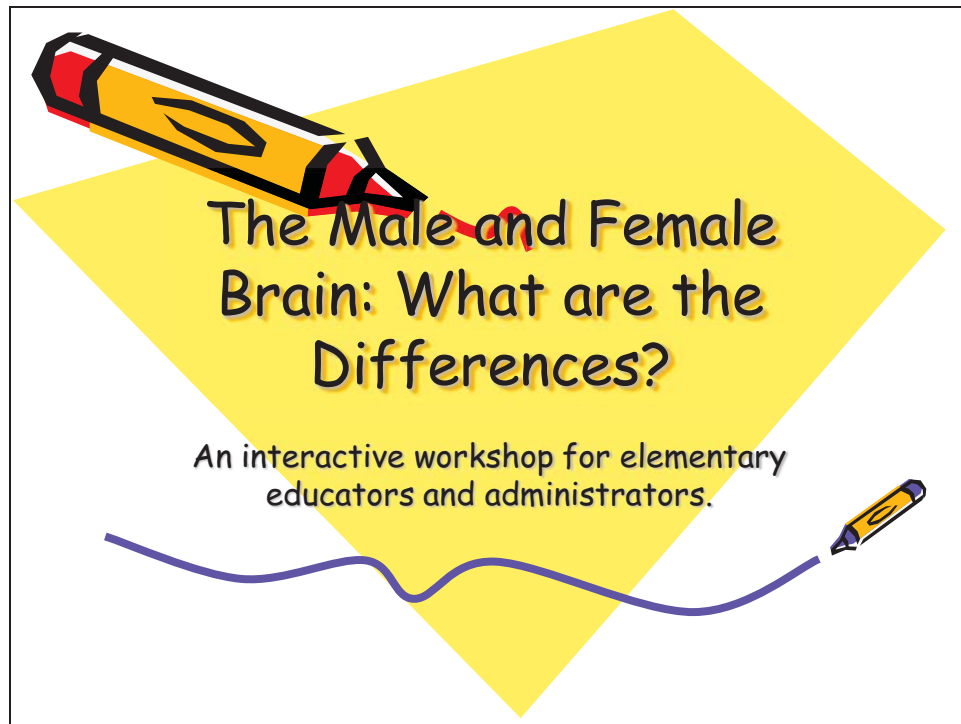
Questionnaire Answers for Review

Take out your questionnaire and let's go over the answers. We will then go through the PowerPoint presentation of research regarding brain differences between genders.

1. The male and female brain develop exactly the same at conception. F
2. Testosterone is first found in the male brain at 3 months of age. F
3. The male processing area uses both sides of the brain. F
4. Most teacher education programs have a course on the gender brain differences. F
5. A male brain has more fluid in its brain stem, allowing messages to move more quickly. T
6. The limbic system, which controls emotional memory and connections, is more acute in females. T
7. Who has a larger memory storage? Females
8. The amygdala is the area of the brain that processes what? Emotions

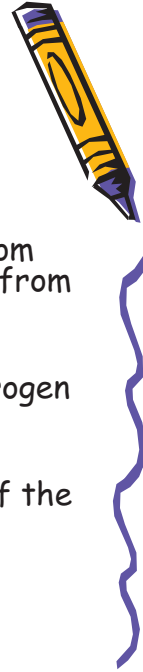
9. Males have a larger amygdala. T
10. The corpus collosum connects the left and right sides of the brain. Males have a larger corpus collosum. F
11. Females have a larger volume of neuropil (the chemical that makes cell to cell communication easier). T
12. The male's cerebellum (the part of the brain that controls reaction time) is smaller than a female's. F
13. Males tend to have a larger inferior parietal lobe (the portion of the brain that integrates information from other parts of the brain). T
14. The male brain uses both sides of the brain for language acquisition. F
15. Females have the ability to listen to up to 7 different auditory inputs. T
16. Males have a better chance to develop ADD. T
17. Which sex has a better sense of smell? Females
18. Which sex typically has better eyesight? Females
19. Which sex has a better sense of hearing? Females
20. Both sexes each have testosterone AND estrogen. T
21. Oxytocin is released in males when they hear a child cry. T
22. Which sex has a more difficult time metabolizing dopamine? Males
23. Which brain is more active? Females
24. Males have a **higher**/lower level of gray matter (thinking matter) and females have a **higher**/lower level of white matter (processing matter).
25. The male and female brains are extremely different. T

Some of these questions were meant to encourage you to stop and think about the students in your classroom and how they behave and what you have observed. Other questions covered research information that you may or may not have had the opportunity to explore in your teacher education courses. Please note that this questionnaire was meant to inspire you to delve further into the research that is available regarding brain differences in the two genders. Let's look at some of that research now. You will see in your packet that there are hard copies of the PowerPoint slides with space for note-taking.



Did you know?

- When a fetus forms, there are cognitive differences happening from DAY ONE!
- If the fetus is male, the brain will develop from the back to the front; a female's will develop from the front to the back.
- Females have testosterone in addition to estrogen in their brains.
- The 2 chemicals account for a large portion of the brain differences.



- The Y chromosome is present at conception and determines how the brain will develop.
- This proves that the brain development and sequence is different between the sexes.
- The 2 chemicals are extremely different in their composition but guide much of the brain's activities and abilities.

How Do We Know?

- Research has been done using positron emission tomography (PET), single photon emission computed tomography (SPECT) and magnetic resonance imaging (MRI).
- Gurian, Stevens & King are researchers in this field and have published many books on the subject along with MANY other researchers.
- Research on the brain dates back to the beginning of time, but more recently, in the past 10 years, it has expanded to include gender differences.
- The information in this PowerPoint is not meant to be a complete list of differences but instead a springboard for educators to discover what research is available on the topic of brain differences between the genders and how that can affect learning and behavior.



- Thanks to technology, scientists and researchers have found vast differences in the male and female brain.

Neurological Differences



- The brain stem sends messages back and forth, and the male brain has more fluid in this area, so messages move more quickly (this area also controls the fight or flight response).
- The corpus collosum is the bridge in the brain that allows the left and right hemispheres to communicate. A female's corpus collosum is larger and more dense, thus allowing them the ability to multitask. Females also can usually verbalize their feelings more quickly than males, who often need time to process their emotions into words.



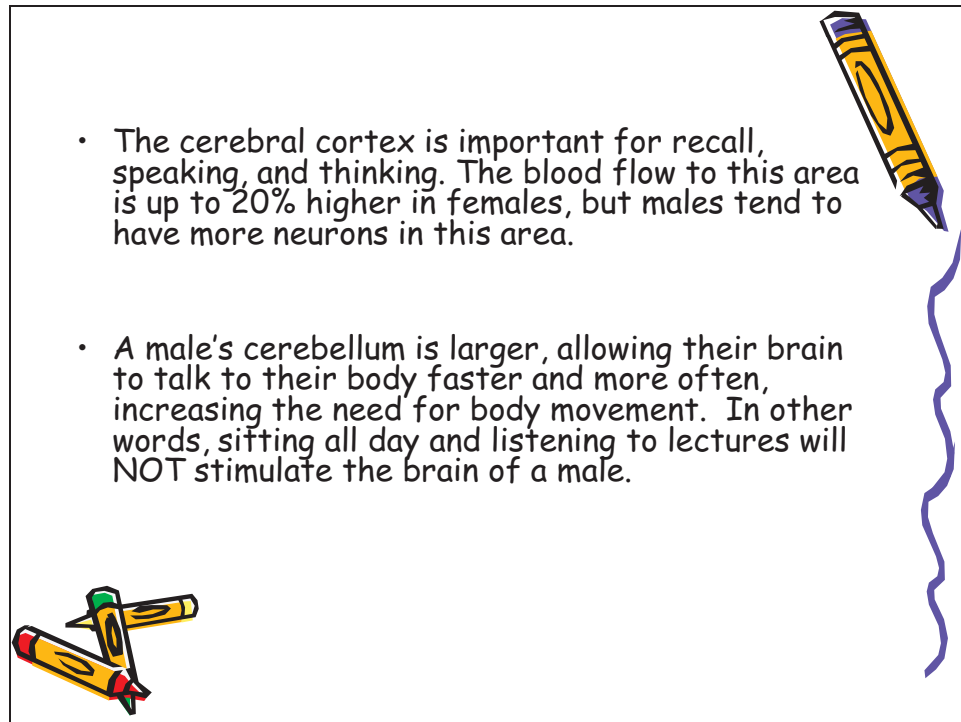
- Males tend to respond more quickly when they feel threatened or emotionally charged. This is due to their quick moving messages by the brain stem.
- Think about how the size and capabilities of the corpus collosum can completely change the way you think, move, react, etc. My niece was born with half of a corpus collosum and at the age of 5, has the capabilities of an 18 month old. This part of the brain is ESSENTIAL in large and small motor skills among other things.

- The limbic system controls sensory and emotional memory, which is more acute in females, resulting in increased emotional memory and the ability to read emotional cues better than most males.
- This area of the brain also allows women a natural tendency to make friends and nurture others. In the classroom, the limbic system may cause social discord for some males and females, as they struggle to control their sensory and emotional connections.



- 
- The hippocampus is the area of the brain that allows one's working memory to convert its information into long-term or permanent memory. It is important in retention and connection making during the learning process and is often larger in females, resulting in larger memory storage.
 - Males often show signs of increased impulsive responses relating to aggression; and this could be connected to the fact that their amygdala tends to be larger (the part of the brain that processes the emotions of anger and fear).
- 

- It is believed that emotions are connected to memories; therefore, when a memory is recalled, emotions can be conjured as well. In the classroom, the amygdala's size and utility could become an issue for males if they cannot control their aggression when faced with a difficult situation.




- Because females have a larger corpus callosum AND an increased blood flow to this area, they have an increased chance of raising their hand first and being called on in the classroom, giving them an increased opportunity to prove their knowledge base.
- When the cerebellum speaks to the body, the male's movements are often in reaction to the brain's impulses to move and be active.

Processing Differences


- The female brain utilizes both hemispheres of the brain.
- The male portion of the brain that controls language acquisition is only found in the left hemisphere.
- Females listen with both sides of their brain while males listen with one.
- Females can listen to and comprehend up to 7 auditory inputs simultaneously.



- With a larger corpus collosum in the female brain (allowing both hemispheres to transmit signals more rapidly), along with the fact that females listen with both sides and can listen to seven different sounds at once, a typical classroom setting is perfect for female learning.



- Males have more neural connections in the right hemisphere (giving them a need for more space to feel comfortable).
- Females have a more acute sense of smell, sight, and hearing; allowing them to take in more information tactilely than males.
- Females tend to see better since they have more cones in their eyes. They usually have better peripheral vision also.
- Males tend to be diagnosed more often with ADD. Why do you think that is?




- Males are movers. They need to be in motion for their brains to be able to make connections and comprehend.
- Female senses are more acute, which can cause issues for them in a classroom. For example, a female sitting next to the garbage can with a rotten banana in it will smell that and lose concentration.
- Females have more cones in their eyes, giving them better straight vision as well as peripheral.
- ADD is diagnosed in the U.S. every day, and more often, it is a male being diagnosed with it. With a classroom tailored to the female learner, it's no wonder males can't stay on task.

Chemical Differences


- Males and females have many of the same chemicals in their brains, just at different volumes.
- Serotonin makes us feel more comfortable and safe. Males have less of this. "If testosterone is the gasoline that powers the brain, serotonin slows the speed and helps one steer."
- Oxytocin gives us the feeling of empathy and concern for others. Females have more of this.



- Testosterone is a chemical derived from cholesterol in the body, and it controls all of the masculine traits for males. This chemical is found in females but in an extremely low dosage. Estrogen is also found in both sexes, but it is the main chemical found in the female body.



- Estrogen makes you more alert and sensitive to stimuli. Females have more of it.
- Progesterone affects nurturing and an overall feeling of well-being. Only females have this.
- Dopamine is a "feel-good" neurotransmitter, affecting things like fidgeting. Males tend to metabolize dopamine slower, increasing the amount of time it takes for them to calm down.




- There are many chemicals found in the brains of both genders, and they all have a particular job. The chemicals are essential to how the brain reacts to situations, interacts with others, and processes information.

Brain Characteristic Differences


- The female brain is always active, even during sleep.
- Males have more gray matter (thinking matter) while females have more white matter (processing matter).
- The male brain develops from the back to the front while the female brain develops from the front to the back...making the growth process completely different.



- The male brain actually has a larger mass than a female brain, but in this instance, size doesn't always dictate the ability.
- If the brain of a male and female develop in different sequences, their characteristics will be different as well.



- "The female brain is predominantly hard-wired for empathy while the male brain is wired for understanding and building systems." Baren-Cohen, 2003
- Males are wired to react first and ask questions later. Females tend to think before acting.
- Females can "read" body language better, while males do not tend to notice anything out of the ordinary.




- These brain characteristics are not absolute, and every individual is unique; but on the whole, these characteristics are found to be true for the majority of humans.

Educational Implications


- For hundreds of years, classrooms have catered to the female learner with paper and pencil work while seated at a desk, causing some to believe that single sex classrooms are the best way for all students to learn.
- According to Gurian (2008), if all educators taught to the strengths of males, females would learn just as well and males would benefit greatly.
- Males respond to **MOVEMENT**. Small movements can go a long way.



- Movement doesn't have to be a full game of baseball on the playground, but instead, a short break to get students moving and their blood flowing can be beneficial to all students. Females respond positively to this stimulation as well.



- Utilizing ones creativity can spark a desire to learn. Allowing for individual expression also fosters growth and learning.
- Technology is key to increasing interest and ability.
- Giving students **CHOICE** gives them the ambition to excel.



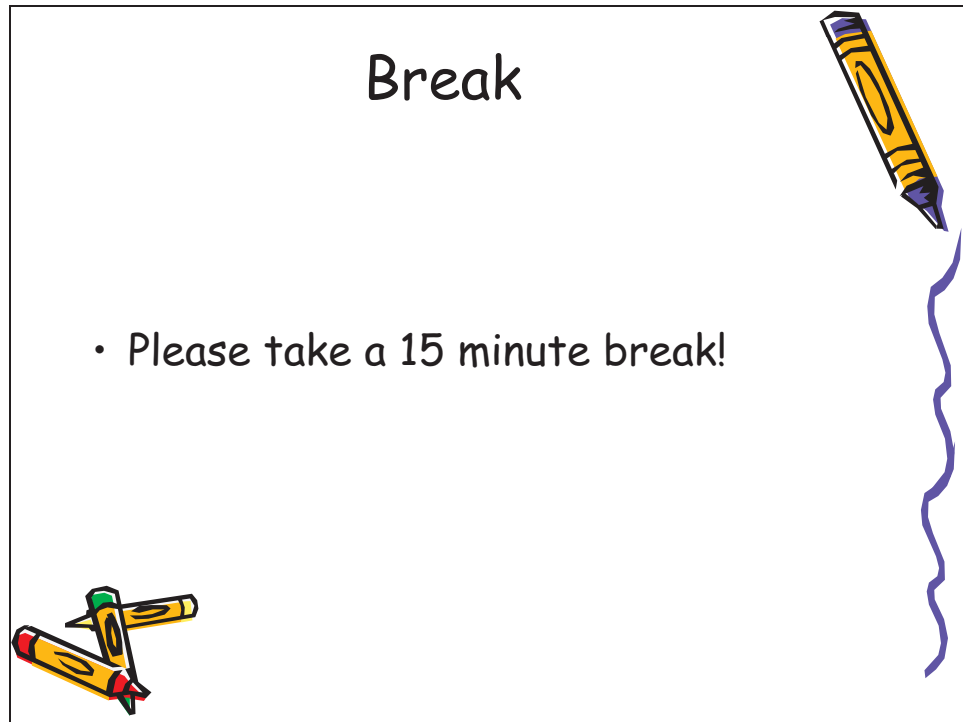
- Every student is unique, and their instruction needs to cater to those different needs and abilities as well. Creativity and **CHOICE** will spark their interest and give them the **MUCH** needed inspiration to excel and be successful students.

Summary

- The cognitive characteristics of males and females can be very different in chemical composition, processing abilities, and tendencies.
- Teaching to BOTH sexes can only improve the learning outcomes for both.
- Understanding students' cognitive differences allows everyone in the classroom to thrive.
- Implementing small changes to the classroom atmosphere and teaching techniques can make a large difference.



- You can take this information and store it in the back of your brain for further use, or you can go in your classroom and make some small changes that can positively affect every student in your room. Every student can benefit from changing things in a small way.



- Please take a small break and we will break into grade level groups when you return.

Small Group Work

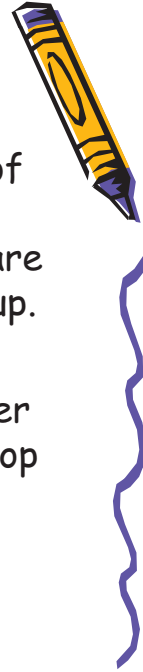
- I would like for you to divide into small groups as follows:
 - Kindergarten and 1st grade
 - 2nd and 3rd grade
 - 4th, 5th and 6th grade
- When you have found a place in the room to work, take a piece of large chart paper and create a list of teacher directed classroom techniques and suggestions for reaching both genders.
- We will discuss this as a whole group in 20 minutes. Please elect a representative to "report" to the whole group with your list.



- At this time, the facilitator will help with the division of groups and observe each group to be sure the dynamic is appropriate and that each group is working toward the end result of a list of ideas.

Large Group Discussion

- Now that you have put together a list of classroom modifications and ideas to better reach every student, we will share some of those thoughts as a whole group.
- May I have a volunteer to make a master list to be distributed after the workshop to the rest of the staff?



- Have one person come up to the whiteboard with their large sticky chart paper list and discuss them with the whole class. The volunteer making the master list will give it to the facilitator, who will type it up for distribution to the staff.

Conclusion

- Where do we go from here? You now know that most of the things you suspected are true...males and females are DIFFERENT! These differences are a HUGE part of who your students are and how they will learn in a classroom setting.
- It is my intent, and that of the administration, that you take this information and use it in your classroom. Please feel free to contact me with any questions you may have.

• Nikki Brooker...nikkibrooker3@yahoo.com



Chapter Summary

Teacher education courses prepare teachers for many aspects of the education profession, but research on the differences between the male and female brain is not usually a topic that is explored. As adults, it is easy to see the differences in males and females in our daily interactions with the opposite sex, but often, these differences are not remembered when in a classroom of little men and women. Their differences are an important aspect of their learning styles and abilities. Educators need to address these differences in a way that does not frustrate all involved. By gaining knowledge of the differences, teachers can individualize instruction for both genders and create a learning environment that inspires all students. This workshop is meant to spark an interest to further examine the differences in the male and female brain and how they affect the classroom environment and learning styles. This workshop is only part of the process, and the author intended to lay the foundation for understanding of how brain and gender differences affect learning. Hopefully, teachers will be inspired to create a learning environment that encourages all students to love learning.

Chapter 5

DISCUSSION

The brain is a complex and intricate system that powers the body and allows for learning, comprehension, coordination, walking, talking, and even breathing (Gurian, 2002). Since the brains of males develop in a different order than those of females, their abilities, nuances, characteristics, and development are unique and need to be understood by the professionals who are held responsible for educating and molding children's minds. The research presented in this project is a springboard for educators to use and examine further the differences and uniqueness of the brains of both genders and how that can affect the classroom atmosphere and learning environment. The purpose of this project was to create a workshop that will help all educators make the connections between brain development, gender differences, and classroom management.

Contribution of the Project

The content of this interactive workshop provides new and experienced teachers the opportunity to examine their knowledge base of brain research using the Prior Knowledge Questionnaire. Next, teachers were introduced to several research based facts regarding the differences between the male and female brain and how they affect learning. Finally, the participants were divided into grade level groups to brainstorm a list of classroom adaptations that can be made to further address the cognitive differences between the male and female brain. The large group was then assembled and a whole group discussion took place, while the presenter created a master list of adaptations. The

intent of the project is that the PowerPoint presentation serve as a launching pad for all educators to learn more about the differences between the male and female brain.

Limitations

Brain research has been conducted for many years, and it would be impossible to include all of it in a 1 day workshop. Expanding the workshop to include more time could allow for more research to be examined. Additionally, follow up in-services would be helpful to each educator that accepts the challenge to teach to every student, to collaborate and share ideas and techniques. Also, the workshop is targeted towards the female learner (since a majority of teachers are female) and could include more brain breaks and activities to stimulate all of the participants.

Peer Assessment Results

Four colleagues reviewed this project and provided feedback. Two of the four colleagues are current elementary teachers (both second grade), one colleague is a retired elementary teacher, and one colleague is a school administrator. This author met with each of them twice. At the first meeting, this author provided an overview of the project and direction regarding what kind of feedback was requested. The second meeting was to discuss their feedback after reviewing the PowerPoint slides. The feedback was overwhelmingly positive. Two of the teachers were requesting that their administration inquire into educating their staff in this research and were interested in learning more. The administrator was equally impressed and asked if this author would be willing to present the workshop to her staff. The overall consensus was that the workshop was applicable, useful, and comprehensive.

Recommendations for Further Development

Classrooms are typically composed of both genders and educators have the challenge of differentiating instruction to fit the needs of every student. Without the background knowledge of research regarding the male and female brain differences, teachers struggle with what accommodations need to be made to reach every student. A website for these modifications would be helpful for all educators to reference strategies to use when faced with a difficult situation. A link with the pertinent research would serve to educate and assist in creating a support system for teachers. Additionally, follow up in-services would be helpful to examine what modifications were made in the school and to address any further issues that may have arisen while adapting for brain differences.

Project Summary

The achievement gap between boys and girls can attribute to behavior issues, learning disabilities, and lower grades for boys (Gurian & Stevens, 2005). If educators were to address the gender brain differences within the classroom, this achievement gap could be closed, or at least reduced. The typical classroom is designed for the female learner, and leaving the male needs unaddressed makes for a classroom that is not conducive for most male learners to excel. One workshop alone can not solve the problem of an achievement gap, but if it sparks the interest of the participants so that they take the information, use it in their classrooms, and tailor their instruction and classroom atmosphere to meet the needs of all students, the goals of this workshop can be met.

REFERENCES

- Baron-Cohen, S. (2003). *The truth about the male and female brain*. New York: Basic Books.
- Blakemore, J., Berenbaum, S., & Liben, L. (2009). *Gender development*. Psychology Press. NY: Taylor & Franis Group.
- Boeree, G. (2002). The emotional nervous system. *General Psychology*. Retreived June 1, 2009, from <http://webpace.ship.edu/cgboer/genpsy.html>
- Brozo, W. (2006). Bridges to literacy for boys. *Educational Leadership*, 64, 71-74.
- Costello, B. (2008). Leveraging gender differences to boost test scores. *The Education Digest*, 73(9), 32-35.
- Dobson, J. (2001). *Bringing up boys: Practical advice and encouragement for those shaping the next generation of men*. Wheaton, IL: Tyndale House Publishers, Inc.
- Gabriel, J. (2001). The truth about boys and girls. *Brain Connection*. Retrieved May 9, 2009, from http://www.brainconnection.com/content/91_1
- Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic.
- Gurian, M. (2002). *The wonder of children*. New York: Atria Books.
- Gurian, M., Henley, P., & Trueman, T. (2001). *Boys and girls learn differently!: A guide for teachers and parents*. San Francisco: Jossey-Bass.
- Gurian, M., & Stevens, K. (2005). *The minds of boys: Saving our sons from falling behind in school and life*. San Francisco: Jossey-Bass.
- Gurian, M., Stevens, K., & King, K. (2008a) *Strategies for teaching boys and girls: Elementary level*. San Francisco: Jossey-Bass.
- Gurian, M., Stevens, K., & King, K. (2008b) *Strategies for teaching boys and girls: Secondary level*. San Francisco: Jossey-Bass.

- Hardin, M. (2000, November 28). *News flash: Men do hear -- But differently than women, brain images show*. Findings presented at the 2000 Scientific Assembly and Annual Meeting of the Radiological Society of North America. Abstract retrieved June 1, 2009, from http://www.medicine.indiana.edu/news_releases/archive_00/men_hearing00.html
- Haynie, W. (2008). Maximizing the learning value of tests in technology education classes: A summary of research findings. *The Technology Teacher*, 1-8.
- James, A. N. (2007). *Teaching the male brain*. Thousand Oaks, CA: Corwin Press.
- King, M. (2001, June 17). Boys and girls: What's the difference? *Connect for Kids*. Retrieved May 15, 2009, from <http://www.connectforkids.org/node/283>
- King, K., & Gurian, M. (2006). Teaching to the minds of boys. *Educational Leadership*, 64(1), 56-61.
- Larimore, B., & Larimore, W. (2008). *His brain, her brain*. Grand Rapids, MI: Zondervan.
- Lenroot, R., Gogtay, N., Greenstein, D., Wells, E., Wallace, G., Clasen, L., et al. (2007). Sexual dimorphism of brain developmental trajectories during childhood and adolescence. *NeuroImage*, 36(4), 1065-1073.
- Levine, M. (2002). *A mind at a time*. New York: Simon & Schuster.
- National Association For Single Sex Public Education. Retrieved May 31, 2009, from <http://www.singlesexschools.org/home-introduction.htm>
- Sabbatini, R. (1997). Are there differences between the brains of males and females? *State University of Campinas*. Retrieved June 3, 2009, from <http://www.cerebromente.org.br/n11/mente/eisntein/cerebro-homens.html>
- Sax, L. (2005). *Why gender matters: What parents and teachers need to know about the emerging science of sex differences*. Blackstone Audiobooks, Inc.
- Sternberg, R. (2008). The answer depends on the question: A reply to Eric Jensen. *Phi Delta Kappan*, 89(6), 418-420.
- Tileston, D.W. (2005). *10 Best Teaching Practices* (2nd ed). Thousand Oaks, CA: Corwin Press.
- Tyre, P. (2005). Boy brains, girl brains. *Newsweek*, 146(12), 59-60.

- Wasserman, L.H. (2007). The correlation between brain development, language acquisition, and cognition. *Early Childhood Education Journal*, 34(6), 415-418.
- Willis, J. (2008). Building a bridge from neuroscience to the classroom. *Phi Delta Kappan*, 89(6), 424-427.
- Zaidel, E., & Lacoboni, M. (2003). *The parallel brain: The cognitive neuroscience of the corpus callosum*. Boston, MA: Massachusetts Institute of Technology.

APPENDIX A

Prior Knowledge Questionnaire

Prior Knowledge Questionnaire

How much do you know about the male and female brain? Please take a few moments to answer the following questions. We will go over the answers in 10 minutes.

1. The male and female brain develop exactly the same at conception. T or F
2. Testosterone is first found in the male brain at 3 months of age. T or F
3. The male processing area uses both sides of the brain. T or F
4. Most teacher education programs have a course on the gender brain differences. T or F
5. A male brain has more fluid in its brain stem, allowing messages to move more quickly. T or F
6. The limbic system, which controls emotional memory and connections, is more acute in females. T or F
7. Who has a larger memory storage? Males or Females
8. The amygdala is the area of the brain that processes what?
9. Males have a larger amygdala (the portion of the brain that. T or F
10. The corpus collosum connects the left and right sides of the brain. Males have a larger corpus collosum. T or F
11. Females have a larger volume of neuropil (the chemical that makes cell to cell communication easier). T or F
12. The male's cerebellum (the part of the brain that controls reaction time) is smaller than a female's. T or F
13. Males tend to have a larger inferior parietal lobe (the portion of the brain that integrates information from other parts of the brain). T or F

14. The male brain uses both sides of the brain for language acquisition. T or F
15. Females have the ability to listen to up to 7 different auditory inputs. T or F
16. Males have a better chance to develop ADD. T or F
17. Which sex has a better sense of smell?
18. Which sex typically has better eyesight?
19. Which sex has a better sense of hearing?
20. Both sexes each have testosterone AND estrogen. T or F
21. Oxytocin is released in males when they hear a child cry. T or F
22. Which sex has a more difficult time metabolizing dopamine?
23. Which brain is more active?
24. Males have a higher/lower level of gray matter (thinking matter) and females have a higher/lower level of white matter (processing matter). Circle the correct answer for both.
25. The male and female brains are extremely different. T or F