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The Benefits of Racial Representation in the Middle School Science Classroom

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Introduction

Introduction

When you think of a scientist, who do you think of? If I were to stop you in the street and ask you to name the first scientist that comes to mind, who would it be? I would bet that it would most likely be Albert Einstein, Isaac Newton, Thomas Edison, or someone of the like. Why is this the case? When going to school, these are the scientists that I had learned about. I did not learn about scientists and engineers of color or women scientists until either high school or college. I have also found this to be the case for many of my students.

In my short experience as a teacher, I have taught at a variety of different schools. From an urban school to the suburbs of the Twin Cities to an upper-middle-class town. Throughout my time at these schools, I have noticed a distinct difference in the diversity of the student populations. Because of these differences, conversations regarding race would either be welcomed and initiated by students or the exact opposite. Through these interactions and my experience at my current school, it has become important to me to bring representation into my science classroom. This is why I have chosen the research question: *How does representation of different races and ethnicities impact middle school students in the science classroom?*

This chapter focuses on my journey to this research question. I explain why this topic is important to me and the relevance to my profession. I will also go over why this topic is important to my colleagues and students. This chapter will end with an overview of what to expect when reading the rest of this paper.

How I Came to My Research Question

Growing up in a small town, I was very aware of being one of the few people of color in my school. With this came uncomfortable questions from both teachers and my peers. People were always curious about me, my culture, and my ethnicity, but I rarely saw myself within the content that I was being taught. There were very few times where I remember learning about Asian people in history class, other than the various wars there that the US has been involved in. I especially do not recall learning about Asian writers in English class. In my science classes, the absence was even more noticeable.

Coming from a biracial family, I had always had this internal struggle of outwardly looking Asian, but "feeling" white. My upbringing was not so different than the average kid in my town. Even though I am half Korean, my exposure to my Korean culture is mostly limited to cuisine. However, because I am a person of color, none of my peers saw the similarities we shared. This went on throughout elementary school, and into middle school.

In my seventh grade social studies class I specifically remember my teacher introducing Culture Week. This was a week where every student chose a country to research. For this project, students were to prepare a presentation on the culture of their chosen country, cook one item of food, and dress in the country's clothing. I was quick to choose South Korea and remember diving into my research by asking my mom questions about the life she remembers when she had lived there. I thought about the food my family would make on Korean Day. I looked in my mom's closet and chose which hanbok (similar to a Japanese kimono) I would wear when I gave my presentation.

This project made me excited to share my culture with my classmates and it made me very proud to be an Asian American. My experiences with this project will always be met with fond memories. It might not have been as significant to my peers, but it was huge to me. The feelings I had with my Culture Week project are how I want my students to feel all of the time, not just for one week. I want my students to identify with what we are learning and to see that the scientific community is more than just the Western world. It's more than what I was taught, which was confined almost exclusively to American and European white men.

It was not until college when I started to see people who looked like me at school. This is also where I had the opportunity to learn about a vast majority of people. This included people of different races, genders, sexualities, nationalities, etc. For my education degree, I took a class called Diversity and Education. One assignment, in particular, has stuck with me – the Identity Paper. Within this paper, I was challenged to write about who I was. Through this paper, I looked back at my schooling and how it has affected me. I wrote about interactions I had had with classmates, friends, and teachers regarding my race. During the writing process, I came to understand my experiences and how they shaped me as a person; I had an epiphany.

In my education classes, I was always taught that in order to make connections with students, I needed to add their interests to the lessons. When going over my elementary through high school experience I had realized that I had rarely been represented in the topics I was learning. From then on, I knew that I wanted to make extra effort to diversify the content of my classes. Now that I am a teacher with control over my own curriculum, I can make this a reality.

I teach in a small private school in a suburb south of the Twin Cities. This school's student body is primarily white with a few students of color in each grade. As a person of color and growing up in a community where I was one of the few minorities, I empathize with my students of color. Going to school I had never seen myself within the curriculum I was taught and always felt "invisible" in a way. Having felt this way growing up and then seeing students in similar situations, I knew something had to be changed. As an educator, one of my main goals is to create an environment where all students feel welcomed and appreciated. One of the ways I can make this happen is by bringing representation into my science classroom.

Significance of Question

In the education world, there have been many studies done on the importance of representation for students of color. The importance of representation goes beyond students seeing themselves in what they are being taught. It also strengthens communities and improves student performance. Representation means that the demographics of the student body are reflected in the leaders that serve the school and the curriculum students are learning (American University School of Education, 2020). Representation shows students what is possible and attainable. For students of color, seeing scientists and engineers that look like them helps them realize that these are professions they can have. Representation can also be in the form of teachers of color. Teachers of color show students of color that their educational career is not driven by white values (Kane & Orsini, 2003).

Not only was I one of the few minority students in my small town growing up, there was also not much representation. In school, I did not see myself reflected in the

people that taught me or within the administration. It was not until college that I had teachers of color, and even then I had only one professor who looked like me. Representation starts in the classroom with the staff and teachers within the school. As one of the few teachers of color at my school, I have the opportunity to start the conversation regarding the lack of representation.

Representation in the classroom is not only important for students of color, but also white students. Representation is a two-way street. For students of color, a lack of representation is immediately obvious and always harmful. For white students, who are always represented, it can be harder to see the benefits. However, there are many. Diverse representation shows both white students and students of color that it's not a white-owned world (Kane & Orsini, 2003).

This research question will be beneficial to my colleagues as well. Through my research and the research done before me, other educators will be able to bring this knowledge to their classrooms. The benefits therefore will cascade through the education system. As more teachers become aware of the need for representation, our students of color will hopefully move into positions of leadership in our society. This point and the two before will be discussed more extensively in Chapter Two.

Lastly, I will benefit from this research question. My main goal coming into this was to become a better teacher for my students. By creating this research question and developing a curriculum, I am one step closer to this goal. I have learned how to write an inclusive curriculum that is custom-made for the needs of my students. Through all of my research, I have learned a lot about subjects that are important to me. I will be more aware of what and how I am teaching and the effects it has on my students.

Capstone Project

My capstone project is a curriculum designed for my middle school science class. It is primarily focused on my eighth grade students. One of my long-term goals with this curriculum is to differentiate it to be used in all three grade levels (sixth, seventh, and eighth grade). This way it can be built upon itself year after year.

This curriculum revolves around bringing representation into the classroom. This will be done through introduction of various scientists and engineers, and then allowing students to take research into their own hands. The goal of this project is to have students be exposed to different perspectives and to learn about people that may be different from themselves.

I have several personal goals for this project. One goal is to have my classroom be more inclusive. For me, this project is just the stepping stone to begin bringing more representation to my classroom. Because I am relatively new to the field of education, it is my hope that this will lay the foundation for a more inclusive classroom and curriculum overall, meaning I would like this project to not be a one-time experience. Eventually, as my teaching experience grows, this curriculum will be embedded within many of the topics I teach. Chapter Three is where a more in-depth description of this project and its components will be.

Summary

So far in this chapter, I have explored the personal and professional importance of the question: *How does representation of different races and ethnicities impact middle school students in the science classroom?* This chapter has given an overview of why this question is important, not only to me, but also to educators and students in general.

Throughout Chapter One, I have explained my experience growing up as a minority and how it shaped me as the educator I am today. This chapter also highlights the process of how I came to my research question and how I will utilize this question in my project to benefit my classroom.

The following chapters will go more in depth about different aspects of this capstone project. Chapter Two will dive into the importance of representation to both white students and students of color using research and data. Effects of racial stereotypes, effects of school diversity, and lastly, representation in the classroom will be reviewed using research that is already available. Chapter Three will lay out my project description. In this chapter, I will provide an overview of the project and my choice of curriculum design. Chapter Four, is a reflection of what I have learned from this project and future directions I may take with it.

CHAPTER TWO

Literature Review

Introduction

In the science classroom, there are many opportunities to bring in perspectives from around the world. This chapter will cover the connections between racial stereotypes, school diversity, and representation in the science classroom. These points will tie back to the initial research question: *How does representation of different races and ethnicities impact middle school students in the science classroom?*

The first section of this chapter will focus on the effects of racial stereotypes. This includes positive/favorable stereotypes and negative stereotypes. The second section will go over the effects of school diversity and how this impacts both students of color and white students. Lastly, the third section will be about representation in the classroom, specifically the science classroom.

Racial Stereotypes

Discussion of Negative Versus Positive Stereotypes

This section focuses on the effects of racial stereotypes. This section discusses positive versus negative stereotypes. It covers the effects of positive and negative stereotypes, explores what a positive stereotype is, as well as discusses whether or not there is such a thing as a "positive" stereotype. The second section will go over how these stereotypes affect students' performance in the classroom.

Racial stereotypes are beliefs about members from a specific racial group. Stereotypes can be held within one's own racial/ethnic group or about another's

racial/ethnic group. Stereotypes may form based on personal experiences, inferences based off of a national ethos, or simply a generalization that may have a small amount of truth (Terracciano et al., 2005). When one thinks of stereotypes, it is safe to assume that they will think of a negative stereotype. In discussions about stereotypes, it is easy to confront negative ones, and all parties can agree that they are negative. However, the flip side is that negative stereotypes dominate racial discussions.

Furthermore, students of color find it much easier to confront them, as their white peers are more likely to be receptive to criticisms of overtly negative ideas. The problem, therefore, is that positive stereotypes are then thought of as harmless compliments rather than destructive stereotypes. In fact, students of color typically find it more difficult to confront their peers when faced with positive stereotypes and by extension are less likely to do so (Alt et al., 2019).

Note that "positive stereotypes" are not actually positive. All races and ethnicities are subject to both positive and negative stereotypes. While negative stereotypes are easily identifiable as *negative*, positive stereotypes can be more insidious and harder to recognize. Even students who are cautious of stereotyping their peers can do so without realizing (Alt et al., 2019). African Americans, for example, face the consequences of positive stereotypes. One particular positive stereotype is the assumption that all African Americans are athletically inclined. Though these stereotypes may have good intentions, they often have detrimental outcomes for students (Czopp et al., 2015).

When it comes to Asian Americans, there are many positive stereotypes associated with this group. One that comes to mind right away is the "model minority." The model minority is a stereotype that has been around since the 1960s. It was put forth

by the *New York Times* around the civil rights era. Asian American scholars asserted that the idea of a "model minority" was meant to undermine the legitimacy of the civil rights movement and was never actually meant to elevate the Asian community (Lee et al., 2009). Nonetheless, the stereotypes remain.

Whether the stereotype in question is categorized as negative or positive, they can have effects on the person it is directed towards. They have real effects on interpersonal relationships, self-image, and academic achievement and performance. For the purposes of this research, this paper will focus on effects in the classroom.

Effects of Stereotypes

This section of Chapter Two focuses on the effects of stereotypes with regards to student performance. In particular, the expectations or lack thereof that stereotypes put on students of color.

Lewis et al. (2000) identify two different types of racial stereotypes. These two are academic and behavioral stereotyping. Academic stereotyping can refer to white students viewing a person from a specific minority group as less intelligent due to their racial identity. However, academic stereotyping is more varied than that. When white students or teachers think they can make inferences about a student of color's academic abilities and performance, they are academically stereotyping them. This can take the form of a comment – "You're so well-spoken!" – that, however innocent the intention, is stereotyping. In many cases, as anyone who has attended school in the United States can verify, this takes the form of expecting an Asian American peer to excel in science or math.

One of the stereotypes that was brought up in the previous section was the model minority myth. This stereotype is an example that has negative effects on more than one minority group. This is an important stereotype to cover in more depth because it affects the whole Asian American community, regardless of ethnic origin.

The idea that Asian Americans are model minorities suggests that Asian Americans will be more successful than other minority groups solely because of their work ethic, perseverance, and belief in the American dream. This belief can lead to psychological consequences for Asian Americans. The model minority myth puts pressure on Asian Americans and can cause stress when students do not meet the expectations for them to be academically successful.

The model minority stereotype has effects on other minority groups as well. This stereotype effectively pits minority groups against one another. This myth has society believe that with simple hard work, you can be successful. This causes people to believe that other minority groups do not work hard enough or are lazy, and that is why they are not successful (Yoo et al., 2010). Tatum (2017) puts it best: the model minority myth "has served to pit Asian Pacific Americans against other groups targeted by racism" (p. 126).

On the flip side, behavioral stereotyping is not to be overlooked. Many students of color report that the stereotyping they experience is not only academic. Behavioral stereotyping is when students outside of a minority group believe that all members of a given group are experts on the experiences of that group (Lewis et al., 2000). These stereotypes are mostly based on older racist beliefs and new ways to explain other's culture. Even if students of color have not had these particular life experiences, they are still expected to be expert ambassadors for their minority group. The burden of these

expectations can be stressful and traumatizing, and is something white peers generally cannot relate to.

Furthermore, the existence of stereotypes leads to the existence of stereotype threats. Stereotype threat is a term that refers to the existence of negative stereotypes and a person's fear of becoming them. This means a person of color may fear that their behaviors are reinforcing a stereotype about their minority group. Additionally, any behavior that can theoretically fit into the stereotype is taken as proof of the stereotype's validity (Steele & Aronson, 1995). Stereotype threat does not refer to non-stereotyped individuals taking one's behavior as proof of a given stereotype. Rather, it is the subject of the stereotype's fear that they are conforming or confirming stereotypes about their race, ethnicity, nationality, etc.

For example, there is a belief that males are generally better at math than females. Ngoma (2016), tells about a teacher's experience with this particular stereotype and the effects it has on his female students. Some of his students fall victim to this threat and are defeated before the math lesson even begins. However, some students take it as a challenge to not be defined by this belief. Whether or not students feel defeated or empowered, there are real consequences in the classroom.

This in turn can cause a person of color to fully take on the stereotype and lose motivation and interest in academic performance. Furthermore, in the case of multiracial students, they may lean into one facet of their identity more than other facets. For example, a biracial Black/White individual who identifies themselves as White tests better than Black/White students who identify as Black. Similarly, an Asian female may do better on a math test when she identifies as Asian versus identifying by her gender.

Studies show that students identifying with their negatively stereotyped racial background can lead to underperformance. On the other hand, students identifying with their positively stereotyped racial background tend to perform better (Rozek & Gaither, 2020). This shows the very real and measurable effects of stereotype threats.

In a way, academic and behavioral stereotyping can become a self-fulfilling prophecy. When one has to constantly prove their peers wrong and grow up mindful of the stereotypes they are expected to simultaneously reinforce and refute, then academic success can become much more difficult than for their white peers.

School Diversity

Diversity is essentially the aspect of what makes people different from one another, especially in reference to the inclusion of different types of people (Merriam-Webster, 2020). Overall, diversity in schools can be in regards to many different factors. Diversity includes, but is not limited to: race, gender, nationality, ability, etc. For the purpose of this paper, the word diversity will be in reference to racial diversity.

The first section of this topic will cover the effects diversity has on student performance. The second section will discuss the benefits that diversity has on students of color. And lastly, the third section will go over the importance and benefits of diversity for white students.

One way school diversity affects students of color is socially. According to Thompson and Schultz (2003), there are six psychological experiences that most students of color likely encounter. These six experiences are 1) social loneliness, 2) racial visibility and social invisibility, 3) class and cultural discomfort among white parents and

administrators, 4) the burden of explaining oneself to white people, 5) complete studies at a demanding school with minimal parent participation, and 6) the burden of having to feel grateful all the time. It is important to note that not all students of color will face these situations.

Although all of these experiences are valid and important, this paper will focus mainly on social loneliness, racial visibility and social invisibility. A common thread between the two is feelings of "otherness."

Benefits for Students of Color

A diverse student population would benefit students of color for a number of reasons. Throughout the average school day, students of color experience countless microaggressions from their peers. As Wong (2013) puts it, microaggressions are "subtle everyday experiences of racism." Examples of these experiences are sayings such as, "Where are you from?" or "When I look at you I don't see color". Microaggressions are not just verbal, but can also be behavioral or nonverbal. A woman clutching her purse as a Black or Latino male walks by is an example of a nonverbal microaggression (Sue et al., 2007).

Microaggressions are harmful to students of color for a multitude of reasons. When a student is faced with a microaggression, they can often spend time and cognitive effort, distracting them from other tasks, to determine if the microaggression even occurred (Harrison & Tanner, 2018). Furthermore, every time a student encounters a microaggression, they go through the process of debating challenging the comment/action or letting it go. A single instance of this may seem trivial. However, imagine the experience of a student of color, who can encounter hundreds of

microaggressions within a small amount of time. Suddenly, this trivial thing adds up and creates a chronically stressful and hostile environment, even if the offenders are well-meaning and do not mean to be offensive.

Additionally, microaggressions can especially affect students who are in the scientific field. According to Harrison and Tanner (2018), microaggressions can leave students feeling isolated, especially in scientific environments, where they may already be a minority. The isolation may lead to stress, anxiety, and depression. These experiences can lead a student to abandoning their interest in the study in favor of areas of study where they feel more welcome. However, more diverse school environments can improve student interactions, mitigate, and even eliminate the effects of microaggressions.

Students of color in a more diverse environment tend to experience less microaggressions versus students of color in an environment that is racially homogeneous. Monoracial students of color and biracial or multiracial students perceived microaggressions to be less offensive when in a more diverse setting. Students with a continued experience in diverse settings tend to reduce the perpetuation of microaggressions (Meyer, 2018).

Students of color would benefit from diverse school environments because they provide the opportunity for students of color from the same minority group to find community with each other. It is important to have peers who understand and have similar experiences to oneself. This way, a student of color is not facing the daily struggle of being both invisible and highly visible alone (Thompson, 2003).

A common experience among students of color is trying to vent to white peers about microaggressions they have faced, only to be met with, although well-intentioned, a lack of understanding (Tatum, 2017). Diversity is vital for students of color because it's important to have peers who genuinely understand the issues they are faced with. Therefore, a student of color who attends a school that is not diverse will have a much harder time finding a social circle that they feel fully accepted in (Tatum 2017).

This is even more evident for students that are biracial or multiracial. For students that identify as either biracial or multiracial it is important to create a community of peers who have similar experiences. According to Rozek and Gaither (2020), biracial students' experiences at school are more unique. They require an environment where their unique experiences are accounted for and supported. In Rozek and Gaither's study they found that in regards to stereotype threat, biracial students did not necessarily benefit from increased diversity, nor was decreased diversity detrimental. Even though biracial students did not particularly benefit from a diverse school environment, the study suggests a more diverse setting leads to the development of more complex and inclusive identities (Rozek & Gaither, 2020).

Furthermore, as this paper is set in the context of middle school, it must be acknowledged that as students grow older, they begin to question their identity. It's often during middle school that students start to become aware of how they are similar and different from their peers and are taking their first real steps towards developing their identities and thinking about life in the future. Students of color often begin thinking about how their race will affect their future during middle school; their white peers will not (Tatum, 2017).

Benefits for White Students

Diversity within a school not only benefits students of color, but also white students. Studies show numerous benefits for white students attending diverse schools, the biggest of which is the exposure to differing perspectives.

As stated in the *Benefits for Students of Color* section, diverse school settings reduce the occurrence of microaggressions (Meyers, 2018). This can be categorized as a benefit for both white students and students of color, depending on the point of view. Attending diverse schools allows students to have interactions with racially diverse individuals. Given that microaggressions occur less often in diverse settings, white students are also benefiting by being cognizant of the experiences of their fellow students.

Exposure to differing perspectives is extremely important in formative years, such as middle school, because it encourages students to develop a slew of vital interpersonal skills. In short, diverse classrooms improve academic achievement for white students. If measured by test scores, which is an extremely narrow measure, the results are more inconclusive. However, student surveys show that white students feel overwhelmingly positive about their preparedness for post-school life as a direct result of the diversity of their school (Siegel-Hawley, 2012).

Overall, white students who attend diverse schools develop important critical thinking and problem-solving skills. These skills lead to higher academic achievement (Siegel-Hawley, 2012). Outside the classroom, this benefits students to become well-rounded individuals who are prepared to enter a diverse world.

Representation in the Classroom

Teachers of Color

One way to bring representation into the classroom is by having teachers of color. Teachers of color are beneficial for both white and students of color. White students certainly benefit from having teachers of color. However, the presence of teachers of color is even more significant for students of color, though studies show all benefits to some degree (Learning Policy Institute, 2018).

Teachers of color are crucial because they are a positive role model for students of color. For many students, regardless of their race, having teachers of color may be the only opportunity they see people of color in positions of leadership. This encourages white students to view people of color as functioning pieces to our society. Students of color have the opportunity to experience seeing someone like them in professions they may aspire to be. Regardless of professional aspirations, having teachers of color serves as encouragement for students of color to maintain their own, individual aspirations (Kane & Orsini, 2003).

One study discussed Black students who had at least one Black teacher in elementary school. It found that the students were 9% more likely to graduate from college and 6% more likely to attend college over their peers who did not have a Black teacher growing up (Gershenson et al., 2017). The main takeaway from this is that the impact of teachers of color lasts with students throughout their lifetimes.

Another benefit to schools having teachers of color is that they boost the academic performance. Not only that, but the presence of teachers of color improved test scores, graduation rates, and even college aspirations for students of color. Both students

of color and white students have reported feeling positive feelings toward their teachers of color (Learning Policy Institute, 2018). Again, this goes back to teachers of color being role models for all students.

Teachers of color challenge the one-sided narrative to include differing perspectives. This in turn brings new perspectives into the classroom. It must be acknowledged that much of the evidence for the benefits of white students is more anecdotal because it has not been studied as much as the benefits for students of color. However, the prevalence of anecdotes is significant and worthy of acknowledgement. A common theme among many is that teachers of color tend to make the effort to encourage discussions revolving around race and ethnicity within the curriculum. This is especially important in middle school classrooms because, as previously noted, teachers of color begin these conversations at a pivotal time in students' lives (Anderson, 2015).

Furthermore, the greater diversity of teachers, the greater their morale. Similar to the need for students of color to have diversity, teachers of color also benefit from diversity among colleagues. Greater diversity of teachers leads to less feelings of isolation, depression, and anxiety which can eventually lead to leaving the teaching profession (Carver-Thomas 2018).

Representation in a Science Classroom

Much of the literature available speaks of the importance of representation within the classroom. However, it seems that despite the research done on racial representation, there is still a gap in research that is specific to science curricula. This is where the purpose of this project comes in.

Since there is such a gap in the research for science classrooms in particular, this section of the paper will speak to gender representation, and representation in general, in the science classroom. The need for increased representation and its apparent benefits can be surmised from existing research on racial disparities in Science, Technology, Engineering, and Mathematics (STEM) (Archer et al., 2015). It stands to reason that the gap in STEM can be addressed, at least in part, by increasing racial and gender representation in science curricula.

A benefit to representation within the classroom is to create an atmosphere where stereotype threat can be minimized. When students see themselves within the curriculum they are being taught, it creates an "identity safe" environment (Ngoma, 2016). Classroom decorations are also vital in creating an inclusive classroom.

According to Carlone and Johnson (2007), the message that is embedded in science classrooms across the United States (and other Western nations) is that being a scientist means being a "white male." Addressing this is especially important to middle school students, as it is a pivotal time that can have long-lasting effects.

Current research on gender representation suggests that despite increased association of women in science, students still encounter antiquated stereotypes that science is for men (Miller et al., 2018). Based on this and Carlone and Johnson's research, we can make the reasonable assumption that when students encounter these stereotypes, the message is that science is for *white* men. To address the gap in racial representation, we must look to strategies developed to address gaps in gender representation.

Recommended best practices for increasing gender representation in the science classroom are: Teaching strategies to increase girls' science achievement, promotion of female role models in science, and extracurriculars that focus on mentoring girls in science (NSTA, 2019). These methods are directed towards gender representation. However, they could be modified for racial representation without dramatically changing them. The strategies for increasing representation in the classroom, despite being developed for specific purposes (such as gender representation), can be widely applied.

Summary

This chapter discussed the main themes for the literature review: racial stereotypes, school diversity, and representation in the classroom. The theme of racial stereotypes led to the discussion of negative and positive stereotypes. After defining the terms and giving examples, the ramifications of such stereotypes were considered. Stereotype threat was a term introduced in this section as well. In regards to this term, people of color may feel worried about falling into a stereotype about their race. The theme school diversity went over the benefits for both students of color and white students. This section discussed microaggressions and the effect diversity may have on the perpetuation of them. Lastly, representation in the classroom was discussed. Within this theme, the importance of teachers of color and the impact their presence has on students was made evident. Finally within the last theme, representation in the science classroom was considered.

This effort to delve into the literature guided us toward a glaring gap within it. Many researchers have discussed the importance of representation, but few focused

primarily on representation in the science classroom. Because of this, the purpose of this paper became evident.

The next chapter will give an overview of the project description. It will outline the goals of the curriculum, who the curriculum is intended for, and how it will be conducted.

CHAPTER THREE

Project Description

Introduction

In this chapter, the nature of the project will be laid out. The project goal is to develop a curriculum to be used in a science classroom. This curriculum's main focus is to bring representation into the classroom. The purpose of this project is to identify an answer to the following research question: *How does representation of different races and ethnicities impact middle school students in the science classroom?*

Chapter Three will cover the project design, beginning with the framework that was chosen for the project. The second section of this chapter will focus on whom this project is intended for and the setting of the project. The third section will give an outline of the project. The fourth section will give a summary of the chapter.

Theoretical Framework

The framework chosen for this project was the Understanding by Design (UbD) framework (Wiggins & McTighe, 2005). This framework was chosen because of its purpose to engage students and to deepen students' understanding of the content. Understanding by Design creates a curriculum based on the long-term goals of the lessons. There are three stages in the Understanding by Design framework: desired results, evidence, and learning plan.

Stage 1 of this framework is the step intended for identifying the desired results of the curriculum. Within this step, curriculum expectations, content standards, and goals are established. There are three goals in Stage 1: transfer, meaning-making, and acquisition. Transfer goals are goals that refer to how students can use the information

they have learned in a new setting. Meaning-making goals are used to deepen students' understanding through the use of essential questions. And lastly, acquisition goals are to have students learn the information from the teacher or instructor through instruction. Stage 2 of the framework is where the assessments are determined. During this stage, students are tasked with applying their knowledge in order to showcase their understanding of the content. The last stage, Stage 3, is where the actual lessons that are being used are planned. Within these plans, the three goals from Stage 1 are addressed (McTighe & Wiggins, 2012).

There are many goals in this project. However, the main goal of this project is to create a curriculum that brings representation of various races and ethnicities into the science classroom. The steps taken to accomplish this goal will be detailed in the following sections.

Audience and Setting

The setting for this capstone project is a pre-k through eighth-grade private school in an upper-middle-class suburb that is south of the Twin Cities. Out of 290 students, the school demographics are as follows: 0.69% African American, 1.38% Native American/Alaskan Native, 1.38% Asian, 0.69% ethnicity unspecified, 0.69% Hispanic/Latino, 0.34% Native Hawaiian/Pacific Islander, 9.31% two or more ethnicities, and 85.52% white. Given that the environment is not particularly diverse, it is important to introduce these perspectives for both the students of color and the white students.

The primary audience for this project will be teachers from similar content areas. Science teachers from various schools may have similar thoughts to mine on how to make their curriculum more inclusive and to bring more representation to their

classrooms. This project would also be giving them resources to teach about diverse scientists and engineers. Since the educators are the people who would be implementing the project, they are the primary audience for this capstone project.

My students are the primary beneficiaries of the project, as it aims to improve their school experience. This will include both students of color and white students. In addition, the school itself benefits from a project that seeks to elevate its students. By instilling new perspectives, worldviews, and ways of thinking into its students, they will be better prepared for life after school. By extension, the school will have a more global-minded and inclusive student and alumni population.

Overall, the project is a curriculum that challenges students to conduct their own research, form opinions, and present them to the class. However, the overarching theme and priority is representation. The first iteration of the curriculum is evaluative, meant to understand students' current knowledge. Students will be surveyed prior to instruction.

Following the pre-survey, students will be met with various materials introducing them to scientists from different backgrounds, cultures, countries, etc. The purpose of this is to widen their scope on the scientists and engineers who contribute to science.

The project will revolve around a student assignment wherein they choose from a predetermined list of diverse scientists, research their pick, and present it to the class. However, even though this capstone project is centered around a two-week student research presentation, the goal is larger than that. Eventually, the framework created by this capstone will be expanded beyond the single student project to encapsulate the entire year's worth of material. In the end, a science curriculum with adequate representation built in will be created.

Rationale

Through this project, I am hoping to have this be a starting point for the conversation about diversity and diversity in science. The purpose of this project is to bring more representation into my science classroom. Representation has been proven to be important in classrooms to help counter harmful racist stereotypes (McCarthy et al., 2005). My students will benefit from the new perspectives they will be introduced to. The scientific community is worldwide, yet current education curricula does not show that. For students of color, it's vital that schools adjust their curricula to give students a realistic idea of the world that awaits them.

Furthermore, current teaching fails to provide adequate representation in any class. The issue is not confined to the science classroom. For example, history classes often portray African Americans as victims or martyrs, and rarely anything else (Epstein et al., 2011). This project addresses one facet of a much larger issue which is the lack of representation in school curricula in general. It is the hope that, by enhancing the science curriculum to be more inclusive, more and more teachers and students will benefit from the changes. Additionally, this project would highlight the talents, importance, and contributions diverse scientists have made to society. It's important that this project doesn't tokenize or misrepresent scientists of color. Instead, the positive contributions will be emphasized.

Materials and Learning Activities

The UbD framework was used to develop the goals of the project, the assessments, and lastly the lesson plans. The main goal for this curriculum is to help students gain a wider perspective of the scientific community's diversity. The project was

then developed to address that goal. The assessments were developed to help the educator understand where students' knowledge is and where their knowledge gaps are. With the goals and assessments in mind, the learning plans were designed to ensure that the goal was met and the assessments supported.

For this capstone project, students are expected to create a presentation on a diverse scientist of their choice and share it with the class. Prior to them making their presentation, students would be surveyed to determine their current knowledge on famous scientists.

As a class, we would explore various materials introducing us to a wider array of scientists and engineers. These materials will include videos, articles, biographies, and any relevant, usable media. The goal for this first stage is surface-level learning. Students will come away with general knowledge on the wider scientific world.

After students have the opportunity to learn as a class about different scientists, they will move to the second stage. Here, they will dive deeper. Students will choose from a predetermined list of scientists that has been assembled with representation in mind. The list is predetermined to ensure that students actually are choosing from a diverse selection, and not simply choosing scientists they have already heard of.

Once students have chosen their scientist, they are expected to design a presentation on their scientific contributions. Of course, all students will be expected to be engaged and learn from each other about each student's respective scientist.

When the project presentations are concluded, the effectiveness of the project will be evaluated. Students will be given a post survey that is similar to the pre-survey, with

the addition of a small essay. This way, their responses from before and after the project can be compared and therefore measured.

The survey method was chosen for this project because the evaluation of students' understanding requires a qualitative method. The information collected was qualitative descriptions of ideas from a group of middle school students. Survey implementation was chosen because survey designs are used to help researchers answer descriptive questions, questions about the relationships between certain variables, and questions about predictive variables (Creswell & Creswell, 2018).

The essay will be used for several reasons. It will continue the conversation beyond the presentations the students gave. It will also require students to think critically about the contributions of others from outside their general sphere of exposure. Students will be asked to think about all the presentations given by themselves and their classmates. The essay will prompt students to think about how the scientific community, and the world at large, has been influenced by such a wide array of scientists.

The goal of the essay is to foster appreciation and understanding of perspectives other than those we are generally presented with in American schools. It will serve as a secondary evaluation for whether or not students have learned from the project.

The ideal timeline for this project would be three weeks with five lessons spanning over 15 school days. The first week is dedicated to introducing the material and students choosing their scientists. The following week is committed to students diving into their research. This last week will be split between students researching and student presentations. The last week is also where students will be evaluated at the very end, following all the presentations.

Summary

This chapter outlined the project and its aspects. In the prior sections, the research method, setting, project description, and timeline were discussed. This chapter is essential in understanding how the project will be implemented in the classroom and why it will be useful in answering the research question.

Chapter Four will be an overview of the reflection of writing the curriculum that was discussed in this chapter. It will go over limitations, possible implications, and future directions.

CHAPTER FOUR

Reflection

Introduction

The goal of this capstone project was to design a curriculum unit to be used in the middle school science classroom that answers the research question: *How does representation of different races and ethnicities impact middle school students in the science classroom?* I came to my research question through personal experiences and realizing the need for this type of curriculum. The curriculum I developed focuses primarily on bringing racial representation to the science classroom. I began my project by first, completing research that surrounds my topic and deciding on the framework that would best fit the needs of my curriculum. This curriculum was designed to be implemented in a middle school science classroom and can be modified to fit high school science as well. The goal for this curriculum was to begin the conversation of representation within science and to introduce students to diverse scientists and engineers.

Chapter Four discusses what I have learned while creating my capstone project. Within this chapter, I will also be referring back to my literature review that helped me create my curriculum. I also cover the strengths and limitations my project has. This chapter also discusses possible future directions the project could go in. I end with reflecting on my experience with the project as a whole.

Creating the Curriculum

While creating the curriculum, I referred back to the literature review. In Chapter Two, much of the literature pointed out the importance of diversity and representation of

people of color in the classroom. Specifically, seeing people of color in leadership positions and how they better our communities is important to both white students and students of color (Kane & Orsini, 2003). When creating this curriculum, I wanted to give my students opportunities that I did not have. This includes learning about various types of people who have contributed to science and why they are significant. Instead of learning about the same scientists from year to year, the hope is to gain new perspectives through the curriculum I designed.

With this in mind, I wanted to create a curriculum that was student-centered and easy to modify or adapt to many different classrooms. The unit I made is three weeks long and specifically geared toward an eighth grade science class. Within these three weeks students will have the opportunity to explore what a scientist is and who is considered a scientist. Along with this they will also learn in small groups about diverse scientists and eventually do their own research on a diverse scientist of their choice. They will then present their findings to their classmates. The unit concludes by students getting the chance to reflect on their learning from both their own presentations and their peers'.

Understanding by Design (Wiggins & McTighe, 2005) was chosen as the framework for the unit because of its emphasis on deepening students' understanding and knowledge on the topic. This framework is used to design curriculum "backwards" using the long-term desired results. There are three stages: Desired Results, Evidence, and Learning Plan. With this framework I was able to create my unit and feel that the goals and objectives I have set for my students are attainable and student-centered.

Strengths and Limitations

I believe the curriculum has many strengths within it, one of them being the perspectives and knowledge students will gain from it. By learning about and exploring scientists of color, it broadens the scope of what science is and who can contribute. This is important for students to be exposed to people of color in positions that are beneficial to society and to see people of color in a positive light. In effect, this will allow students to see their own potentials and have them realize that people of color are beneficial to our communities.

The curriculum can also be molded by others to fit the needs of their classrooms. The expectations and delivery of the unit can be changed to fit other classrooms while keeping the objectives the same. This project can also be modified to fit other subjects, such as language arts, history, art, or music. Instead of scientists, other subjects could have students research people of color that have influenced history, writing, or the arts.

I feel that this unit can be the starting point for teachers to bring more representation into their classrooms, especially if they do not know where to start. Hopefully this project will open the door for teachers to begin the conversation of how people of various abilities, race, genders, etc. have contributed to our communities.

Every project has its limitations, and mine is no different. One limitation in particular is that this unit is just the beginning of bringing representation into science classrooms, it is only scratching the surface of what representation should be. This project is only one unit out of an entire year of curriculum. The project has an important goal and I feel that this goal should be implemented throughout the school year.

Another limitation is that this curriculum has not been tested out on students. Since it has not been used in the classroom yet, there may be kinks that need to be

worked out that I am unaware of. Because of this, I am unsure on how the project would be received by students and what may need to be changed based off of how students perform during the unit.

Possible Future Work

One of the main goals for the project was to use it within my own classroom. This project is just the beginning to bring representation into my classroom. The way I designed this curriculum, it is geared toward eighth grade. Eventually I would like to have a project like this for each middle school grade level, sixth, seventh, and eighth. The goal for this would be for the projects to build on each other and the learning deepen as students progress to the next grade level.

I would also like to bring representation into more units. I do not want to limit representation to be just during this unit. My goal is to at some point bring representation into all aspects of my classroom. It is my hope that this project will be a foundational stepping stone towards a recreated curriculum that spans an entire school year. This includes the decorations I have hanging in the classroom, scientists and engineers that are brought up throughout the year, and possibly incorporating a scientist of the month.

For the future I would love this project to be how I begin the school year. After introducing the Nature of Science, I can discuss with my students about what types of people are scientists and that they are in fact scientists as well. Beyond representation, I hope to promote perspectives of equity and social justice through lessons that encourage looking at current social issues through the lens of a scientist or researcher. To reiterate, this project is just the beginning of how I would like to bring new and diverse

perspectives into my science classroom. I also hope that this project would be helpful to other teachers, no matter their subject area or grade level.

Summary

This project was created to answer the question: *How does representation of different races and ethnicities impact middle school students in the science classroom?* In this chapter I discussed how I came to create my curriculum by referring back to the literature review in Chapter Two. The strengths and possible limitations for the curriculum were also explored during this chapter. Lastly, I discussed the future work I can do with this project and how it can influence me and others as well.

My hopes for this curriculum is to share it with my colleagues and to start the conversation about representation throughout my school. I also hope to help other science teachers bring in diverse perspectives that their students can relate to and learn from.

By creating this curriculum and researching the various aspects that it encompasses, I have learned the importance of representation of all kinds, not only race representation. However, my work is not complete with this project. The curriculum will continue to evolve and fit the needs of my students as need be. I also plan to continue to research and educate myself on how best to bring representation into my middle school science classroom.

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