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ARE KINDERGARTEN TEACHERS AWARE OF THEIR UNCONSCIOUS BIAS OF GENDER IN STEM (SCIENCE, TECHNOLOGY, ENGINEERING AND MATH) EDUCATION?

by
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A capstone submitted in partial fulfillment of the requirements for the degree of Master of Arts in Education: Natural Science and Environmental Education.

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TABLE OF CONTENTS

CHAPTER ONE:

Introduction……..3

My Foundation…….6

My Lens of Gratitude……...8

Conclusion……... 9

CHAPTER TWO: Literature Review……...……..11

Why? …….. ……..12

How Gender Determines Choice……. …….…...13

Gender Versus Sexulaity….. …….16

Stereotypes and Normative Behavior……..18

The Cycle……...22

Understanding the Cycle…….……...24

How Unconscious Bias Affects Student Learning……..26

Deconstruction of Gender Inequity…….30

Conclusion……..31

CHAPTER THREE: Project Description……..32

Introduction and Rational…….33

Timeline and Setting……35

Participants……....44

Challenges…….....44

Professional Development Framework Overview…….....35

Understanding the Adult Learner…….....36

Unconscious Bias and Self-Efficacy……...….37

Introspection……..…...…....39

Tools to Deconstruct the Cycle of Socialization…….……40

Summary…….….41

CHAPTER FOUR: Reflection……...…. 42

REFERENCES…….…43

CHAPTER ONE

Introduction

Over the past three years, I have been working with elementary teachers, all female, to support STEM in their classrooms. There has been an overwhelming theme of fear and doubt from these female educators to teach STEM education. While I may not understand where their personal fear and doubt comes from, I can feel and see where my own fear originated due to being a female child in my household. Growing up on a pig farm in Northern Wisconsin, there were many responsibilities that were required for each member of the family. The responsibilities that were placed upon me were very different from the responsibilities my male family members were expected to complete. I was more than capable of helping with cutting wood by holding the trunk of the tree as it entered the saw bed and carrying the cut log to the pile. However, when it came to executing the mechanical task of the saw bed, that responsibility was left to the males. This has affected me throughout my path in life because it has given me strength to prove my family wrong.

My concern is that the fears and doubts that many female teachers have at the elementary level are being projected onto their students. My hope is that if elementary educators can recognize their unconscious bias, they may have courageous conversations to stop the cycle of oppression and give young females the grit and strength to feel like they belong! *Are kindergarten teachers aware of their unconscious bias in STEM (Science, Technology, Engineering and Math) education towards gender?* My research

aims to create a workshop for elementary teachers to recognize their own unconscious bias towards gender equity in STEM. Through their learning, elementary teachers may help female and male students recognize that gender is fluid in order to promote gender equity. In return, it will give females, and just as notably, young males the courage to stand up for equity for all.

For the purpose of this study, Science, Technology, Engineering, and Math (STEM) is defined by the National Science Foundation as "the physical, biological, computer and information sciences, engineering and engineering technologies, and mathematics." (National Science Foundation, 2018) The social and behavioral sciences, such as psychology and economics, are not included, nor are medical areas, such as doctors and nurses. College and university STEM faculty are included when possible, but not high school nor middle school faculty.

Gaining an understanding of how and why young women are making the decision to not enter in the STEM academy is paramount to the future success of our programs and our country. The development of world-class talent in STEM is critical to America's global leadership according to the United States labor market. Supporting female STEM students is not only an essential part of America's strategy to out-innovate, out-educate, and out-build the rest of the world. It is also important to women themselves.

According to the National Girls Collaborative Project, "Male students were more likely than female students to take engineering (3% versus 1%) and computer science courses (7% versus 4%) and enrolled in AP computer science and at a much higher rate (81% males; 19% females)" (National Science Board, 2017). There are many factors that

attribute to these percentages. However, as educators, we can control the locus within our in classroom.

My Foundation

As a I reflect on my own conscious biases, it becomes apparent that the basic human need of belongingness is at the root of why young women may be falling through the STEM pipeline. When a human being feels as though they belong, there are greater possibilities they will be a part of a system rather than avoid it. "Some very recent research has shown that increasing people's sense of belongingness can help people, and minority students in particular, withstand the challenges of negative stereotypes in the classroom, producing higher GPAs and more success" (Walton & Cohen, 2011 as cited in Cook et al., 2012). If the message is that a young woman does not belong, then why would one join a system where she does not feel welcome?

Some of the conscious and unconscious gender biases that I see in the modern classroom continue to be uncannily similar to those I experienced growing up on a farm in Northern Wisconsin in the early 1980s and 1990s. My family valued being tough, tenacious, and resilient. At times, maintaining that persona was challenging, but in the end, it gave me a unique experience for which I am thankful. When I wanted to escape that persona as a child, I found security on the bank of the Namekagon River, that flowed behind our house. The Namekagon River became a place of tranquility and something that was concrete. It silenced the rage that took place under the roof I called home.

There was an animal on the Namekagon that had a special place in my heart, a Mallard Duck that I named "Willy." Willy did not judge, nor yell, scream or even raise a fuss when I slouched under the tree. As seasons changed, Willy would come and go. In

my young mind, he persisted just to come back and see me, as did I with him. Willy was my first teacher. He taught me the feelings of belonging and connection. Willy was important, because the environment that I grew up in cultivated a myriad of gender bias. Consequently, I knew that I was different. However, knowing that feeling to belong can be a key to success as Willy the duck was for me.

Throughout my childhood, I enjoyed doing "boy-only" activities. I enjoyed such things as playing baseball, collecting baseball cards, fishing, and building things. Often times, I was mistaken for a boy. I would tuck my hair up under my Oakland A's baseball cap because my mother refused to cut my hair. There was an expectation that I try to wear dresses and play with dolls. As the youngest of seven children, my two older brothers constantly reinforced that I was limited in my ability because I was a girl. While multiple times, I was expected to identify and retrieve a tool such as a crescent wrench, I was never expected to use it for its purpose, but rather hand it over to my brother or father. These stereotypes and patterns of men and their behavior was reinforced when I entered the social institution of school. I remember one specific time in kindergarten; my teacher, Ms. U, reprimanded me for playing trucks with the boys because that "was not very lady like." This affected me because I started to question my own path.

My Lens of Gratitude

As I entered the military in 2001, it became very apparent to me that my passion for doing "boy-things" had led me into a non-traditional career pathway. While in the military, on a daily basis, there were many reminders that I was not just a soldier — I was a *female* soldier. Day after day, I had to invariably prove myself by going above and beyond to obtain respect from my fellow soldiers. In 2008, I re-entered the civilian world

and began a career in the Army Corps of Engineers. The cycle of oppression continued and now I was labeled a *female* engineer not just an engineer.

At this point in my life, I was struggling with what actions to take. How do I make my beliefs and my behaviors congruent? My inner voice kept speaking to me, and I decided I to quit working for the Army Corps with the intent to create change. While my inner voice knew change needed to be created, I was not exactly sure what or how that change would look.

In 2010, I took one small step that created interesting repercussions and decided to enter a middle school classroom and teach STEM. I believed that small steps taken by thousands of people would eventually change the character of our communities. Once in the classroom, I found that public school perpetuated the stereotypes that I was on a mission to dissolve. My first teaching experience was in a traditional high school shop class setting (e.g. metals, woods, and autos). One of the other engineering teachers came up to me and said, "ponytails don't belong here," as well as engaging in other inappropriate gestures and actions.It was misogynistic and oppressive which made me frustrated and angry.

My roles of soldier, engineer, and educator have created within me a motivation for change. Since becoming a middle school STEM teacher, my goal is to treat students and peers as candles ready to be lit rather than vessels to be filled. Like most educators, I carry a dream inside—to teach young females and males to challenge and break the cycle of oppression and gender stereotypes, to usher in a new wave of liberation, empowerment, and equity for females who have been historically targeted by systemic injustice and gender stereotypes. I want to move forward and help young students with

pride in their identity, interrupting the cycle of oppression, and modeling a new way of behaving and believing.

As public educators, it is our responsibility to engage and speak out about the unearned privileges we enjoy as members of a dominant group, privileges we have been taught for so long to deny or ignore. Consider the words of Gandhi, "As human beings, our greatness lies not so much in being able to remake the world, as in being able to remake ourselves." I think this is paramount to create a tool so kindergarten and elementary teachers can recognize their own bias surrounding STEM and gender. With this new self-awareness of gender bias and its detrimental effects, the hope is it will allow all students the possibility to succeed in public education that extends into the workplace.

This project came to inception through my experience working with elementary teachers to create Science Technology Engineering and Math (STEM) integrated units and my personal quest to promote equity in STEM. The goal is to find ways to encourage female students to continue STEM. I am, however, tired of the articles and the research placing the blame on the young women of our society— placing the blame in a way that says it is their fault for not engaging in STEM activities. Granted, the problem of gender bias, as it relates to success, is one that extends well beyond K-12 classrooms, but in context of the educational setting, it certainly originates there. And how teachers may be embedding their own fears of STEM onto their students. So, how does the institution of education address it and create a safe learning environment?

Conclusion

In Chapter Two, I will address the dimensional identities that exist among the scale of gender and acknowledge the cycle of oppression and how it ties in with one's self efficacy as it specifically connects to teaching (STEM) curriculum. I will

contextualize and identify success factors, through practical and local methods, that will help examine the conscious and unconscious bias of kindergarten teachers in a classroom setting. The intended outcome is to create a classroom that is equitable for all students to learn.

CHAPTER TWO

Literature Review

Science, Technology, Engineering and Math (STEM) is a curriculum based on the thought of educating students in four specific disciplines (science, technology, engineering and mathematics) in an interdisciplinary and applied approach. During the Obama Administration, there was a movement to promote STEM equity for all. In 2013, President Obama set forth a campaign called "Educate to Innovate," which provided public education with one billion dollars to create motion in STEM equity across the United States. Rather than teach the four disciplines as separate and distinct subjects, STEM integrates them into a close-knit learning models based on real-world problems. The intent to integrate the four disciplines of STEM rather than separate them is to assist with the future careers. Students must understand that there is not one silo from which to work but rather all four disciplines fit together in the workplace. My research question: *Are kindergarten teachers aware of their unconscious bias in STEM (Science, Technology, Engineering and Math) education towards gender?* Gender, normative behavior, stereotyping and sex schemas, investigating STEM teaching efficacy and how that projects onto students in public school institutions are all factors that could impact their unconscious bias.

The U.S. Department of Education's mission is to "promote student achievement and preparation for global competitiveness by fostering educational excellence and

ensuring equal access"(U.S. Department of Education 2018). The social institution of public education maintains the goal that all students can succeed. In order to do this, educators must create an inclusive environment for all to learn. This thought process and schema is directly related to the number of young women entering the field of STEM (Table 1). When looking at the graph, it is remarkable that the percentage has gone up, in 2006 there were 19.3% females as opposed to 2014 there were 19.9%. However, the data shows that equality has consistently not been met because it was only .6%.

Bachelor's Degrees by Gender

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Female	19.3%	18.1%	18.0%	17.8%	18.1%	18.4%	18.9%	19.1%	19.9%
Male	80.7%	81.9%	82.0%	82.2%	81.9%	81.6%	81.1%	80.9%	80.1%

Table 1.Number of young women who attended public school and went on to STEM degrees as opposed to the number of males. (Yoder, 2015)

In 2014, less than twenty percent of the female population went into STEM fields. If the public education is supposed to be creating equal opportunity for their students as institutions, they are failing to generate female interest in STEM. The United States has historically been a leader in these fields, but fewer students have been focusing on these topics recently. According to the U.S. Department of Education (2018), only 16 percent of high school students are interested in a STEM

career[1] and have proven a proficiency[2] in mathematics. So according to include first name as well Smith:

> To meet the projected workforce need of 1 million additional STEM graduates by 2022, and to realize the vision of a highly diverse, creative, and sufficient STEM workforce and a STEM-literate citizenry, the nation must engage all students. This effort must include women and minorities who are poorly represented in many STEM fields—despite the fact that these demographic groups comprise more than two-thirds of college students. Failing to engage underrepresented groups will lead to shortfalls in our Nation's STEM workforce and, more importantly, will prevent the STEM professions from capitalizing on the power of human diversity, a historical strength and competitive edge of the American economy and will deprive some of our citizens from engaging in rewarding and remunerative careers (2017).

This is why there is a drastic push in STEM education. In order to address the underrepresentation of women in STEM, there is a need to investigate this root of the problem. This research will start at the beginning of public education in STEM because teachers are generally unaware of their own biased teaching behaviors because they are simply teaching how they were taught and the subtle gender inequities found within the

---

[1] According to the US Department of Labor the top projected STEM jobs are as follows: web developers; computer user support specialists and computer network support specialists; civil engineering technicians; and environmental science and protection technicians, including health.

[2] The term proficiency according to the Common Core website: To understand how proficiency works in educational contexts, it is important to recognize that all proficiency determinations are based on some form of standards or measurement system, and that proficiency levels change in direct relation to the scales, standards, tests, and calculation methods being used to evaluate and determine proficiency.

teachers schema are overlooked (Sadker & Zittleman, 2009). Generally, try not to end a paragraph with source information, but rather, with your words.

Rationale

The fact that there are comparatively few women in STEM fields is not a new phenomenon; however, the issue has become a topic of discussion by many scholars over the past few years due to high demand and the number of vacant jobs in STEM fields. As public educators, we are failing not only our young girls but also our young boys to have the opportunity to work with these young women.

A common thought throughout the literature is the concept of a "leaky pipeline" theory. This reference is regarding young women getting lost during the process of going into STEM fields due to possible discrimination or lack of interest. There is an overwhelming focus on how do we "fix" women and young girls to want to be and stay in STEM fields (Pell, 1996). There are many factors that cause young women to "leak out of the pipeline. However, foundational it starts at any early age that is why awareness needs to be brought to the attention of kindergarten teachers conscious and unconscious bias and the effect those biases can have on their students in STEM pathways. Kindergarten teachers' actions and words can affect our young girls as well as, and just as importantly our young boys, as it relates to their gender in STEM education.

How Gender Determines Choice

Gender is a label made by the social construct of humans. The label is what we have decided to use to "normalize" the behavior of certain group of people (Ridgeway, 2011). This construct is foundationally built by an individual's personal schema and is

very pertinent depending on the social construct built around that individual (Ridgeway, 2011).

Introducing Gender Schema Theory in 1981, child psychologist, add first name Berm believes that young women and men learn their roles by prescribed normative behavior within one's own culture. Normative behavior is defined by social psychologists as, "the influence of other people that leads us to conform in order to be liked and accepted by them" (Aronson, 2015, p. 75) which drives the individual into a certain group in order to gain acceptance. Thus, driving one's self into assimilation of what masculine and feminine means, acts, and looks like. As small children, Americans learn these schemas based on the culture they surround themselves with hence developing a sense of self-concept into their own societal norms. The child, in turn, applies schematic selectivity in order to develop self-concepts in their own eyes (Berm, 1981). Thus, boys and girls begin learning how to be men and women almost as soon as they are born.

According to Berm, nearly all societies teach their children two things about gender: they teach that the subordinate network of sex-related associations can develop a schema for the individual child; second, they teach the individual child the dichotomy between what it means to be male or female in the domain of one's own culture. The typical child learns from observing people such as a parent/guardian, a teacher, or peers. Then the child takes that experience and builds a schema of what may be considered normative behavior (Berm, 1981). This behavior then becomes a function of that child's existence with what is deemed appropriate and inappropriate behaviors.

Include first name Anderson (1983) gives the example of this sex-typing in elementary schools. The examples she gives include: girls and boys line up separately or

alternately; they learn songs in which the young men are strong and heros while young women need to be rescued. (Anderson, 1983), which continues to exaggerate sexual distinctions of males and females in public institutions. As small children, they work vigorously to understand their social world and label themselves within the context of gender (Anderson, 1983). The dichotomy of gender places people in a box, making explicit expectations based on one's sex.

The way that one has learned performance of gendered behavior---what we commonly associate with femininity and masculinity---is an act of sorts, a performance, one that is imposed upon us by normative societal expectations, as Judith Butler claims when she calls "a more radical use of the doctrine of constitution that takes the social agent as an *object* rather than the subject of constitutive acts" (1990, p.270). In other words, the American society has deemed normative behaviors for a girl to be a prescribed set of rules as defined by one's culture.

Metaphorically, we are all puppets that are attached to culturally constructed strings that are forced to act a certain way based on our social constructs that we, as humans, have created. While still inside the mother's womb, there is discussion of socialized colors of pink and blue. For example, gender reveal events are prevalent today; the socialized colors identify a baby's gender when a friend makes a cake and inside the cake there will be pink or blue frosting or when a piñata is filled with either pink or blue confetti. In a recent study done by a Harvard psychologist, it was found that "on the basis of posited social-role theory of gender and helping, that the male gender role fosters helping that is heroic and chivalrous, whereas the female gender role fosters helping that is nurturing and caring" (Crowley, 1996, p.16). The adults teach children

how to be a "grown up" through explicit lessons and through daily interactions with each other. For example, a mother who stays at home and does the homemaking propagates the stereotype that this is the "woman's job." Furthermore, Robbe Thorne deals extensively with the socialization of boys and girls in *Gender Play: Girls and Boys in School* (Thorne, 1993), explaining that the outliers who do not fall within this social construct are often outcast or viewed as abnormal within their own culture and society.

Gender Versus Sexuality

Part of the problem is the confusion around the terms sex, sexuality, and gender. One of the common misconceptions is that women who enter non-traditional career fields may be labeled automatically as part of the homosexual community. In order to make sense of the misuse of these particular labels, it is paramount that STEM teachers know the difference between: gender, sex, and sexuality.

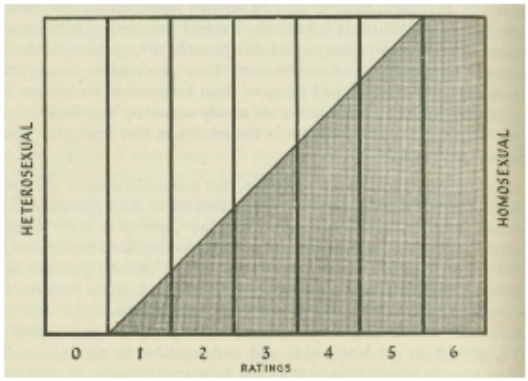
In the 6th edition of *Gender vs. Sexuality,* Lipps (2017) agrees that as a society we cannot use *gender* and *sex* interchangeably. According to Lipps, *sex* can only be used to describe a human's anatomical parts. On the other hand, she reinforces that gender is a label used to make roles within cultural expectations of a particular society. Societies over the decades have distinguished humans based on their anatomical parts, which creates a divide between humans. As a society, we need to deconstruct the gender schema and allow it to flow with the fluidity of the individual human. This distinction is "humanly made" by placing labels on the oppressed group (Schwable, 2002).

Centuries of research have been conducted around the term sexuality (Irvine 2017). She dates some of the early research back to when sexuality became a focus of medical study for scientists such as Richard von Krafft-Ebing (1840–1902), Havelock

Ellis (1859–1939), and Albert Moll (1862–1939), all of whom developed new methodologies and taxonomies of sexuality. Lipps goes on to discuss the evolution of the term *sexuality* in the United States culture.

According to the American Sociological Association, "Like gender, sexuality is not just biologically constructed, but is shaped by social and cultural factors. Empirical research on sexual identity and behavior reveals such great variation that sociologists refer to multiple sexualities rather than a single sexuality," (2017) making gender just as fluid as sexuality. The first reports published on this topic, *Sexual Behavior in the Human Male* (1948) by Alfred Kinsey and Wardell Pomery, used the Kinsey Scale (Figure 1) to show the sexuality continuum:

The Kinsey Scale: A scale used to rate sexuality.



Rating | *Description*
0 | *Exclusively heterosexual*
1 | *Predominantly heterosexual, only incidentally homosexual*
2 | *Predominantly heterosexual, but more than incidentally homosexual*
3 | *Equally heterosexual and homosexual*
4 | *Predominantly homosexual, but more than incidentally heterosexual*
5 | *Predominantly homosexual, only incidentally heterosexual*
6 | *Exclusively homosexual*
X | *No socio-sexual contacts or reactions*

Figure 1. The Kinsey Scale. (Kinsey & Wardell, as cited by Weinrich, 2014)

This scale challenges the commonly accepted binary thinking of 2 types of sexuality: heterosexuality and homoosexuality. Fineman (2010) notes that emotionologies—political, social, and cultural constructs of emotion—shape the values accorded to specific occupational groups. There tends to be a cultural expectation that if a woman is an engineer, she is automatically coined as being a lesbian. This fear of a

label may lead some young woman to not want to pursue a career in engineering. Because others have taught them that being a lesbian is wrong, they do not want that label upon them.

Stereotypes and Normative Behavior

The repetition of embedded societal norms of the gender schema develops what American society labels as gender norms. According to the American Psychological Association (2018), *gender norms* refer to, "the socially constructed roles, behaviors, activities, and attributes that a given society considers appropriate for boys and men or girls and women" (p. 2105). I like to think of it as a labeled box with assumptions made about individuals that makes it impossible to process and synthesis for those that fear difference.

Normative behavior can also be described as a stereotype or a label. In the book *Framed by Gender,* Ridgeway (2011) conceptualizes gender in the same manner as Sandra Berm, but goes into greater detail of how these gender lines create stereotypes, which then create inequalities for women. Stereotypes are placed on a particular group of individuals to elicit a negative connotation towards that particular group. Because gender is a primary social structure, it outlines roles within societal norms and how women should or should not act. Socialization and cultural norms shape the values, beliefs, and choices of young people. In particular, cultural histories related to "gender influence the cognitive, social, and emotional development of children and play a role in their academic identity formation (Ferrari & Mahalingam, 1998)." The normative behavior creates a socialization of stereotypes, for which there are widely held beliefs regarding which activities boys or girls are more likely to transcend in, or in which activities they

should or should not participate. Discriminatory treatment, often stemming from the social construct of males and females, can prevent them from pursuing certain career pathways.

According to Ridgeway (2011), stereotypes transcend institutional barriers and become a way of life and making sense between interactions of genders. This entrenchment of interaction between the two sexes becomes implicitly embedded in the individual's schema (Ridgeway, 2011). Giddens takes it to another step and states that not only are there implicit biases and explicit biases, but that stereotypes become "rules to the game" of a specific culture (2014). It becomes a set of instructions of how humans "ought (positive prescription)/ ought-not (negative prescription)" to be and act (Giddens, 2014). For example, if a woman chooses not to abide by the rules of the game, she may assume a new label that is undesirable. If a woman does not work within the social construct, she can be labeled as "domineering and arrogant" (Giddens, 2014). In the 6th edition of *Gender vs Sexuality,* Lipps describes this as "content of gender" stereotypes (2011). According to her research, social structures build a library of adjectives to describe the theoretical frame work of how and why men and women have different expectations in society (Lipps, 2011). Figure 2 is a list of descriptive words that Lipps found through Williams and Bennet.

Gender stereotypes have the capacity to reinforce or intimidate humans from making choices that do not coordinate with set gender roles in society (Eagly, 1987; Eccles, 1987; Raty et al., 2002). Research demonstrates that generating negative gender stereotypes can be destructive for the achievement of girls in tests of mathematics,

science, and spatial reasoning (Aronson, 2002; Aronson & Steele, 2005; Steele, Spencer, & Aronson, 2002).

Adjectives used stereotypically to describe the female and male gender.

	Females	
Affective	Fussy	Sensitive
Appreciative	Gentle	Sentimental
Charming	High Strung	Submissive
Complaining	Meek	Talkative
Dreamy	Mild	Weak
Emotional	Naggy	
Femine	Prudish	
Fickle	Rattlebrained	
	Males	
Adventurous	Dominant	Realistic
Aggressive	Daring	Stable
Ambitious	Independent	Steady
Assertive	Jolly	Stern
Courageous	Logical	Tough
Confident	Loud	Unemotional
Cruel	Masculine	
Daring	Rationale	

Figure 2. Adjectives stereotypically used with women and men (Bennet & Williams, 1975 as cited by Lipps, 2011)

In addition, stereotypes abrade female math self-efficacy within math and science-related fields (Steele, 1997), likely causing young women to identify with and pursue non-STEM pathways (Eccles et al., 1999). Gender socialization and cultural norms transcend beliefs, enthusiasm, and assumptions about STEM careers. Although unfavorable stereotypes and cultural values often remain for generations, before salient changes begin to materialize, there are ways to break the cycle of perpetuated societal norms.

The Cycle

As seen in the previous sections, the oppression of gender is like a closed loop system in engineering. The input into the system are our societal norms and stereotypes. As children grow older, the stereotypes feed the same rhetoric of what certain roles of gender "ought" to be. Hence, the stereotypes return to the initial input and is cycled again and again. The social system in the United States of America has been fed the same rhetoric for centuries about the capabilities around women in STEM fields. The system has created a macro-level social structure as well as a micro-level of individual self-disbelief. Bobbi Harro's (1984) research refers to this as the Cycle of Socialization (Figure 3). Women are systematically trained to stay in this loop, inevitably creating a core of: confusion, hurt, anger, and fear over and over again.

Understanding the Cycle of Socialization

According to Adams, Bell, & Griffin (1997), the Cycle of Socialization shows how humans are socialized to act upon certain roles within their own social structure as well as how humans are altered by the system of oppression. It also shows how humans aid in the perpetuation of the oppressive system function upon power of the dominant group. In *Maid in America* by Romero (1992), at the beginning of the cycle you have no control and as humans grow they are bombarded with messages that may be negative or positive. Which then generates internalized patterns that Romero calls boundaries that may limit that particular human's potential. Unless humans decide to step outside the

boundary and advocate for themselves and others, breaking the cycle of socialization will be a challenge.

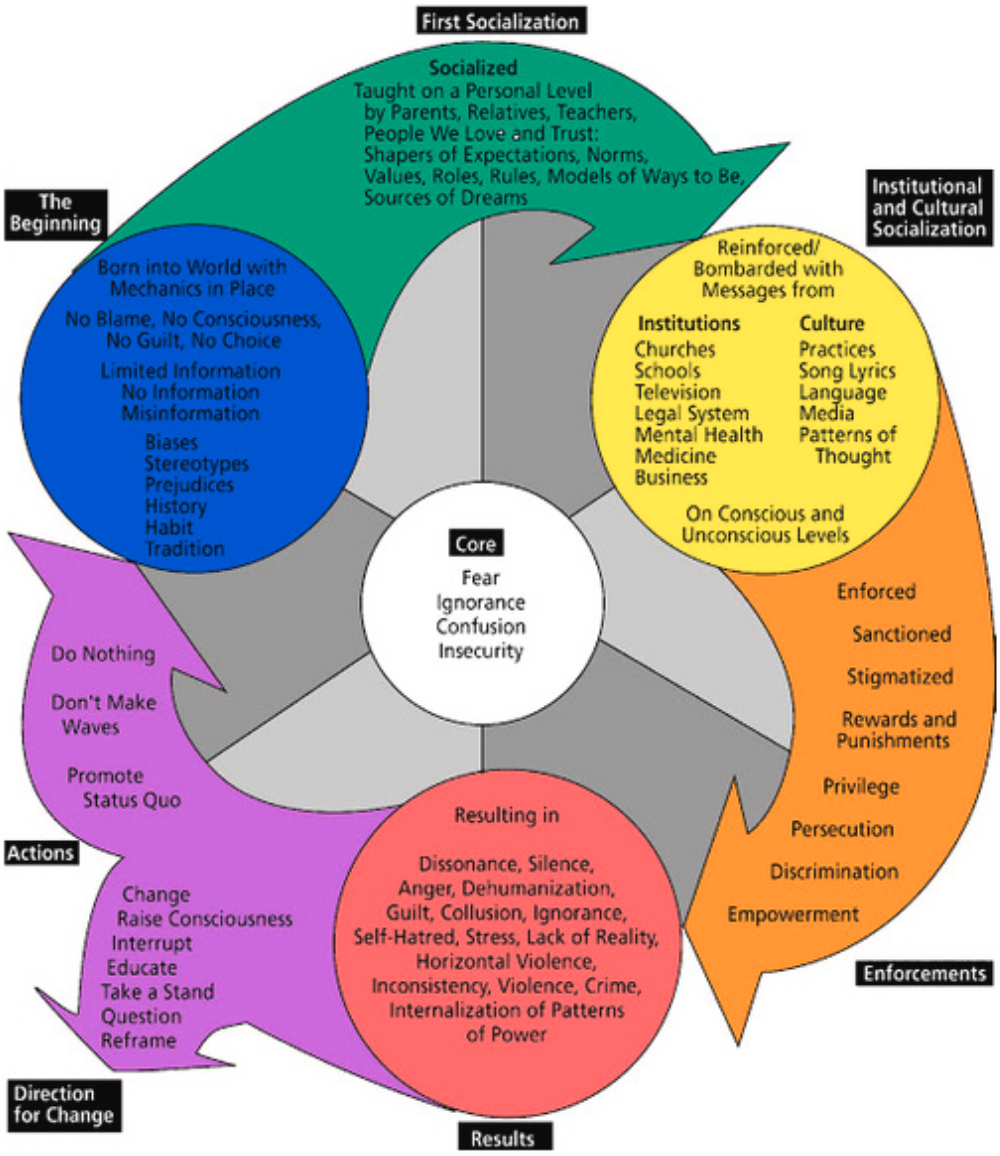


Figure 3. Bobbi, Harro. (1998) *CYCLE OF SOCIALIZATION (6)*New York

Throughout the research capsulized with women in engineering and STEM fields, the evidence shows a history of childhood events that lend to the differences in gender. The articles reviewed and analyzed demonstrate a development of stereotypical

judgments about which gender are capable of math, science, and engineering with children. The educators within the system, whether intentionally or unintentionally, play a role in sharing a perspective on the evolution of the distinction within gender 'norms'.

The effect on teachers.

According to United States Bureau of Labor, male educators only make up only 2.3% of pre-k and kindergarten teachers (2017). So there is a high probability that the first interaction the majority of kindergarten students in the United States will have is with a female teacher. If female teachers are carrying stereotypes and gender normative behavior ideals that they have been taught over and over again, one could assume that these thoughts may be projected onto their students. Some kindergarten teachers may not be aware that they are oppressed in the cycle of socialization because to the individual it has been normalized. Some female kindergarten teachers may begin to form negative mindsets about their capability in science, especially physical science, as early as second grade (Mitchell & Webber, 2015). So when teachers walk into to a classroom to teach a lesson in STEM, some may live with in the cycle of oppression perpetuating negative stereotypes; may it be conscious or unconscious.

The Wisconsin Department of Education requires pre-K teachers to only have one three credit course in math and science. This may develop some self-efficacy issues as well as carrying the backpack of oppression for female kindergarten educators because their exposure is very limited. Self-efficacy refers to individuals' beliefs about their capabilities to carry out a particular course of action successfully (Bandura, 1997). Several studies have been done to address the issue of whether a women's self-efficacy is an important factor of shaping their decisions about whether to enter STEM education

(Tellhed, Backstrom, & Bjorklunds, 2017). Though the concepts are theoretical, the implications are concrete. The messages students gather from years of socialization influence their attitudes about science and math, their self-efficacy beliefs, their choice of coursework, and even their future career plans.

Similar to efficacy, teacher confidence for teaching STEM is an important predictor of ability to teach STEM-related content (Ford, 2007; Jarrett, 1999). Harlen and Holroyd (1997) maintained that low teacher confidence can have a negative influence on student learning. Jarrett (1999) reported that teacher confidence is influenced by their K–12 educational experiences, teacher preparation curriculum, and informal learning opportunities. Teachers with poor self-worth toward STEM tend to neglect teaching STEM (Appleton, 2003). Since philosophies of the teacher are frequently transferred to their students (Deemer, 2004), poor self-worth toward STEM may be initiated and enhanced by teachers.

A study done by Knight and Cunningham, (2004), which asked students to simply take 5-10 minutes to sketch out on a scratch sheet of paper what an engineer looks like, found "When asked to draw a scientist, both male and female students are more likely to draw men. Of the 64 drawings with evidence of gender, 61% were male characteristics (short hair, square shoulders, necktie), and 39% were female (long hair)" (p. 15). Another study, done shortly after the release of the above information, was completed again, but instead with a group of female kindergarten teachers. The results of this from the teachers were congruent with those of the students asked to draw an engineer (Cunningham & Lachapelle, 2007). In a similar study, pre-K female teachers

overwhelmingly demonstrated the same stereotypes as well as misconceptions of what a person in STEM does.

How Conscious and Unconscious Bias Affects Student Learning

The articles reviewed and analyzed demonstrate a development of stereotypical judgments about which gender is capable of math, science, and engineering with students in a classroom setting. The educators within the system, whether intentionally or unintentionally, clearly play a role in sharing a perspective on the evolution of the distinction within gender 'norms'.

Over time, history has shown that there are stereotypical tendencies about gender and intellect. Research links intellectual capabilities and how the stereotypical viewpoints can affect children's interests. One such experimental study by Bian, Leslie, and Cimpian (2017) was administered at the University of Illinois and involved 400 children. The intent of the experiment was to see at what age children begin to establish the stereotypes surrounding intellectual capabilities and their interests. While there were differences between the boys and the girls, the study revealed that the stereotypes evolved very early in life; as early as the age of six.

According to one experiment, the word 'brilliance' was a word that boys, by the age of 6, were more likely to connect with as a descriptor where girls were less likely to attach to that label. In another experiment where games labeled as being for 'smart' children, girls, by age six, were less likely than their male counterparts to be interested in games labeled for 'really really smart kids'. Considering that some research shows that there is an assumption that being good at math and science is related to 'brilliance',

findings could pose a feasible reason for girls' decreased interest in being a participant in STEM fields (Bian, Leslie, and Cimpian 2017).

In a study sample done by Ball et al. (2017), using more than 1000 students in an urban setting where the population was in a predominantly minority school district in the southeastern United States, students' mindsets with regard to STEM were examined using the expectancy-value theory (EVT). The Expectancy-Value Theory posits that attitudes are constructed by expectancies for success as well as 'subjective task value', which is composed of several aspects, including the utility value---how practical does one see something aiding in the success of a desired end--- and the intrinsic value---how much one finds pleasure and significance from an activity. When intrinsic value is in play, it seems to be the steadiest predictor of high scores on math and science, according to Ball et al. (2017) and is also considered to be associated with greater confidence towards STEM. But again, there were gender disparities. As in the relation toward the importance of math and science, utility values and expectancies had a greater effect on girls' than on boys' attitudes. The researchers theorize that it may be akin to the fact that girls had a lower utility values and expectancies than boys. This information leads to another distinction between males and females and their attitudes toward STEM that manifests throughout childhood.

The question as to how gendered attitudes in young children form continues to be of some disagreement. For some, the evolution of gender disparities are seen as more or less 'natural' rather than something that is socially learned. Buser, Peter, and Wolter (2017) completed a study of 250 students in Bern, Switzerland that provides evidence of the argument. The eagerness with which to compete in eighth grade was a valid predictor

of selecting a math-intensive specialization one and a half years later in Swiss academic high schools. With boys being more willing to participate in competitions, there was a demonstration of further gender disparities for the educational choices that students made with courses.

Another area of gender disparities that play a role in developing stereotypical attitudes comes in part because of the social influences in life. These social influences can play a role in the choices that are made on both ends of the gender. Eliasson, Karlsson, and Sorensen (2017) administered a study of science classrooms in six schools in Sweden. The focus was on seven male and seven female teachers' classrooms and the science lessons they taught. Upon reflection of the lessons that were video recorded, it was discovered that the teachers leaned toward asking mostly closed-ended questions. The outcome of those questions was that the boys were much more inclined to answer the closed-ended forms of questions. The thought process for this reflection is that a closed-ended questions, in contrast to open ended questions, generally have one answer for the response and it takes less effort to vocalize a response to those closed-ended questions. It seems, boys are more likely to shout out an answer than girls. Whereas, open-ended questions seem to draw in greater participation from girls. The other factor in the research shows there are fewer open ended questions that are presented to the class so the conclusions could be questionable. In considering the difference between closed-ended versus open-ended questions, it can be recognized that closed-ended questions are simple in that there are limited set of possible responses. Whereas open-ended questions will require a greater sense of thought process giving deeper insights. So, the authors contend that closed questions are of a lower order requiring a minimum amount of thinking skills.

In connection with teachings in science classrooms, closed-ended questions lack the enrichment to learning. Consequently, if a different approach were taken with a focus on more critical thinking, the teachings of science could be amplified and encourage gender equality within the classrooms.

Another area of substantial influence for children's choice in majors and careers comes from parent occupations. Jacobs, Ahmad, and Sax (2017) used data from a national, longitudinal study of college students in the United States between 1976 and 2011, consisting of data for virtually one million first-year students, that found both mothers and fathers influence the choices of both daughters and sons. Research has shown that sons are more likely to pursue careers within the similar parameters as their father rather than their mother. Girls, over time, have also followed in their fathers' path with careers. However, since the 1990's, the roles mothers have has become more significant and influential to girls. With more mothers having careers within the STEM field, it seems natural that the influence for daughters to enter into careers within the STEM field would grow. However, there are still a limited number of females within the STEM field which lends to girls following few mothers into the STEM world. This continues to lend to building on the interest in the engineering profession for girls which seems to remain low. Jacobs et al. (2017) does not characterize the method by which parents impact their children's choices. However, childhood experiences on major and career choices later in life are a part of the impact for those choices.

Deconstruction of gender inequity. Although the majority of teachers believe in gender equality, "gender differences are deeply embedded in societal expectations, underpinning what it means to be a socially accepted person (Cushman, 2010, p.1213)."

Female teachers have been subjected to the American Cycle of Socialization their entire lives. As female kindergarten teachers walk into a kindergarten classroom, they carry with them a backpack of oppression. They have been told by other adults, the toy aisle, Disney movies, and social institutions that they should act and a be certain way. As educators of young boys and girls, kindergarten teachers need to be made aware that they are part of the cycle of socialization to help us in the balance of equality in order to eradicate the stereotypes of gender, normative behavior and sex-typing students. The goal is to create a classroom that every student can learn and feel there are no limits for them no matter how they identify. The students can just be viewed as a human rather than being labeled because of the anantomical parts that are between their legs. The cycle of socialization needs to stop the moment the children enter the door, so in kindergarten classrooms it is paramount that teachers address their own bias in STEM in how it relates to the gender of students. As educators of young boys and girls, kindergarten teachers need to be made aware that they are part of the cycle of socialization to help us in the balance of equality in order to eradicate the stereotypes of gender, normative behavior and sex-typing students. The goal is to create a classroom that every student can learn and feel there are no limits for them no matter how they identify.

Conclusion

In Chapter Three, teachers will partake in understanding how their unconscious bias towards STEM gender equity may affect students in their classroom by projecting stereotypes. Secondly, kindergarten teachers will have time to write their own gender identity story and reflect upon their own bias. Lastly, teachers will create a toolbox of

ways to deconstruct their unconscious bias and create a classroom of equity for all students.

CHAPTER THREE

Methodology

Introduction

A professional development workshop was created to focus on the research question presented in Chapter One, "*Are kindergarten teachers aware of their unconscious bias towards gender in STEM (Science, Technology, Engineering and Math) education ?"* In chapter two, the research focused on gender, normative behavior, stereotyping and sex schemas, investigating STEM teaching efficacy and how that projects onto students in public school institutions. Chapter Three describes the method in which the professional development workshop was developed to include key elements to promote equity in STEM education classrooms. In this chapter, I discuss: rationale, timeline, setting, and participants, as well as the framework of the professional workshop.

Rationale

The layers of oppression act like the foundation in a house. As you layer the bricks, you become entrapped in your thinking of how different genders should act or behave. Some of the bricks that influence young humans are parents, society, and social institutions such as public schools. As one of the few female engineering teachers in the state of Wisconsin, I have found that more and more people are reaching out to me to find out how to get more young women participating in their STEM programs. In my district, I am also working with elementary teachers to create integrated units in STEM.

The intention of this project is to create / build a professional development workshop to counter female bias towards STEM subjects. The goal is to show teachers how to see implicit bias and the self-fulfilling prophecy through building awareness of their unconscious bias around gender in STEM. As stated in the previous chapter, no single entity is at fault in the continual lack of growth and achievement for young women in STEM. Some kindergarten teachers come to school and have lived within the cycle of socialization their entire life and may lack awareness of their unconscious bias (Gorski, 2008). In creating a professional development workshop plan to support awareness of the implicit bias in STEM and to implement culturally responsive teaching practices, teachers will not only become aware of these topics but will also come away with strategies to counteract these unconscious biases in themselves (Gorski, 2008).

A study of Jones, Evans, Burns, and Campbell (2000) focused on how use of a gender resource model would affect gender-biased teaching tendencies. Jones et al. (2000) provided teachers with a self-aided module aimed at reducing gender bias in the classroom. The module contained research on gender equity in the classroom, with specific activities to aid in the reduction of stereotypical thinking in students, as well as self-evaluation worksheets for teachers. The findings from this study support the hypothesis that "...female students would move from a position of relative deficiency toward more equity in total interactions..." (Jones et al., 2000, p.6). This shows that teachers who are made conscious of their gender-biased teaching tendencies and are given strategies and resources to battle bias, will be better equipped to create gender equity in their classrooms.

Timeline and Setting

All certified staff in the Wisconsin school district in which I work are required to complete fourteen hours of floating Professional Development outside of their contract hours during the school year or by attending Summer Academy classes held on various dates. A 3-hour course titled unconscious bias of gender in STEM education will provide an option fulfillment of these professional development hours. Used for the Summer Academy classes, my classroom is a traditional woodshop; there are machines throughout and workbench-style seating. As a part of the presentations, there are PowerPoint slides coupled with multimedia resources such as TED Talks. As a part of the professional development, there are also multiple scholarly articles and professionals in the field to facilitate the conversation in greater detail. I also integrate Project Based Learning (PBL) into the presentation by having teachers physically make a wooden toolbox in hopes that it will have a long lasting effect on teachers. According to Strobel (2018) "comparing learning outcomes for students taught via project-based learning versus traditional instruction show that when implemented well, PBL increases long-term retention of content" and act as a reminder of gender bias.

Participants

My target audience is female and non-binary kindergarten teachers, but I would welcome others and hold separate sessions for those that identify as male. According to *Combining Human Diversity and Social Justice Education: A Conceptual Framework*: "Social work education has not yet formulated an explicit educational framework that combines diversity and oppression, but academicians are examining new approaches" (Van Soest, Canon, & Grant, 2000, p. 13). One of the new approaches is creating safe

spaces. According to the article "Safe Space: Student Perspectives on Classroom Environment," the term "safe space has been extended to refer to an autonomous space for individuals who feel marginalized to come together to communicate regarding their experiences with marginalization" (Holley & Steiner, 2013, p. 15). Although the majority of the research has been done with younger students, I would like to create an environment that is safe for female kindergarten teachers to be open.

Understanding the adult learner. I will be using Knowles's (1980) modern practice of adult learning: Andragogy. Andragogy is based on the assumption that, in order to be effective, teachers must explain to adult learners their reasons for teaching specific skills; learners must know "why." Effective instruction also involves the learner in solving real-life problems (Knowles, 1980). I will also be integrating Project Based Learning (Dewey, 1989) in order to have learners take on an active role in the learning process and use their prior skills, knowledge, and experiences to construct, design, and develop solutions to problems typically encountered in real-world scenarios (Savery, 2006).

Challenges. Unfortunately gender stereotypes have become a part of the American classroom culture. Addressing these issues with teachers may raise some challenges throughout the professional development workshop. While confronting an unknown bias may be uncomfortable for some teachers, it is important to address these feelings respectfully and personally. If a conversation becomes elevated due to varying perspectives on a topic, I will ask that person to discuss their concerns face to face. I also plan to have guest speakers who are currently employed in STEM fields to back up my claims and use data and scholarly articles and research to aid in courageous conversations

about unconscious bias toward gender in STEM (Science, Technology, Engineering and Math) education.

Professional Development Framework Overview

Teachers will be part of a three hour professional development workshop. The learning targets will be outlined by utilizing my school district template for professional development workshops (appendix A). The professional development workshop will be modeled after a multitude of different resources with the goal being that female kindergarten teachers will break down gender stereotypes.

During the professional development workshop, there will be three areas of focus for professional growth. Teachers will first define key terms: *gender, sex,* and *sexuality*. Teachers will then learn how the *cycle of socialization* has created oppressed and marginalized groups. Teachers will begin to understand why and how their unconscious bias exists. Teachers will then learn a framework that will aid in the deconstruction of their own oppression and examining one's own gender inequality which can assist in closing the divide between teachers and their own gender bias. Teachers will then use a framework similar to teaching in a culturally responsive classroom, as well as the eight principles of Landson and Billings, the growth and fixed mindset, and training in gender-responsive classrooms. After the professional development, teachers will be able to take time for reflection and evaluate how their experiences within the cycle of socialization form their interaction with students in the realm of gender equality.

Unconscious Bias and Self-Efficacy

Teachers will partake in understanding how their unconscious bias towards STEM gender equity may affect students in their classroom by projecting stereotypes; for

example, Dr. Rydell "found that one source was the girls' female teachers. The more anxious a teacher was about her own math ability, the more likely girls in her class endorsed the stereotype that 'boys are good at math and girls are good at reading.' And, when girls endorsed this stereotype, they showed less math achievement by school year end" (2015, p.5). In addition, female teachers' self-efficacy about their own capabilities of teaching STEM may impact both males and females in their classrooms (Rydell, 2015).

With the intention to create courageous conversations about gender, I have chosen articles, short video clips, and a practical activity to invoke powerful and meaningful conversations around gender equity in STEM. The articles are intended to provoke thought and not assign blame. The video is a clip from the organization of TED Talks, which is a source to build and encourage conversations. TED Talks is a nonpartisan nonprofit devoted to spreading ideas, usually in the form of short, powerful talks. According to the TED Talk website, they are "building a clearinghouse of free knowledge from the world's most inspired thinkers — and a community of curious souls to engage with ideas and each other, both online and at TED events around the world, all year long" (2018).

Secondly, I will be using an assessment tool called the Implicit Association Test (IAT), which is commonly used to measure implicit bias in individuals. According to The White House Office of Technology and Science:

> The IAT measures the strength of associations between concepts (e.g., black people, old people, or gay people) and evaluations (e.g., good or bad) or characteristics (e.g., athletic, smart, or clumsy). The IAT is based on the

> observation that people place two words in the same category more quickly if the words are already associated in the brain. For example, the rate at which a person can link the words "black" or "white" with "good" or "bad" indicates their implicit bias. In this 1 NRC. (2006) Beyond Bias and Barriers. National Academies Press, Washington, DC. 2 ways, the IAT measures attitudes and beliefs that people may be unwilling or unable to report (2018).

The intended purpose of having participated in the IAT is to aid the teachers in creating awareness about their unconscious bias. I will also be using portions from *Blindspot* (2013) by Mahzarin R. Banaji as part of the conversation so that teachers understand how their bias impacts them on daily basis.

Introspection

According to John Pepper (2016), introspection is the "process of being aware of one's own awareness" (p.208). Kindergarten teachers will have time to write their own gender identity story and reflect upon their own bias. This reflection will be used to evalute the teachers' reflections by utilizing an exit ticket. Exit tickets are a way to measure what the teachers are learning during the presentations (Pepper, 2018) which will help me know what the teachers' take-aways are. There will be several opportunities to collaborate about the emotion and feelings surrounding gender and how it affects their classroom environment. Continual work with gender and the type of projections they are presenting in school and how it affects student achievement is needed in order to make classrooms equitable. It is important for teachers to have transparency in their own lives before further working with students. Teachers will partake in readings from *Mindset*

(2006) by Carol Dweck and engage in more recent articles written by Dweck highlighting "false growth mindset." Dweck states that teachers need to tell students the truth so that teachers do not give students false hope.

Tools to Deconstruct the Cycle of Socialization

As stated in *Unconscious Bias in the Classroom: Evidence and Opportunities* (2017), the following steps will aid in the deconstruction of Unconscious Bias (UB) also known as implicit bias:

> Nurturing the motivation to reduce UB by building an awareness of one's own biases without shaming or blaming (Devine & Monteith, 1993). Building awareness of the shared psychological basis for UB (Burgess et al., 2007). Promoting evaluating individuals through individuation (unique attributes) rather than social categorization (group membership) (Blair, 2002). Reducing the anxiety of out-group interactions through increased contact between two or more social groups (Schellhaas & Dovidio, 2016). Enhancing emotional-regulation skills that promote positive emotions when interacting with out-groups (e.g., visualizing the "Best Possible Self"; Sheldon & Lyubomirsky, 2006). Increasing empathy and perspective taking (Dovidio et al., 2004; Okonofua, Paunesku, & Walton, 2016). Building a sense of partnership that reduces out-group status (Dovidio et al., 2004). (p. 11)

Kindergarten teachers are on the frontline of change. They are the students' first public institutional interaction that constructs educational schemas. The intent of this professional development workshop is to create a space where teachers can comfortably

expressing their own bias to be able to meet the needs of their students. During the deconstruction of their own bias, I will use several methods from Ladson-Billings in the *Dreamkeepers* (1994). Billings identified eight principles in culturally responsive practices: communication of high expectations, active teaching methods, practitioner as facilitator, inclusion of culturally and linguistically diverse students, cultural sensitivity, reshaping the curriculum or delivery of services, student-controlled discourse, and small group instruction.

Summary

The setting and participants involved in the professional development workshop opportunity are provided at the beginning of this chapter. The project description explains the content and lesson plan template for my professional development unit on the unconscious bias of kindergarten teachers (appendix A). In chapter 4, I will reflect on the process used to develop the workshop.

CHAPTER FOUR

Conclusion

Introduction

My project answers the question, *are kindergarten teachers aware of their unconscious bias of gender in Science, Technology, Engineering and Math (STEM) education?* I chose to focus on the gender discrepancy in STEM because it has directly affected my path and journey in life. I also chose the questions as this topic is becoming increasingly important to economic prosperity of our country. I wanted to create a resource for districts that are struggling to obtain young women interested in STEM education since this seems to be a systemic issue across the United States. This undertaking involved developing a process for participants to first realize their own lens in which they see the world and then creating an understanding how they may Participants are than asked to dissect their vocabulary to create a safe equitable space for all students can learn with the physical construction of a toolkit.

What I Have Learned

Throughout this process as a researcher, I have learned that organizing my thoughts into one succinct lesson is hard. I had to break down my topic into a myriad of sub topics in order to access the root of the issue. There are multiple factors that lead humans to have bias to gender and trying to synthesize that into the literature review was a very daunting task. I found that it was a lot easier for me to purchase physical books and use a color coded system to aid in my organization.

Connections to Literature Review

The part of the literature review that was the most helpful in the development of the workshop was Bobbi Harro's visual representations of the cyclical motion of The Cycle of Socialization in American culture. It clarifies where human's unconscious mind has been bombarded with social expectations of how and what to act like depending on your biological sex. According to Adams, Bell, & Griffin(1997), the Cycle of Socialization shows how humans are socialized to act upon certain roles within their own social structure as well as how humans are altered by the system of oppression. It also shows how humans aid in the perpetuation of the oppressive system function upon power of the dominant group. In *Maid in America* by Romero (1992), at the beginning of the cycle, you have no control and as humans grow, they are bombarded with messages that may be negative or positive. This then generates internalized patterns that Romero calls boundaries that may limit that particular human's potential. Unless humans decide to step outside the boundary and advocate for themselves and others, breaking the cycle of socialization will be a challenge.

Throughout the research capsulized with women in engineering and STEM fields, the evidence shows a history of childhood events that lend to the differences in gender. The articles reviewed and analyzed demonstrate a development of stereotypical judgments about which gender are capable of math, science, and engineering with children. The educators within the system, whether intentionally or unintentionally, play a role in sharing a perspective on the evolution of the distinction within gender 'norms'.

Tellhed, Backstrom, & Bjorklund's work around the theory of self efficacy was also astonishing statistical data which revealed that female kindergarten teachers had the

same stereotypes as their young students. And in return, Jarrett (1999) reported that teacher confidence is influenced by their K–12 educational experiences, teacher preparation curriculum, and informal learning opportunities. Teachers with poor self-worth toward STEM tend to neglect teaching STEM (Appleton, 2003). Since philosophies of the teacher are frequently transferred to their students (Deemer, 2004), poor self-worth toward STEM may be initiated and enhanced by teachers. While building the workshop, the fears and oppression was definitely something I had to be mindful when creating the lessons.

Implications

Equity in STEM education is not only important at a classroom level but as a nation in order for the United States to compete on an international level. This workshop strives to help participants to recognize that it is not their fault if they have inherent fears about teaching STEM. It was constructed for the participant to understand their lens and unconscious bias in which they see the world. Once the metaphorical lens has become focused then having participants understand how to deconstruct and The Cycle of Socialization by physically constructing a tool box of self efficacy to help them understand gender normative behavior.

Limitations

Unfortunately there are many limiting factors to this workshop. This is a workshop developed with the intent to be used with all kindergarten teachers, however, it is not connected to any standards. It requires school districts to find a person who would be willing to share this information and make themselves part of the process. The school

district would also have to set aside professional learning time for participants to receive the information.

One of the driving factors for this professional development is that it left flexibility to allow participants to share their struggles and triumphs. The lessons are designed to invoke courageous conversations and finding a person to lead those conversations maybe difficult.

Future Projects

Schools across the country are trying to encourage more young women to become interested in STEM education, and because of this, I see the potential to expand upon my thinking. The Wisconsin Department of Education requires pre-K teachers to only have one three credit course in math and science. This may develop some self-efficacy issues as well as carrying the backpack of oppression for female kindergarten educators because their exposure is very limited. Self-efficacy refers to individuals' beliefs about their capabilities to carry out a particular course of action successfully (Bandura, 1997). Several studies have been done to address the issue of whether a women's self-efficacy is an important factor of shaping their decisions about whether to enter STEM education (Tellhed, Backstrom, & Bjorklunds, 2017). Though the concepts are theoretical, the implications are concrete. The messages students gather from years of socialization influence their attitudes about science and math, their self-efficacy beliefs, their choice of coursework, and even their future career plans. I would like to see more training put into pre-service teaching so that female teachers come to kindergarten classrooms affirmed that math and science are not scary concept to teach. I think it is necessary to carry out a

longitudinal study to see if building self-efficacy in teachers would project onto their students in long run.

Communications

I am providing an opportunity with my current school district staff to be a part of this professional development experience. The staff are required to complete fourteen hours of floating Professional Development outside of their contract hours during the school year or by attending Summer Academy classes held on various dates. A 3-hour course titled *Unconscious Bias of Gender in STEM Education* will provide an option fulfillment of these professional development hours. I have also been asked to talk at our state organization Wisconsin Technology and Engineering Education Conference where I will host a break out session.

Long-term Benefits

This professional workshop has the potential to increase the number of young women going into STEM careers. In return, the increase of young women in STEM would close the shortage of qualified workers in United States. More importantly, generating young females to have the courage and grit to become leaders in STEM careers across our nation.

Conclusion

This project has given me the ability to answer the following question *are kindergarten teachers aware of their unconscious bias of gender in STEM education?* This project has also become a resource for me when other professionals are searching for the why and how as a district we have a 1:1 ratio of males to females in our 8th grade STEM courses. This is a topic I am truly passionate about to help create change for our

future leaders in STEM because the female voice needs to be brought to STEM world. And my hope is it will give young teachers the grit and courage to have conversations with young women and young men about playing with “boy” toys and and in turn making it about ‘human’ toys.

References

Andre, T., Whigham, M., Hendrickson, A., & Chambers, S. (1999). Competency beliefs, positive affect, and gender stereotypes of elementary students and their parents about science versus other school subjects. *Journal of Research in Science Teaching, 36*(6), 719-747.

Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. Retrieved from https://papers.ssrn.com/abstract=1964782

Beilock, S. L., Gunderson, E. A., Ramirez, G., & Levine, S. C. (2010). Female teachers' math anxiety affects girls' math achievement. *Proceedings of the National Academy of Sciences, 107*(5), 1860-1863.

Bem, S. L. (1983). Gender schema theory and its implications for child development: Raising gender-aschematic children in a gender-schematic society. *Signs: Journal of Women in Culture and Society, 8*(4), 598-616. doi:10.1086/493998

Bielby, W. T. (2000). Minimizing workplace gender and racial bias. *Contemporary Sociology, 29*(1), 120-129. doi:10.2307/2654937

Blakemore, J. E. O., Berenbaum, S. A., & Liben, L. S. (2008). "*Gender development"*. New York City, New York: Psychology Press.

Bottia, M. C., Stearns, E., Mickelson, R. A., Moller, S., & Valentino, L. (2015). *Growing the roots of STEM majors: Female math and science high school*

faculty and the participation of students in STEM. Retrieved from http://www.sciencedirect.com/science/article/pii/S0272775715000035

Brainerd, C. (2008). "*Developmental review*" Retrieved from https://www.journals.elsevier.com/developmental-review

Ridgeway, C. L. (2011). *Framed by gender: How gender inequality persists in the modern world*. Retrieved from http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780199755776.001.0001/acprof-9780199755776

Committee on Integrated STEM Education. (2014). In Greg Pearson, Heidi Schweingruber (Eds.), *STEM integration in K-12 education : Status, prospects, and an agenda for research*. Washington, D.C.: National Academies Press. Retrieved from http://ebookcentral.proquest.com/lib/hamline/detail.action?docID=3379257

Crespi, I. (2018). *Gender socialization within the family: A study on adolescents and their parents in Great Britain.*ido:10.1177/2158244015595258

Smith, D. F. (1973). Yes, american schools are feminized. *The Phi Delta Kappan, 54*(10), 703-704.

Dewey. J. (1889). *School and society.* New York, NY: Penn State Press.

E. Katherine, & Shartriya, C. (2018). *Social justice and parent partnerships in multicultural education contexts.*New York City, New York : IGI Global.

WhiteHouse.gov. (n.d.). Educate to innovate. Retrieved from https://obamawhitehouse.archives.gov/node/175736

Fleming, P. J., & Agnew-Brune, C. (2015). Current trends in the study of gender norms and health behaviors. *Current Opinion in Psychology, 5*, 72-77. 10.1016/j.copsyc.2015.05.001 Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4461071/

Gorski, P. (2008). The myth of the culture of poverty. *Educational Leadership, 65*(7), 32– 36.

Gerde, H. K., Pierce, S. J., Lee, K., & Van Egeren, L. A. (2018). Early childhood educators' self-efficacy in science, math, and literacy instruction and science practice in the classroom. *Early Education and Development, 29*(1), 70-90. doi:10.1080/10409289.2017.1360127

Harro, B. (1998) *CYCLE OF SOCIALIZATION.* New York, NY: Routledge.

Hart, H. H. (1976). *A compendium*. New York, NY: Hart.

Holley, L. C., & Steiner, S. (2005). Safe space: Student perspectives on classroom environment. *Journal of Social Work Education, 41*(1), 49-64. doi:10.5175/JSWE.2005.200300343

Hughes, E. C. (1945). Dilemmas and contradictions of status. *American Journal of Sociology, 50*(5), 353-359. doi:10.1086/219652

Irvine, J. M. (2014). Is sexuality research ‘dirty work’? institutionalized stigma in the production of sexual knowledge. *Sexualities, 17*(5-6), 632-656. doi:10.1177/1363460713516338

Keller, C. (2001). Effect of teachers' stereotyping on students' stereotyping of mathematics as a male domain. *The Journal of Social Psychology, 141*(2), 165-173.

Kettrey, H. H. (2016). What’s gender got to do with it? sexual double standards and power in heterosexual college hookups. *The Journal of Sex Research, 53*(7), 754-765. 10.1080/00224499.2016.1145181

Killermann, S. (2013). *The social justice advocate's handbook : A guide to gender / written & illustrated by Sam Killermann*. Austin, TX: Impetus Books.

Bureau of Labor Statistics. (n.d.). Kindergarten and elementary school teachers: Occupational outlook handbook. Retrieved from https://www.bls.gov/ooh/Education-Training-and-Library/Kindergarten-and-elementary-school-teachers.htm

Knowles, M. (1980). T*he modern practice of adult education: Andragogy versus pedagogy. Rev. and updated ed.* Englewood Cliffs, NJ: Cambridge Adult Education.

Knowles, M. (1984). *Andragogy in action: Applying modern principles of adult learning.* San Francisco, CA: Carney

Jossey-Bass.Jones, K., Evans, C., Byrd, R., Campbell, K. (2000) Gender equity training and teaching behavior. *Journal of Instructional Psychology, 27*(3), 173-178.

Lips, H. M. (2017). *Sex and gender: An introduction, sixth edition.* New York City, New York: Waveland Press.

Martin, C., DiDonato, M., Clary, L., Fabes, R., Kreiger, T., Palermo, F., & Hanish, L. (2012). Preschool children with gender normative and gender non-normative peer preferences: Psychosocial and environmental correlates. *Archives of Sexual Behavior, 41*(4), 831-847. doi:10.1007/s10508-012-9950-6

Marvin, F. O. (1901). The cultural value of engineering education. *Science, 14*(343), 121-126.

Nadelson, L. S., Callahan, J., Pyke, P., Hay, A., Dance, M., & Pfiester, J. (2013). Teacher STEM perception and preparation: Inquiry-based STEM professional development for elementary teachers.*The Journal of Educational Research, 106*(2), 157-168. doi:10.1080/00220671.2012.667014

Pell, A. N. (1996). Fixing the leaky pipeline: Women scientists in academia. *Journal of Animal Science, 74*(11), 2843-2848. 10.2527/1996.74112843x Retrieved from https://academic.oup.com/jas/article/74/11/2843/4624842

Pepper, J. (2016, June 20). Pepperspectives: Over Coming implicit bias. Retrieved from http://pepperspectives.blogspot.com/2016/06/overcoming-implicit-bias.html

Plante, I., Protzko, J., & Aronson, J. (2010). Girls' internalization of their female teacher's anxiety: A "real-world" stereotype threat effect? *Proceedings of the National Academy of Sciences, 107*(20), E79.

Edutopia.org. (2018). Recognizing and overcoming false growth mindset. Retrieved from https://www.edutopia.org/blog/recognizing-overcoming-false-growth-mindset-carol-dweck

Ridgeway, C. L. (2011). *Framed by gender: "How gender inequality persists in the modern world."* Oxford, UK: Oxford University Press.

Rinke, C. R., Gladstone-Brown, W., Kinlaw, C. R., & Cappiello, J. (2016). Characterizing STEM teacher education: Affordances and constraints of explicit STEM preparation for elementary teachers. *School Science and Mathematics, 116*(6), 300-309. 10.1111/ssm.12185

Romero, M. (2016). "*Maid in the USA."*New York CIty, New York: Routledge.

Roopnarine, L. (2005). *The cycle of racial oppression in guyana*. Mona, Guyana: Taylor & Francis Ltd.

Ruble, D. N., Martin, C. L. and Berenbaum, S. A. (2007). Gender Development. In Handbook of Child Psychology (eds W. Damon, R. M. Lerner and N. Eisenberg). doi:10.1002/9780470147658.chpsy0314

Rydell, S. (2018, April 15th). *When negative gender stereotypes hang heavy in the classroom, girls learn less*. *"Psychology Today." Retrieved from*

http://www.psychologytoday.com/blog/choke/201008/when-negative-gender-stereotypes-hang-heavy-in-the-classroom-girls-learn-less

Sadker, D. & Zittleman, K. *(2009). "Still failing at fairness*."Retrieved from http://www.simonandschuster.com/books/Still-Failing-at-Fairness/David-Sadker/9781416552475

Smith, M. (2016). STEM for all. Retrieved from https://obamawhitehouse.archives.gov/blog/2016/02/11/stem-all

Shapiro, J., & Williams, A. (2012). The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. *Sex Roles, 66*(3), 175-183. doi:10.1007/s11199-011-0051-0

Snyder, C., Peeler, J., & May, D. J. (2008). Combining human diversity and social justice education: A conceptual framework. *Journal of Social Work Education, 44*(1), 145-161.

STEIN, A., & PLUMMER, K. (1994). "I can't even think straight": Queer theory and the missing sexual revolution in sociology. *Sociological Theory, 12*(2), 178.

Taningco, M. T. V., Mathew, A. B., & Pachon, H. P. (2008). *STEM professions: "Opportunities and challenges for latinos in science, technology, engineering, and mathematics. A review of literature."* Tomas Rivera Policy Institute. (ED502063)

U.S. Department of Education. (2011). Mission. Retrieved from https://www2.ed.gov/about/overview/mission/mission.html

Wang, M., & Degol, J. (2013). Motivational pathways to STEM career choices: Using expectancy–value perspective to understand individual and gender differences in STEM fields. *Developmental Review, 33*(4), 304-340.

Voyer, D., PhD. (2016). When stereotypes affect our thinking. *Psychology Today.* Retrieved from https://www.psychologytoday.com/blog/perceptual-asymmetries/201602/when-stereotypes-affect-our-thinking

Yoder, B. L. (2018). Engineering by the numbers. Retrieved from https://www.asee.org/papers-and-publications/publications/college-profiles/15EngineeringbytheNumbersPart1.pdf

Appendix A

Gender Equity

Instruction Plan:
Facilitating Awareness of Gender Equity in Female Kindergarten Teachers

Objectives: •	**An Invitation:** •

Team Members: Jodie Bray

Professional Learning Agenda			
Time		**Why - Purpose**	**How - Process** **Materials Needed**