IMPACT OF STEM GUEST SPEAKERS ON SIXTH GRADE SCIENCE STUDENTS

by

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in

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TABLE OF CONTENTS

TABLE OF CONTENTS CONTINUED

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

How do preconceived notions of who is a scientist change with the introduction of STEM professionals in the sixth-grade classroom? Over five months, sixth-grade students engaged in four virtual interviews with four different STEM professionals, learning about their careers and participating in questions-and-answer sessions. Before the interviews, students shared their notions by completing a prediction survey and drawing what they thought a "typical" scientist looked like. After each interview, they reflected on their notions through a reflection survey. At the end of all interviews, they completed a post-thoughts survey and a post-draw-a-scientist drawing. The overall results from the pre-and post-surveys and drawings indicated a positive shift in students' perceptions of who can be a scientist. Results highlighted a positive influence of guest speakers, inspiring students to take an interest in STEM careers. This action research demonstrated that engaging sixth-grade students with various STEM professionals through virtual interviews broadened their notions of STEM professionals.

CHAPTER ONE

BACKGROUND AND INTRODUCTION

Context of the Study

I am a sixth-grade general science teacher at Memorial Elementary School in Hopedale, Massachusetts. Memorial Elementary School is a K-6 public school that enrolls approximately 533 students. Our district, Hopedale Public Schools, is a Title I district. Thirteen percent of our students come from low-income families. Of the 533 students enrolled, 82% are White, 11% are Hispanic, 5% are of two or more races, 1% are Black, and 1% are Asian or Pacific Islander (Great Schools, 2023). I teach four periods of general science, and all four periods deliver identical lessons. I teach the following content: physical science, space science, and life science to sixth-grade science students. I have 87 students, and overall, they are well-behaved. My school does not face many behavioral or parent/guardian support issues. Our parents/guardians are well involved in our students' academic success, which sets a good demeanor in the classroom.

In 2021, I took a "Teaching Science in an Elementary Classroom" class as part of my undergraduate Elementary Education program at Bridgewater State University in Massachusetts. One assignment examined how children perceived scientists. I discovered that when many children think of a scientist, they have a stereotypical image in their minds. This image typically depicts an older Caucasian man working with chemicals in a white lab coat (Figure 1).

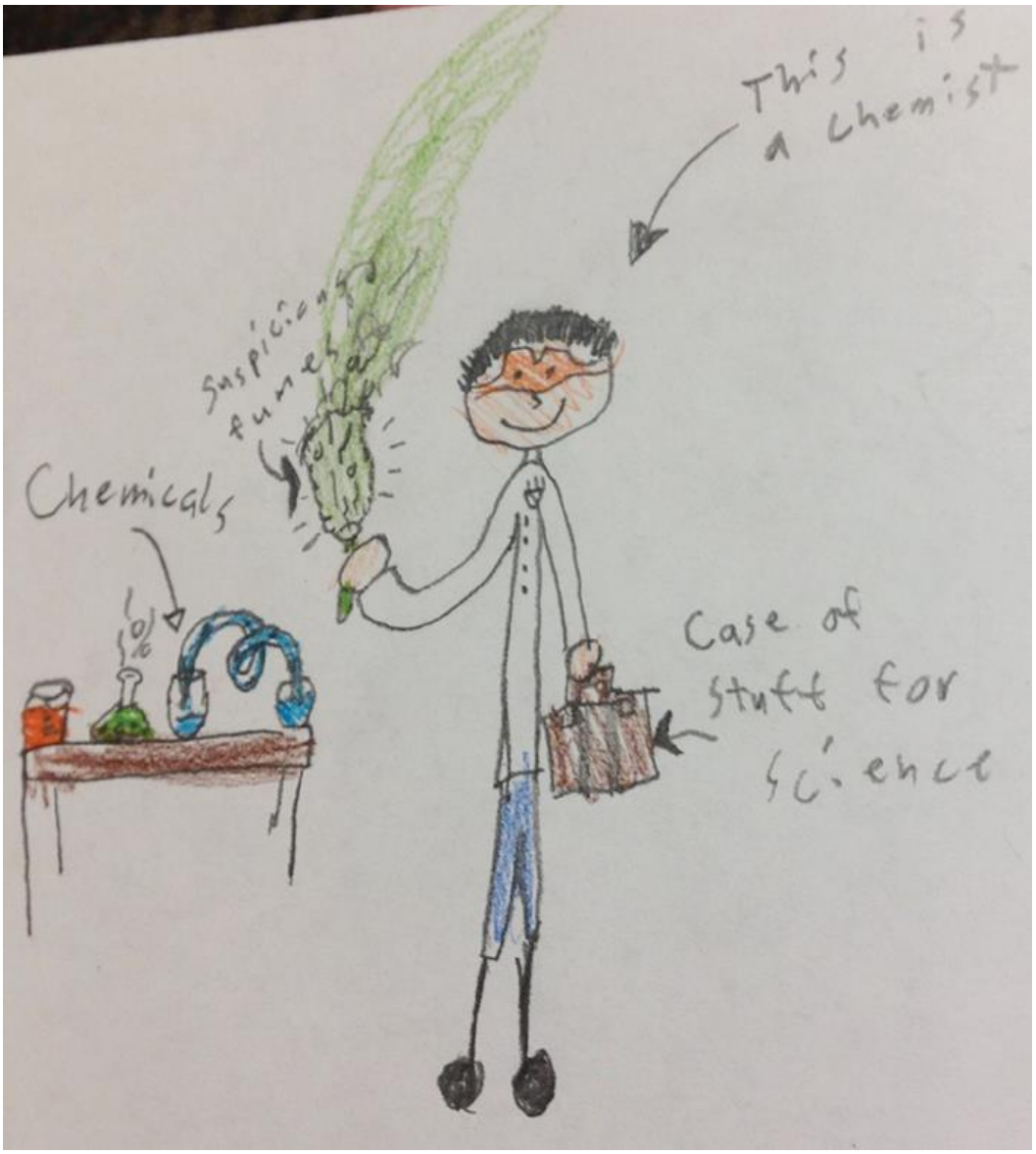

Figure 1. A child's drawing of a stereotypical scientist. Student drawing of a scientist. The scientist is drawn to working with chemicals. "Draw a Scientist" (Kelly, 2018).

Ever since this assignment in my undergraduate program, I have been driven to show my current and future students that scientists are not limited by stereotypes. When I started teaching in 2022, I included a lesson at the beginning of the school year that taught students about who can be a scientist and diversity within the science community. However, I have always wanted to go

further and introduce my students to current scientists, hoping to showcase the diversity of professionals and disciplines in the science, technology, engineering, and mathematics (STEM) fields. I hope that by doing so, my students will better understand the breadth of STEM careers and build a sense of belonging for my students in STEM. I also believe that bringing in STEM professionals will give students a greater understanding of what scientists do for a living and that scientists come from various backgrounds. My experience as an educator informed my interest in integrating different STEM professionals into the classroom curriculum and, therefore, the purpose of my study.

Focus Question

My focus question was, What are the impacts of STEM guest speakers on sixth-grade science students' preconceived notions of STEM professionals? This project aimed to develop teaching strategies to enhance students' understanding of STEM professionals.

CHAPTER TWO

CONCEPTUAL FRAMEWORK

Draw-A-Scientist

A child often develops a scientist's perspective and keeps ideas in mind before expressing interest in a job or career. The activity of drawing a scientist has become a widely established tool for understanding how children represent and identify with scientists. Since 1995, the Draw-a-Scientist Checklist has assessed children's illustrations of scientists by classifying the drawings as stereotypical due to their appearance and the presence of objects such as lab coats, glasses, or beakers (Figure 1). For the past 50 years, students have frequently shown scientists in illustrations as males in a laboratory performing experiments with dangerous chemicals (Farland-Smith 2012).

A study of 5,000 children's drawings of scientists conducted over several decades discovered that nearly all the illustrations were of men. The image frequently depicted the male scientist in a lab coat, wearing eyeglasses, having facial hair, and working indoors with laboratory equipment (Chambers, 1983). Only 28 children, 0.6% of the sample, drew a female scientist, suggesting to researchers that children often associate science with men. Gender-science stereotypes develop through direct and indirect observations of social groups, with children actively seeking cues to determine appropriate activities for boys and girls, as gender is a significant social identity (Bigler & Liben, 2007). As children age, they learn stereotypes about scientists from media sources like television shows, movies, books, and magazines, which often showcase more male scientists than female scientists. As media exposure accumulates, older

children may associate science with men more often (Steinke, 2007). Based on the male depiction of scientists, children's aspirational pursuits may be limited.

Women's presence in science has increased significantly in the United States since the 1960s and 1970s. Women obtained 19% of bachelor's degrees in chemistry in the United States in 1966 and 48% of such degrees in 2015 (National Science Foundation, 2017). Female scientists have also gained more media exposure and were frequently depicted in popular children's television shows, science textbooks, magazines, and other mass media products (Steinke, 2013). It is considerable that the increase in the presence of female scientists in the media could be connected to more females obtaining STEM degrees.

Gender Roles

Early in life, children develop gender schemas and memory structures that categorize gender-related information (Liben & Signorella 1993). These schemas help them understand their experiences and make decisions about their behavior (Bem, 1993). At around two or three years old, children begin classifying others based on gender, and between two and three, gender awareness and sex-related behavior increase. Children's gender identity development relies on these schemas, but they also often acquire prejudices from gender communication (Campbell et al. 2004). Increased exposure to scientists from diverse ethnicities and different genders may allow children to build a sense of belonging in STEM and consider a career in STEM.

Research shows that negative gender stereotypes can change women's perceptions of their ability and competence in math and science, resulting in poorer performance (Smith et al., 2007). Because children generally identify traditionally masculine occupations with higher status and see men as more competent, this stereotype reduces female students' interest in pursuing

science and engineering careers (Liben et al., 2001). Gender stereotypes in the media and messages about scientists, as well as gender information, might influence children's impressions of others and themselves in STEM careers.

Science Influences on Children

Various social and cultural elements, such as those from the home, school, and popular culture, impact how young children view scientists and engineers. Parents, teachers, classmates, and media sources communicate these factors to children, affecting how they perceive the issue. Children frequently encounter ideas of scientists in the works of popular culture, including stories, films, and television shows, which may have an impact on how they perceive the looks, personality qualities, and way of life of scientists. Comprehension of how these images affect people's views and potential interest in pursuing science, engineering, and technology careers depends on comprehending these visuals (Steinke, 2007). The varied effects of science on young children highlight how various social and cultural factors contribute to shaping a young child's perception of who embodies a scientist.

Media

According to a 2021 Common Sense Media survey, children aged 8 to 12 have an average daily screen time of five hours and thirty-three minutes. Eighty-seven percent of this screen time is spent watching television or online video shows. Television is a key socialization component and frequently uses stereotypes (Cherney & London, 2006). Given that many children have gender-stereotypical ideas of professional roles and values, how various media modes portray female scientists is important. Children's career aspirations and choices are

influenced by cultural norms and gender role expectations (Steinke, 2007). A 2006 study showed that young girls in the United States often have few opportunities to observe female scientist role models in the media. Most programming is dominated by male scientists and engineers, and representations of these professions frequently reinforce gender stereotypes by underplaying female knowledge, stressing conflicts, portraying women as younger and more attractive, lacking scientific research skills, and highlighting women as possible distractions (Cherney & London, 2006). Given increased media exposure, young children must see diverse platforms actively welcoming and showcasing people of all genders and ethnicities, particularly in STEM.

A study found that middle school-aged children often view scientist characters in television programs as unmarried Caucasian men with high-status positions and intelligence. However, National Science Foundation-funded programs show a more equal representation of female and male scientist characters, which is encouraging, especially for girls. The study also found that male and female scientist characters were rarely identified as nerdy or geeky, and the wishful identification analysis showed that scientist characters were most likely to be intelligent, encouraging identification for both boys and girls (Long et al., 2010).

Children's Books

Many elementary schools devote more instructional time to teaching literacy than science. Often, elementary teachers will integrate science trade books into their literature lessons. This strategy makes science content accessible to students (Blank, 2013). Science trade books help students acquire vocabulary and concepts to explore ideas, reflecting the diversity of scientists and allowing them to learn about their behavior and appearance (Farland, 2006). However, studies have shown that science trade books have misrepresented gender roles, the

nature of science, and disciplines. A study of 104 science-related children's books in 2005 revealed that 60.8% of the illustrations featured male scientists, while 39.2% featured female scientists. In addition, 78.4% of the men in their samples were revealed as white scientists (Rawson & McCool 2014).

In addition, 44 children's science books found in a public children's library room; results found that the books were predominantly focused on life sciences (55%), followed by space sciences (14%), earth sciences (11%), and general sciences (11%). In the early elementary school years, where science curriculum exposure is limited, it becomes crucial for young children to be introduced to various children's books that offer diverse perspectives on science (Ford, 2006).

Guest Speakers in the Classroom

Interventions can change children's preconceived notions of scientists, particularly those less stereotypically masculine or feminine (Bodzin & Gehringer, 2001). Research has emphasized the educational benefits of bringing guest speakers into the classroom. Bringing in outside speakers provides students numerous opportunities to absorb and engage with content. Furthermore, guest speakers give teachers an experienced professional knowledgeable in their topic area (Robinson & Kakela, 2006). An action research study performed in a high school science classroom investigated the impact of guest speakers on students' interests, motivation, and future career plans. The findings suggested that the guest speakers' presentations and information shared influenced student perceptions. The study also revealed that younger students, ages 11- 14, were more receptive to motivational speakers when the content was

relevant to their life experiences. However, the impact of guest speakers on students' desire to pursue a STEM career was not significant (Ward, 2011).

CHAPTER THREE

METHODOLOGY

Demographics

The action research study involved two groups of sixth-grade science students at Memorial Elementary School in Hopedale, Massachusetts, (*N*=42). Both student groups were academically placed in non-inclusion classroom settings, meaning they did not receive special education services. Across the two groups, 61% of the students were female, while 39% were male. One hundred percent of the students were White. It is to be recognized that the sample group is small, and an error in data was likely due to the number of students available for this action research.

Treatment

This study focused on the impact of Science, Technology, Engineering, and Mathematics (STEM) guest speakers on sixth-grade science students' preconceived notions of STEM professionals and was conducted over five months. Over this period, the sixth-grade students were taught general science content in the following domains: space science, earth science, and chemistry. After the students finished learning all the required content for each domain, the students participated in a whole-grade virtual interview with a STEM professional who specialized in the domain content. Four STEM professionals were interviewed: a female astrophysicist, a male space science educator, a male paleontologist, and a female ocean chemist. All four guest speakers were White and did not identify as coming from any diverse ethnicities.

All four interviews were 30 minutes long and held virtually through Zoom. Each guest speaker was asked the same introduction questions and specific domain questions from the students. Before each interview, all students took a pre-survey to share what they expected of the guest speaker, considering the speaker's personality and physical appearance. After the interview, all students took a post-survey to share their thoughts on the guest speaker and if they were influenced by the guest speaker. The research methodology for this project received an exemption from Montana State University's Institutional Review Board, and compliance for work with human subjects was maintained (Appendix A).

Data Collection and Analysis Strategies

Before the STEM guest speaker interviews, students were asked to create a Pre-Draw-A-Scientist Drawing. The students were asked to imagine a scientist from a television show, movie, book, or other source and then draw the scientist in detail. After the drawing, the students completed a Pre-Draw-A-Scientist Survey (Appendix B). The survey included stereotypical physical descriptors of Einstein-like scientists and regular, diverse-looking scientists. They were asked to select any physical descriptions that appeared on their drawings of a scientist. The physical descriptors were processed into quantitative data to assign an average percentage to the most popular and least popular physical descriptions.

In addition to the Pre- and Post-Draw-A-Scientist Drawings, students also drew Mid-Draw-A-Scientist Drawings. These mid-drawings aimed to understand whether the students' viewed types of scientists the way the guest speakers presented them. The students would complete a Mid-Draw-A-Scientist after finishing the domain of science and after the guest speaker interview that represented that domain of science. For example, after listening to the

Astrophysicist speaker and Space Science educator who highlighted careers in space science, students were asked to draw a space scientist. Similarly, following the presentation by the Paleontologist speaker, students were asked to draw an Earth scientist, and after the Ocean Chemist speaker, they were asked to draw a chemist. In total, there were three mid-drawings. The procedures for these mid-drawings followed the same protocol as the pre-and post-drawings and involved using the same descriptor surveys. After completing all three mid-drawings, the data was used to measure growth or change in students' perceptions of the types of scientists. Additionally, the mid-drawings were used to see if the students drew the guest speakers representing that science domain.

The students were asked to complete a Thoughts of Scientists Survey before and after the series of STEM guest speaker interviews (Appendix C). The Thoughts of Scientists Survey was adapted from the 1982 Fraser Test of Science-Related Attitudes survey and included various statements regarding scientists and stereotypes. For example, one statement read, "*Scientists like to spend their days off in their lab."* Another was, "*Few scientists are happily married*." The students were asked to rate the statements as either true or false. For each statement, quantitative data, such as percentages of true and false, were processed. The pre-surveys and post-surveys were compared to track the students' changes.

Before the guest speaker interview, students completed the Predictions of Guest Speaker Survey (Appendix D). The Predictions of Guest Speaker Survey asked students to share their predictions on areas like the guest speaker's demeanor, appearance, and even expectations about the interview. After each interview, students were given the Reflection of Guest Speaker Survey (Appendix E), where they were asked the same questions from the Predictions Survey along with

specific questions about how much they enjoyed the interview and asked to share other comments about the guest speaker (Figure 2). The Predictions of Guest Speaker Survey and Reflection of Guest Speaker Survey data were collected to assess students' perceptions of the speakers and compare their expectations to reality.

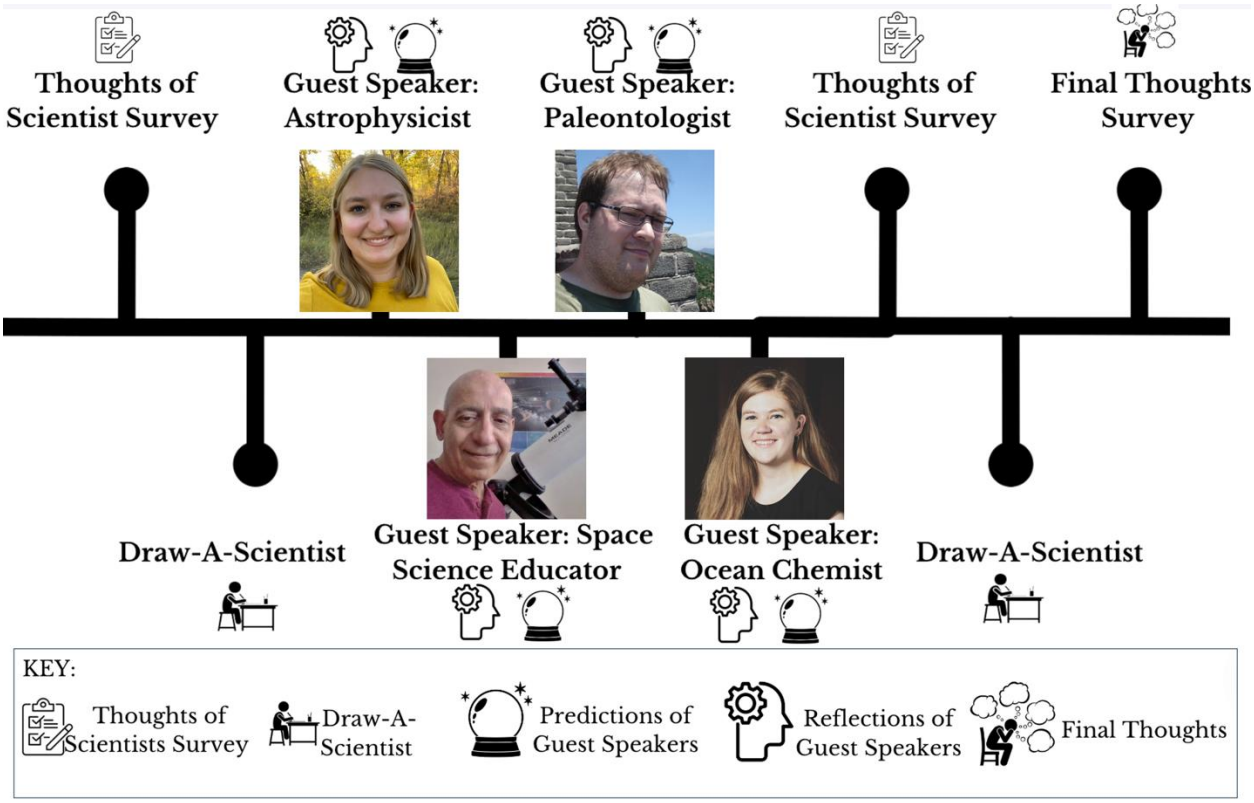

Figure 2. Timeline of Methodology (guest speakers' photos were derived from a web browser search).

After the four virtual interviews with the guest speakers, students completed the Final Thoughts Survey (Appendix F). This survey allowed students to share their thoughts and opinions on the guest speakers outside of the questions asked on the post-survey. The results of the Final Thoughts Survey were used to provide a more in-depth qualitative explanation for the quantitative findings of the Predictions and Reflections of Guest Speaker Surveys.

The variety of data analysis instruments used to answer the primary question is outlined in Table 1.

Table 1. The triangulation matrix shows the data source for the focus question being answered in the research project.

Focus Question	Data Source	Data Source	Data Source	Data Source
What are the impacts of STEM guest speakers on students' preconceived notions?	Pre- and Post-Thoughts of Scientist Surveys	Pre-, Mid-, and Post- Draw-A-Scientist	Pre- and Post-Guest Speaker Surveys (Predictions of Guest Speaker Survey and Prediction of Guest Speaker Survey)	Post-Treatment Final Thoughts Survey

CHAPTER FOUR

DATA ANALYSIS

Before Treatment Results

Pre-Thoughts on Scientist Survey Results

The Pre-Thoughts on Scientists Survey results showed that students had preexisting beliefs about scientists' identities regarding their appearance, physical fitness, and family relationships. The bar graph below highlights the results from the Pre-Thoughts on Scientists Survey (Figure 3). The first question assessed scientists' appearance, and 90% of students agreed that if they met a scientist, they would appear like everyone else, (*N*=42). The next question examined students' beliefs about scientists' physical fitness; 90% of students agreed that scientists are equally fit as everyone else. Additionally, 86% of students agreed that scientists enjoy sports as much as regular individuals. The fourth question evaluated the students' beliefs about scientists' personal beliefs, and 71% of students agreed that scientists are happily married, whereas 29% disagreed. The last question on the survey assessed students' desire to pursue STEM professions, and 90% of students agreed that working as a scientist would be interesting.

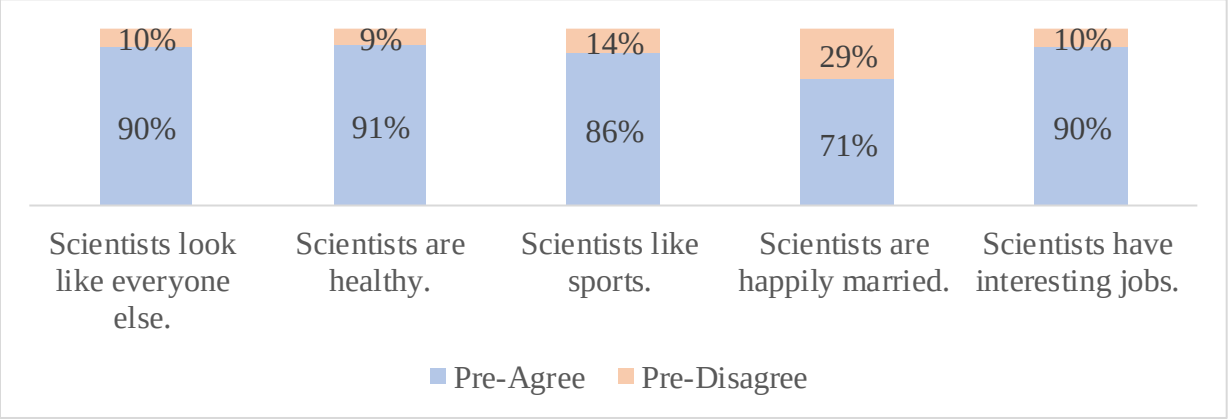

Figure 3. Pre-Thoughts of Scientist Survey results. Students were asked to agree or disagree with different statements about a scientist's lifestyle, (*N*=42).

Pre- Draw-A-Scientist Results

The results of the Pre-Draw-A-Scientist showed that students had a stereotypical idea of a scientist, such as depicting an adult-aged male working in a lab and wearing a lab coat. The bar graph below highlights the results from the Pre-Draw-A-Scientist Drawings (Figure 4). The Pre-Draw-A-Scientist Drawings from Student A and Student B (Figure 5) were also selected to model common themes amongst the sample group. The first depiction of the drawings identified gender, 64% of students drew a male as their scientist, while 36% drew a female as their scientist. The second depiction of the drawings identified attire, 90% of students drew their scientists wearing a lab coat. The third depiction of the drawings identified the scientist's age: 14% of students drew younger scientists, 74% drew adult-aged scientists, and 12% drew older scientists. In addition to the physical appearance of the scientists in the drawings, students had a notion of scientists working in the field of chemistry. When students were asked what type of scientist their drawing was, 60% selected a Physical Scientist, indicating chemistry or physics; 14% selected a Life Scientist; 14% selected Other Scientists; 7% selected an Earth Scientist, and 2% selected a Space Scientist.

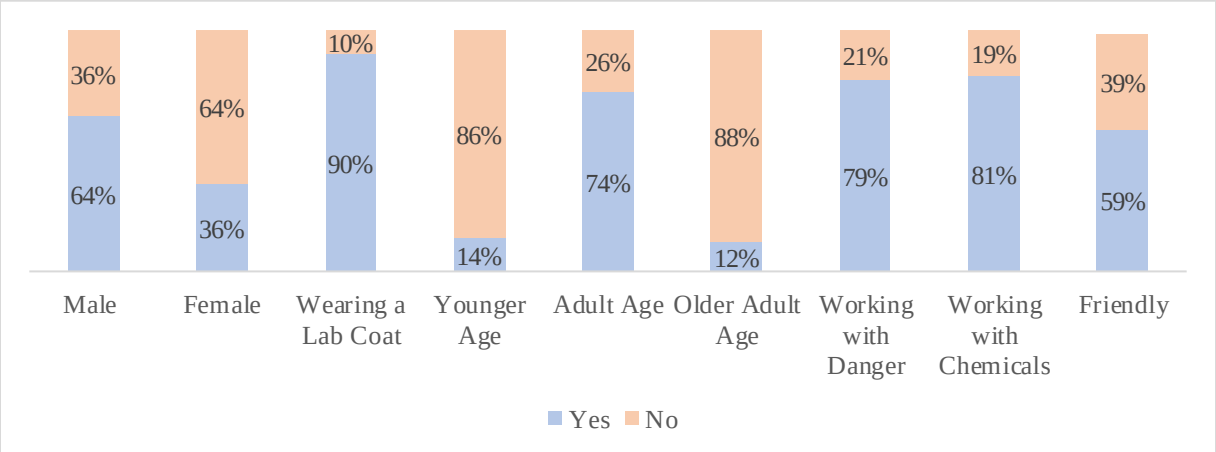

Figure 4. Pre-Draw-A-Scientist. Bar graphs show the percentages of each physical descriptor selected from the students' pre-drawings, (*N*=42).

When students were asked what made them draw their scientist like that, Student A said, “I decided to draw my scientist like this because this was my initial thought on what a scientist looked like.” Student B said, “I decided to draw the scientist this way because I thought of the basic scientist that most people picture, lab coat, chemicals, and indoors.”

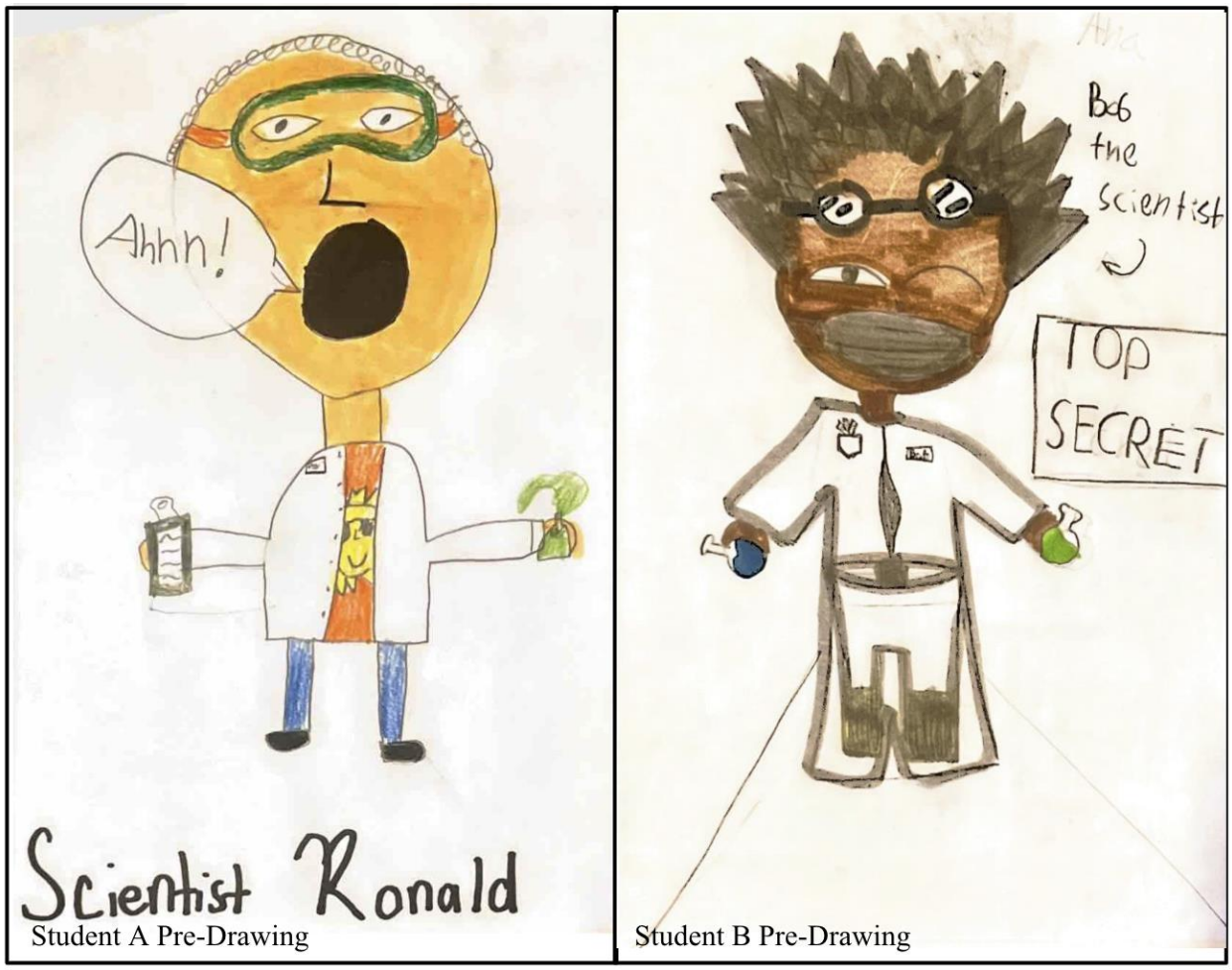

Figure 5. Student’s A and B Pre-Draw-A-Scientist. Drawings show a stereotypical scientist, indicating a man wearing a lab coat and working with chemicals.

During Treatment Results

Predictions of Guest Speaker Survey Results

The Prediction of Guest Speaker Survey results showed that students expected the guest speakers to be male. The bar graph below highlights the expected gender results from the Predictions of Guest Speakers Survey (Figure 6). Before each guest speaker's appearance, students were asked to make predictions about the guest speaker's gender. On average, 69% of the students expected the guest speakers to be male. For the first guest speaker, the astrophysicist, 51% of students believed they would be male, while 49% were female. For the second guest speaker, the space science educator, 85% of students believed they would be male, while 15% were female. For the third guest speaker, the paleontologist, 72% of students believed they would be male, while 28% were female. For the fourth and last guest speaker, the ocean chemist, 68% of students believed they would be male, while 32% were female.

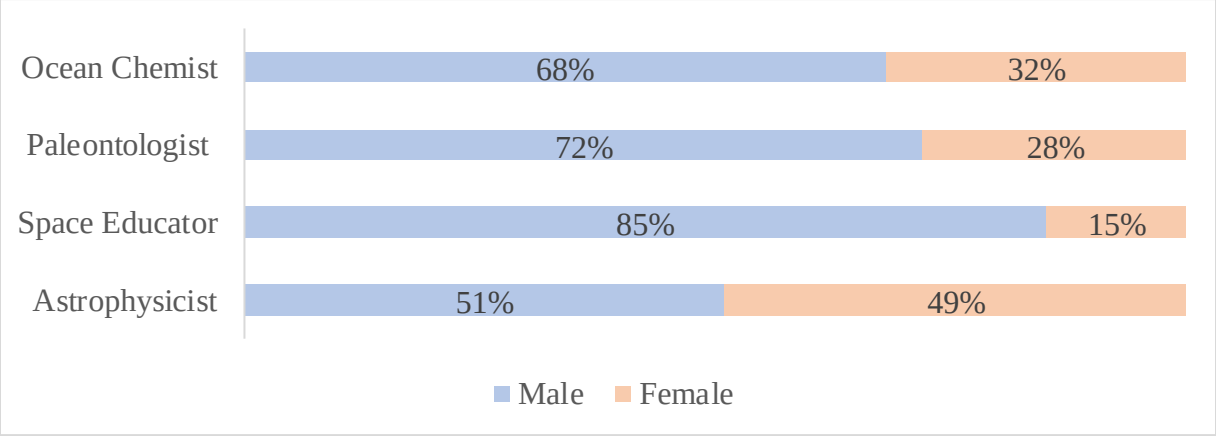

Figure 6. Students were asked if they believed the guest speaker would be male or female (Astrophysicist Guest Speaker, *n*=38, Space Science Educator Guest Speaker, *n*=41, Paleontologist Guest Speaker, n=39, Ocean Chemist Guest Speaker, *n*=37).

The Predictions of Guest Speaker Survey also showed that students had a mixed association of age for scientists. The bar graph below highlights the expected age results from the Predictions of Guest Speakers Survey (Figure 7). On average, 43% of the students expected the guest speakers to be older, and 57% expected the guest speakers to be younger. For the first guest speaker, the astrophysicist, 50% believed they would be older, while 50% were younger. For the second guest speaker, the space science educator, 44% of students believed they would be older, while 56% were younger. For the third guest speaker, the paleontologist, 59% of students believed they would be older, while 28% were younger. For the fourth and last guest speaker, the ocean chemist, 19% of students believed they would be older, while 81% were younger.

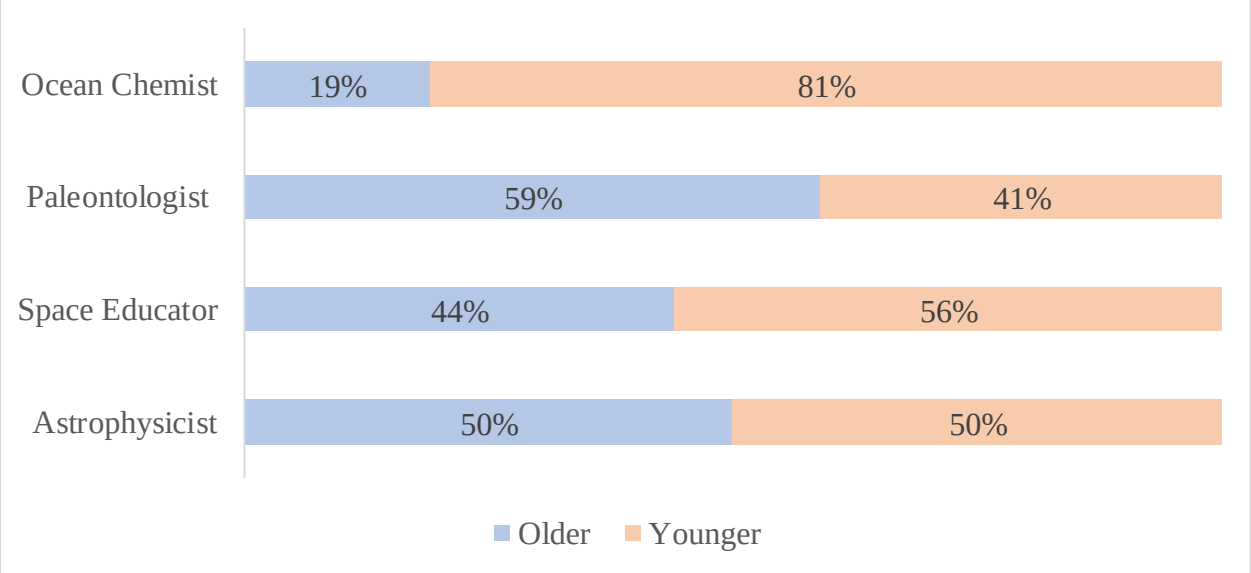

Figure 7. Students were asked if they believed the guest speaker would be younger or older, (Astrophysicist Guest Speaker, *n*=38, Space Science Educator Guest Speaker, *n*=41, Paleontologist Guest Speaker, n=39, Ocean Chemist Guest Speaker, *n*=37).

The Predictions of Guest Speaker Survey lastly showed that students had a shift in predicted attire for the guest speaker. For the first guest speaker, the astrophysicist, 24% of

students believed they were going to be wearing a lab coat, whereas, for the second, third, and fourth guest speakers, the percentage of predicted lab coats dropped to 2% for the Space Science Educator, 3% for the Paleontologist, 3% for the Ocean Chemist. By the fourth guest speaker, the Ocean Chemist, 81% of the students predicted they would wear casual clothing.

Reflection of Guest Speaker Survey Results

The Reflection of Guest Speaker Survey showed a change in gender, age, and attire from the Prediction of Guest Speaker Surveys. For the Astrophysicist guest speaker, 100% of students correctly recognized her as female, 95% thought she was younger, 57% thought she was dressed professionally, and 43% thought she was dressed casually. For the Space Science Educator guest speaker, 100% of students correctly recognized him as male, 100% thought he was older, and 100% thought he was dressed casually. For the Paleontologist guest speaker, 100% of students correctly recognized him as male, 54% thought he was younger, and 100% thought he was dressed casually. For the Ocean Chemist guest speaker, 100% of students correctly recognized her as female, 97% thought she was younger, and 100% thought she was dressed casually.

When students were asked if they expected the guest speaker to look that way, there were varying answers for each guest speaker. The bar graph below highlights the expectations of the guest speaker results from the Reflection of Guest Speaker Surveys (Figure 8). For the Astrophysicist guest speaker, 70% of students thought she would look that way. When asked to explain their answer, students who disagreed said, “I thought the guest speaker was going to be a man.” For the Space Educator guest speaker, 60% of students thought he would look that way. When asked to explain their answer, students who disagreed said, “I thought he was going to be younger.” For the Paleontologist guest speaker, 95% of students thought he would look that way.

For the Ocean Chemist guest speaker, 62% thought she would look that way. When asked to explain their answer, students who disagreed said, “I thought she was going to be a male” and “I thought she was going to be older.”

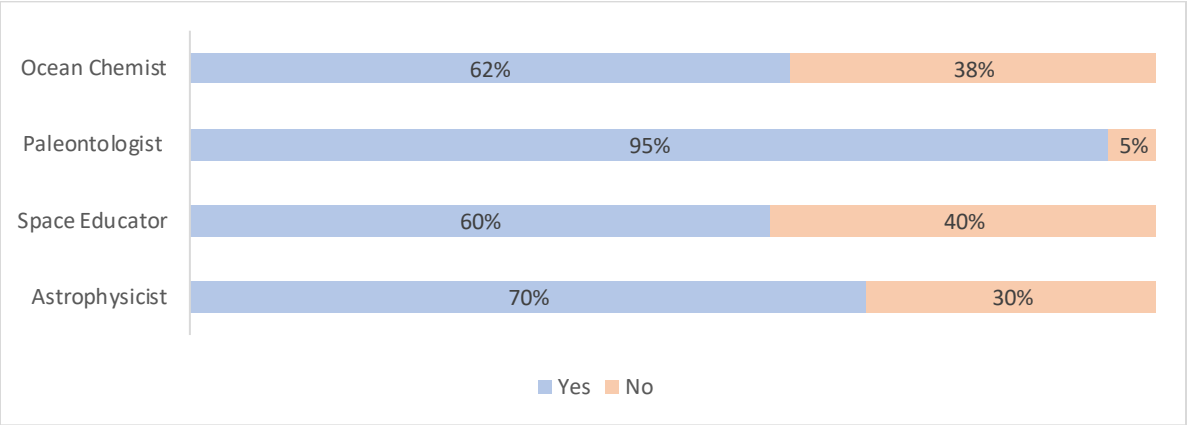

Figure 8. Students were asked if they expected the guest speaker to look how they did, (Astrophysicist Guest Speaker, *n*=38, Space Science Educator Guest Speaker, *n*=41, Paleontologist Guest Speaker, n=39, Ocean Chemist Guest Speaker, *n*=37).

The Reflection of Guest Speaker Survey showed a positive influence on the students. The bar graph below highlights the results of the prediction inspiration from the Prediction of Guest Speaker survey compared to the reflection inspiration from the Reflection of Guest Speaker Survey (Figure 9). On average, 83% of students felt inspired by one of the guest speakers. Specifically, 84% of students were inspired by the Astrophysicist, 78% by the Space Educator, 85% by the Paleontologist, and 84% by the Ocean Chemist.

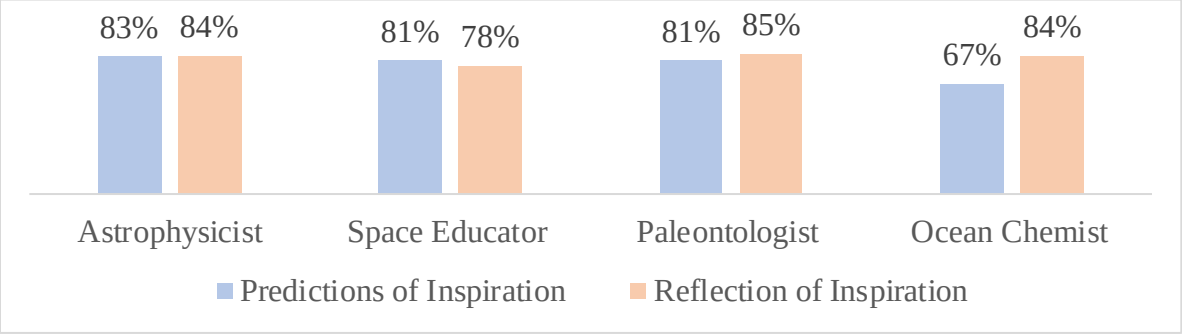

Figure 9. Highlights the results of the prediction inspiration from the Prediction of Guest Speaker Survey compared to the reflection inspiration from the Reflection of Guest Speaker Survey, (*N*=42).

When asked how the Astrophysicist inspired them or changed their minds, some students responded, "I feel like this could be one of the things I want to do with the rest of my life," while others said, "The guest speaker inspired me to be an astronomer." Regarding the Space Educator, some students mentioned, "The guest speaker helped me better understand exoplanets." For the Paleontologist, responses included, "Not all fossils are just dinos and that is cool because for the longest time, I thought they were just dinos," and, "I thought if you were a paleontologist, then you find fossils all day every day but there is also a lot of reading and writing in it." For the Ocean Chemist, students said, "I did not think that that kind of science existed. Also, that seems fun to explore and I could imagine myself doing that," and, "I wanted to be an astrologist but now I kind of want to be a marine biologist."

The results also showed a slight change in who the students thought a scientist could be. The bar graph below highlights the mind-changing results of the guest speakers among the students from the Reflection of Guest Speaker Surveys (Figure 10). On average, 25% of students selected agreed the guest speaker changed their mind about who a scientist could be; 24% of students agreed that maybe the guest speaker changed their mind about who a scientist could be; and 52% of students agreed that the guest speaker did not change their minds about who a

scientist could be. When asked why they agreed they did not change their minds on who could be a scientist, students said, “I chose no because I always thought/knew that anyone of any age, gender, and looks can be a scientist” and “I always thought that anyone can be a scientist and the three guest speakers this year showed me that this is true.”

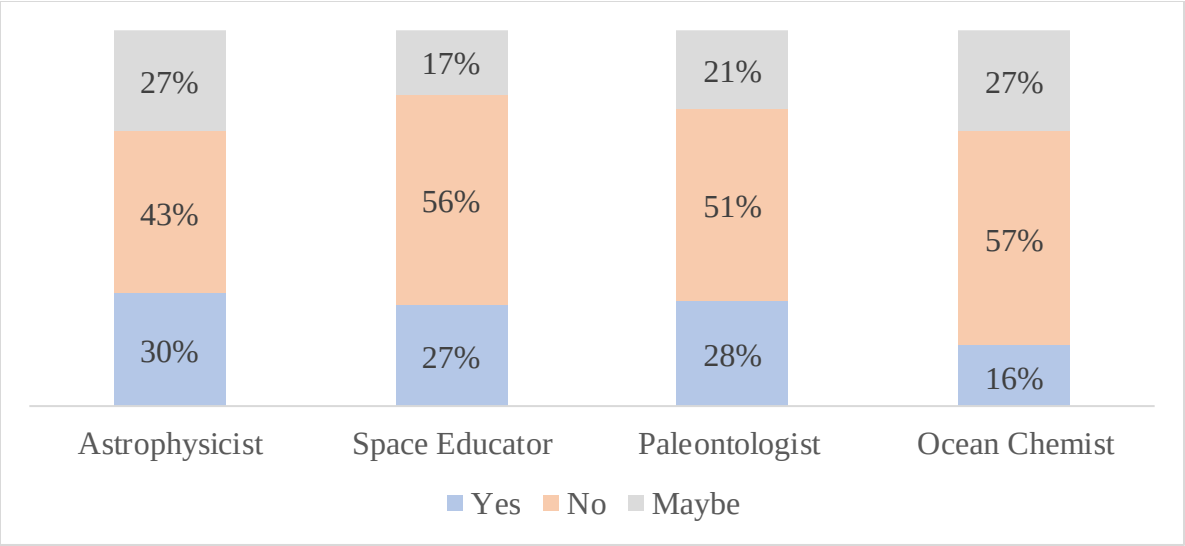

Figure 10. Students were asked if the guest speaker changed their minds about who could be a scientist, (Astrophysicist Guest Speaker, *n*=38, Space Science Educator Guest Speaker, *n*=41, Paleontologist Guest Speaker, n=39, Ocean Chemist Guest Speaker, *n*=37).

Mid-Draw-A-Scientist Results

The Mid-Draw-A-Scientist Survey showed that students had mixed notions about the gender of their scientists. The bar graph below highlights the results of the scientist's gender from the Mid-Draw-A-Scientist Drawings (Figure 11). On average, 60% of students drew male scientists, and 40% drew female scientists. For the Mid-Draw-A-Space Scientist, 62% of students drew a male, and 38% drew a female. For the Mid-Draw-A-Earth Scientist, 67% of students drew a male, and 33% drew a female. For the Mid-Draw-A-Chemist, 52% of students drew a male, and 48% drew a female.

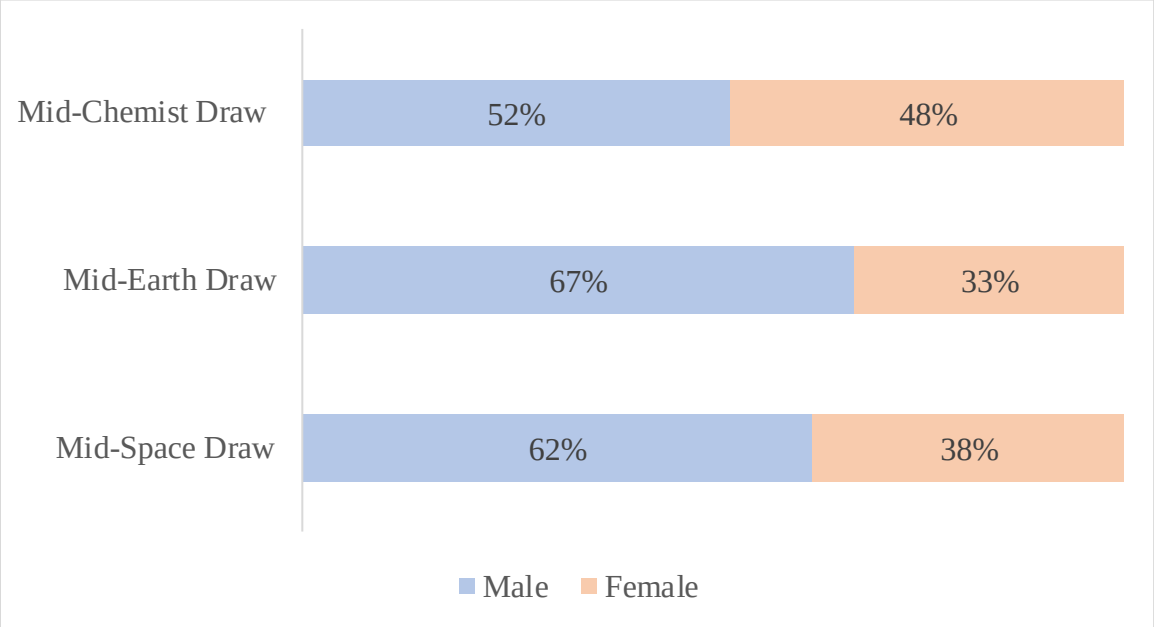

Figure 11. Mid-Draw-A-Scientist Survey. Students selected which gender their scientist presented as (*N=42*).

The Mid-Draw-A-Scientist Survey also showed that students associated scientists as adults. The bar graph below highlights the results of the scientist's age from the Mid-Draw-A-Scientist Drawings (Figure 12). On average, 58% of students drew their science as adults. For the Mid-Draw-A-Space Scientist, 57% of students aged their scientist as Adult, 24% aged their scientist as Young, and 19% aged their scientist as an Older Adult. For the Mid-Draw-A-Earth Scientist, 55% of students aged their scientist as Adult, 38% aged their scientist as Young, and 7% aged their scientist as an Older Adult. For the Mid-Draw-A-Chemist Scientist, 67% of students aged their scientist as Adult, 26% as Young, and 7% as Older Adult. Student A's Mid-Draw-A-Scientists represented the common adult-aged theme among the sample group (Figure 13).

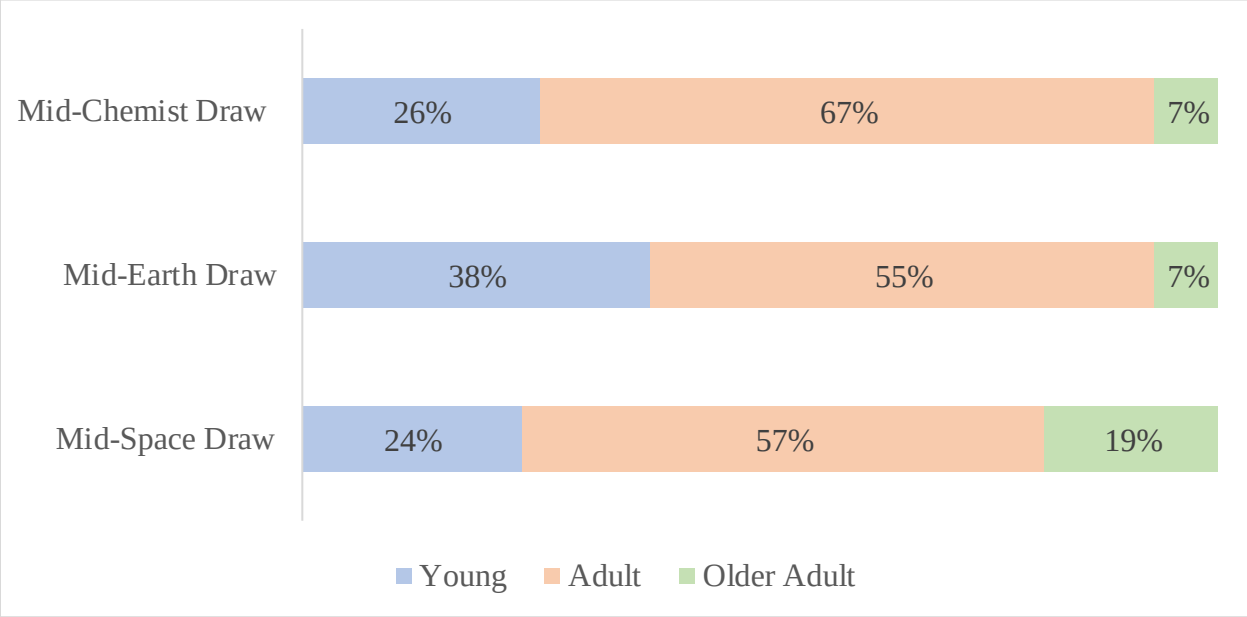

Figure 12. Mid-Draw-A-Scientist Survey. Students estimated the age range of their scientist in their drawing, (*N=42*).

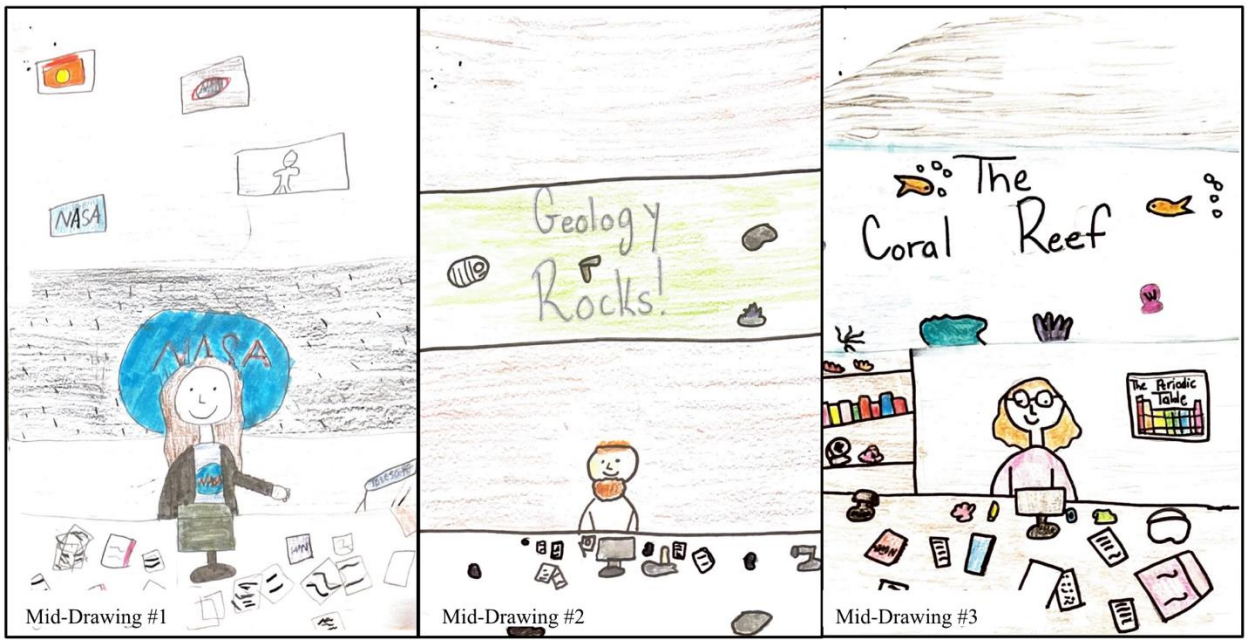

Figure 13. Student A. Mid-Draw-A-Scientist(s), showing a representation of a common adult-aged theme.

The Mid-Draw-A-Scientist Survey also showed that students did not associate all scientists with lab coats. The bar graph below highlights the results of the scientist's attire in lab

labs from the Mid-Draw-A-Scientist Drawings (Figure 14). On average, 60% of students drew no lab coats on their scientists. For the Mid-Draw-A-Space Scientist, 60% of students did not draw a lab coat on their scientist, whereas 40% did draw a lab coat on their scientist. For the Mid-Draw-A-Earth Scientist, 69% of students did not draw a lab coat on their scientist, whereas 31% did draw a lab coat on their scientist. For the Mid-Draw-A-Chemist Scientist, 52% of students did not draw a lab coat on their scientist, whereas 48% did draw a lab coat on their scientist. Student C's Mid-Draw-A-Scientists represented the decrease in lab coat present theme among the sample group (Figure 15).

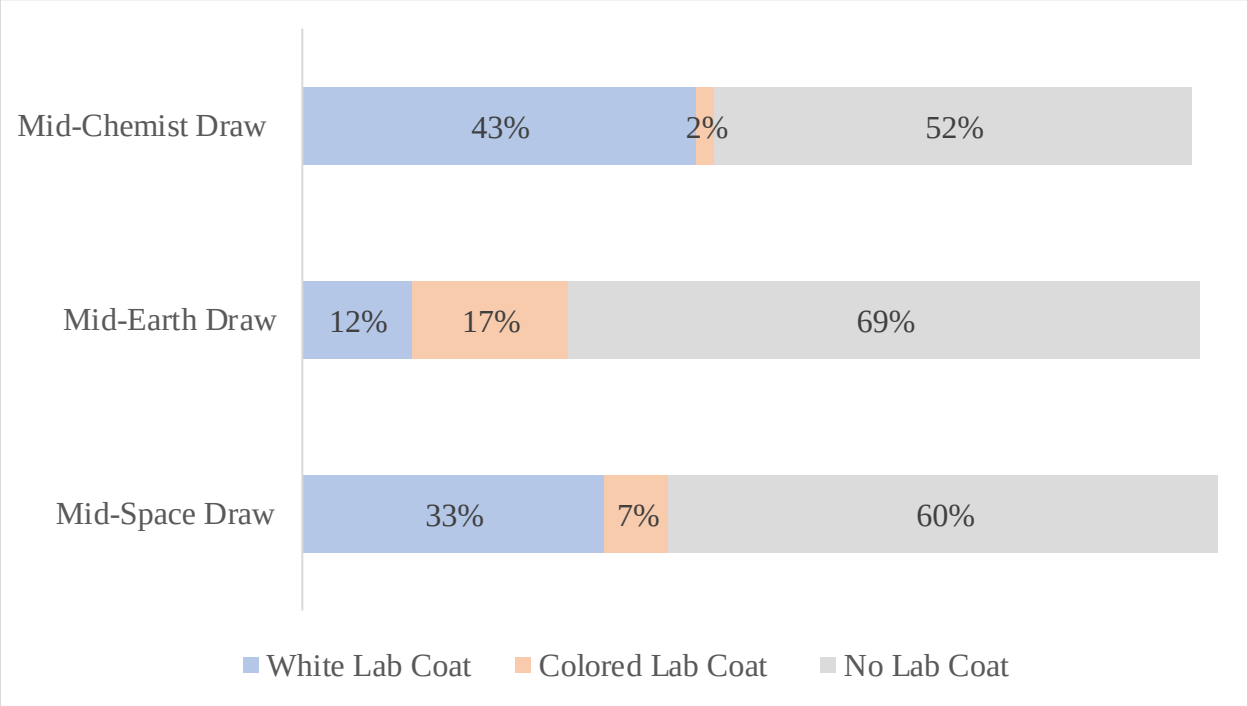

Figure 14. Mid-Draw-A-Scientist Survey. Students selected if their scientist drawing had a lab coat on, (*N=42).*

Figure 15. Student C. Mid-Draw-A-Scientist(s) represents the decrease in lab coat present theme among the sample group.

A shift in descriptors is noticeable when comparing the average results of the Mid-Draw-A-Scientist to the Pre-Draw-A-Scientist. The bar graph below highlights the differences from the Pre-Draw-A-Scientist to the average Mid-Draw-A-Scientist (Figure 16). When gender is examined, a slight shift is notable; the average gender in the Mid-Drawings was 60% male and 40% female, with a 4% increase in female representations compared to the Pre-Drawings. The presence of lab coats dropped from 80% in the Pre-Drawings to 40% in the average Mid-Drawings. The average age in the Mid-Drawings also indicated a slight increase in younger scientists. Also, the depiction of scientists working in dangerous environments decreased from 79% in the Pre-Drawings to 33% in the average Mid-Drawings. Additionally, the appearance of test tubes dropped from 81% in the Pre-Drawings to 29% in the Post-Drawings. Finally, the portrayal of scientists with a friendly demeanor increased from 59% in the Pre-Drawings to 83% in the Mid-Drawings.

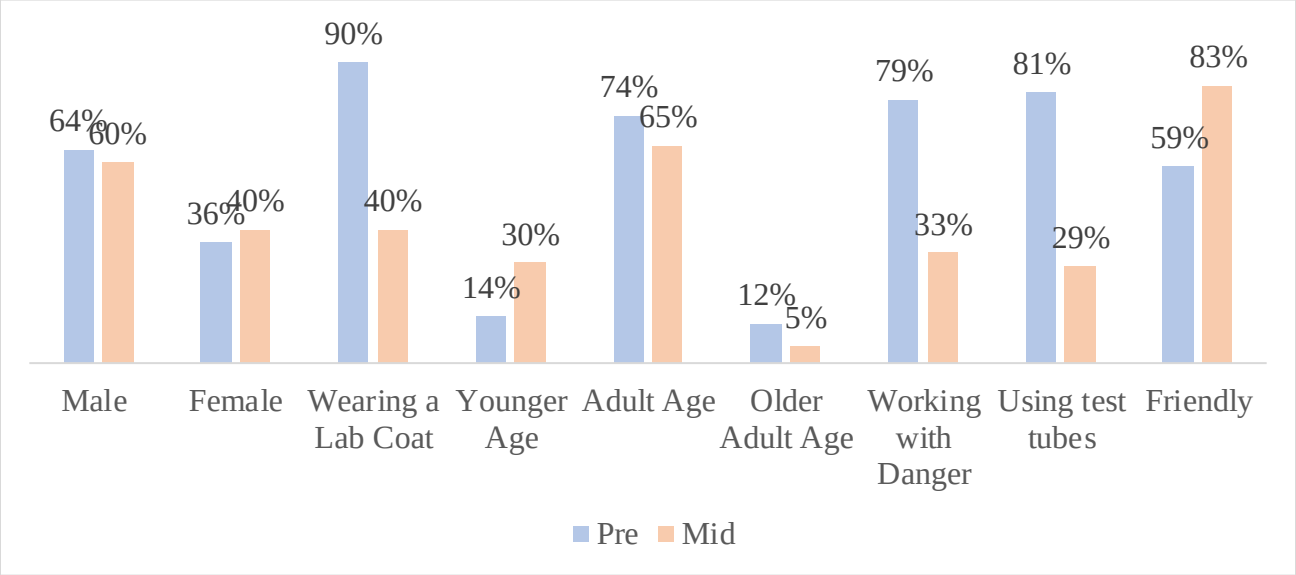

Figure 16. Results of the Pre-Draw-A-Scientist compared to the results of the Mid-Draw-A-Scientist, (*N*=42).

Post Treatment Results

Post Thoughts on Scientist Results

The results of the Post-Thoughts on Scientist Survey showed that students' understanding of the identity of a scientist slightly increased. The bar graph below highlights the results from the Post Thoughts of Scientist Surveys (Figure 17). According to the survey, 95% of students agreed that if they met a scientist, they would appear like everyone else. Compared to the Pre-Thoughts of a Scientist Survey, this is a 5% change in favor of scientists appearing like everyone else. The change was not significantly different when a statistical analysis was conducted (p=.39). Ninety-five percent of students agreed that scientists are equally fit as everyone else. Compared to the Pre-Thoughts of a Scientist Survey, this is a 5% change in favor of scientists being just as fit as everyone else. The statistical analysis showed no significant difference (p=.39). Additionally, 95% of students agreed that scientists enjoy sports as much as regular individuals. Compared to the Pre-Thoughts of a Scientist Survey, this is a 9% change in favor of

enjoying sports just as much as everyone else. The statistical analysis showed no significant difference (p=.13). Seventy-nine percent of students agreed that scientists are happily married. Compared to the Pre-Thoughts of a Scientist Survey, this is an 8% change in favor of happily married scientists. The statistical analysis showed no significant difference (p=.39). Ninety-eight percent of students agreed that working as a scientist would be interesting. Compared to the Pre-Thoughts of a Scientist Survey, this is an 8% change in favor of scientists having interesting jobs. The statistical analysis showed no significant difference (p=1.00).

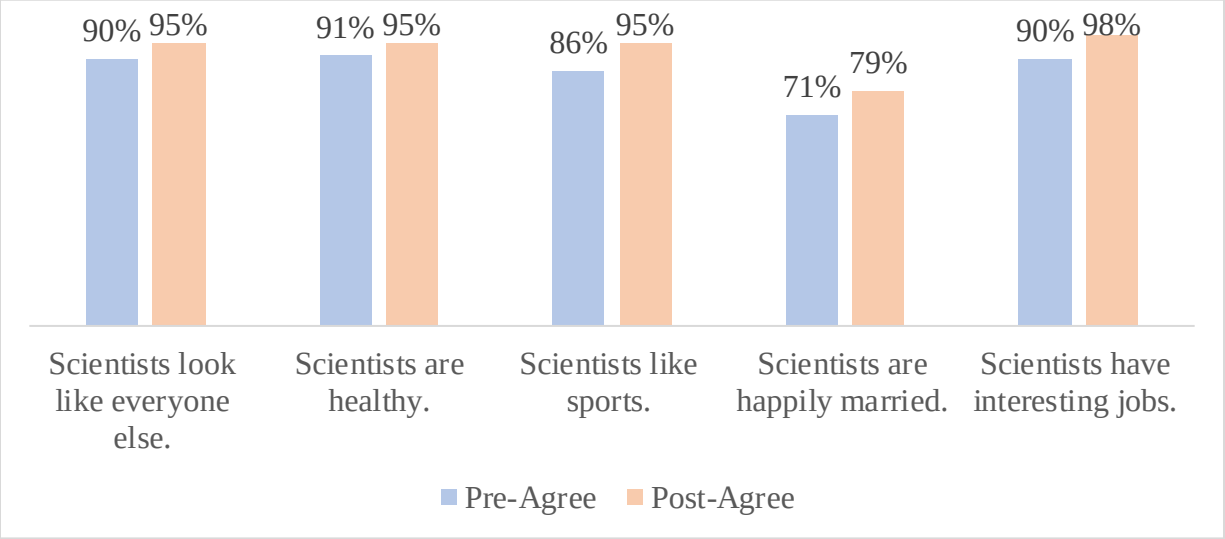

Figure 17. Pre-and Post-Thoughts of a Scientist agree on results. Students were asked to agree or disagree with different statements about a scientist's lifestyle, (*N*=42).

Post Draw-A-Scientist Results

A shift in descriptors is noticeable when comparing the Pre-Draw-A-Scientist to the average results of the Mid-Draw-A-Scientist to the Post-Draw-A-Scientist. The bar graph below highlights the differences from the Pre-Draw-A-Scientist to the average Mid-Draw-A-Scientist to the Post-Draw-A-Scientist (Figure 18). When gender was examined, a shift was notable: the average gender in the Post-Drawings was 42% male and 57% female, with a 21% increase in

female representations compared to the Pre-Drawings. The statistical analysis showed no significant difference (p=.07). Student A Pre-Draw-A-Scientist and Post-Draw-A-Scientist are provided below to model the changes noted in gender (Figure 19). The presence of lab coats dropped from 80% in the Pre-Drawings to 55% in the Post-Drawings. The statistical analysis showed a significant difference (p=.002). The age depicted in the Post-Drawings also indicated an increase in younger scientists, rising from 14% in the Pre-Drawings to 45% in the Post-Drawings. The statistical analysis showed a significant difference (p=.004). The depiction of scientists working in dangerous environments slightly decreased from 79% in the Pre-Drawings to 64% in the Post-Drawings. Student D's Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist demonstrated a shift in the work environment (Figure 20). Additionally, the appearance of test tubes fell from 81% in the Pre-Drawings to 67% in the Post-Drawings. Finally, the portrayal of scientists with a friendly demeanor increased from 59% in the Pre-Drawings to 93% in the Post-Drawings.

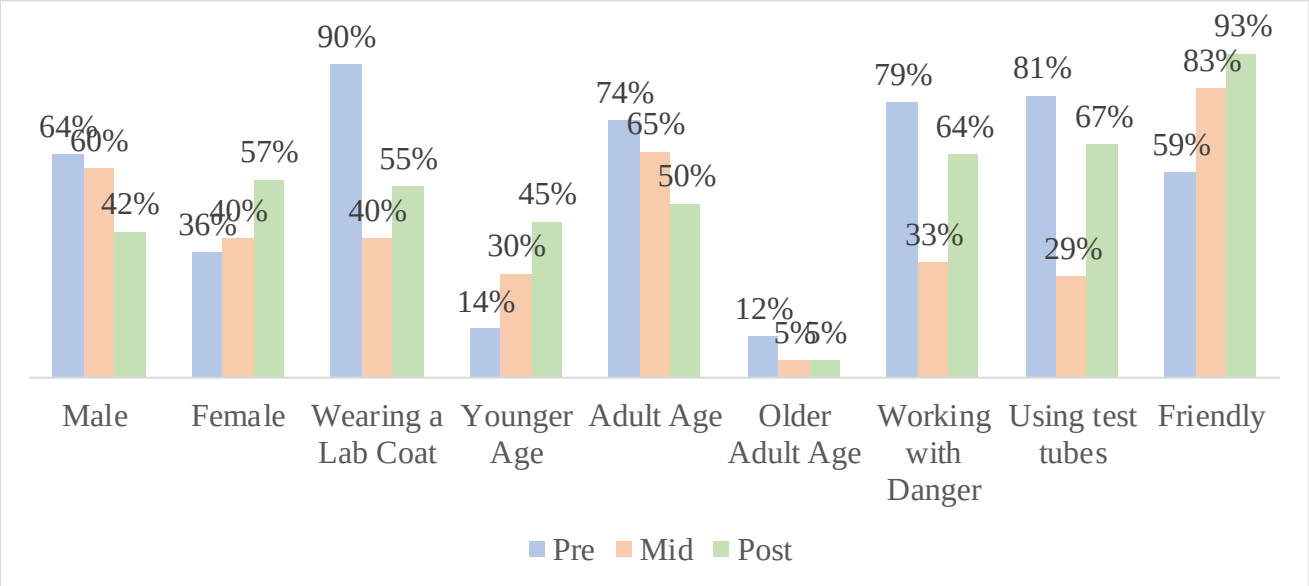

Figure 18. Comparison of results between the Pre-Draw-A-Scientist, averages of the Mid-Draw-A-Scientist, and Post-Draw-A-Scientist, (*N*=42).

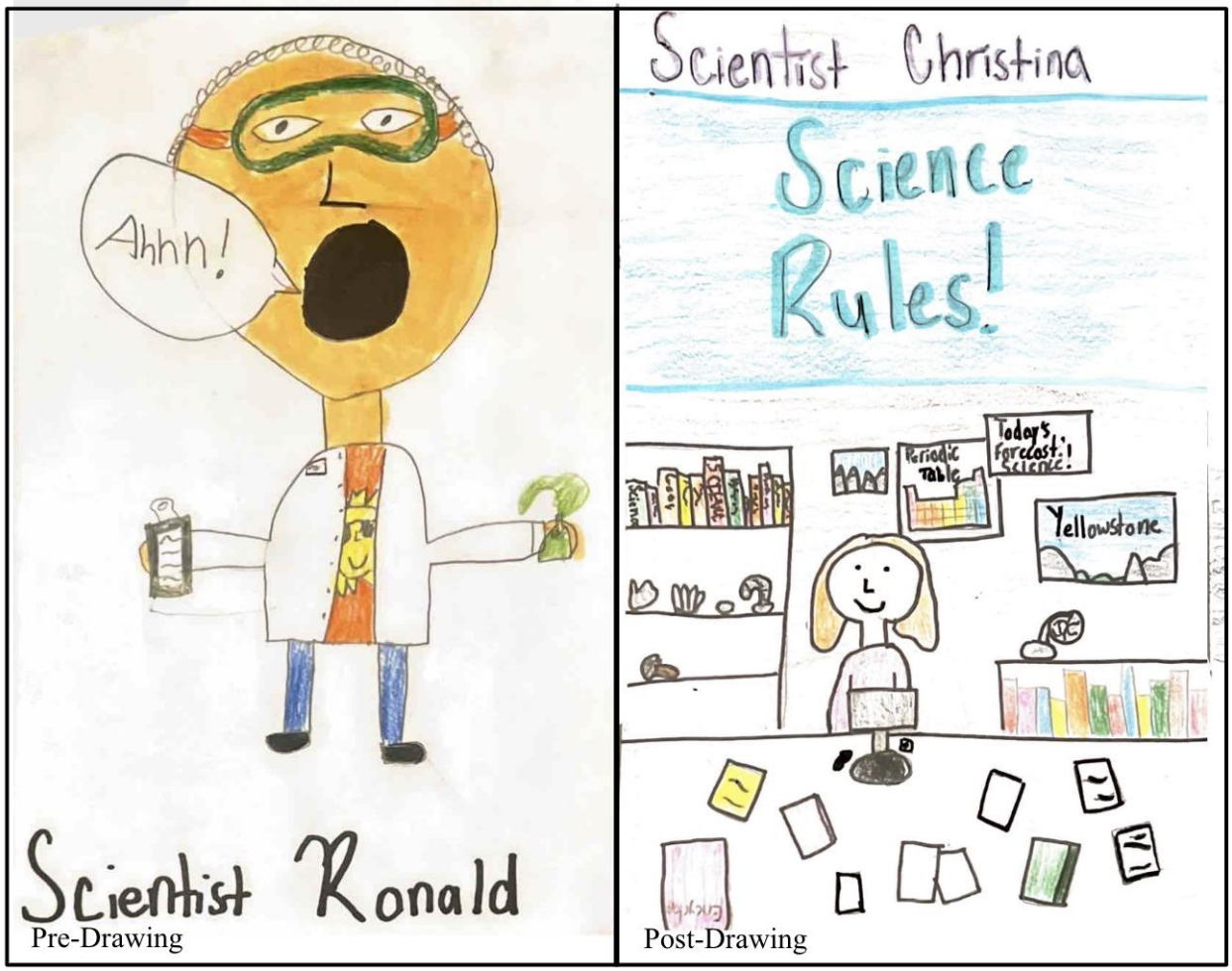

Figure 19. Student A. Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist. Student A's Pre-Draw-A-Scientist to Post-Draw-A-Scientist model a theme of student drawing changing genders.

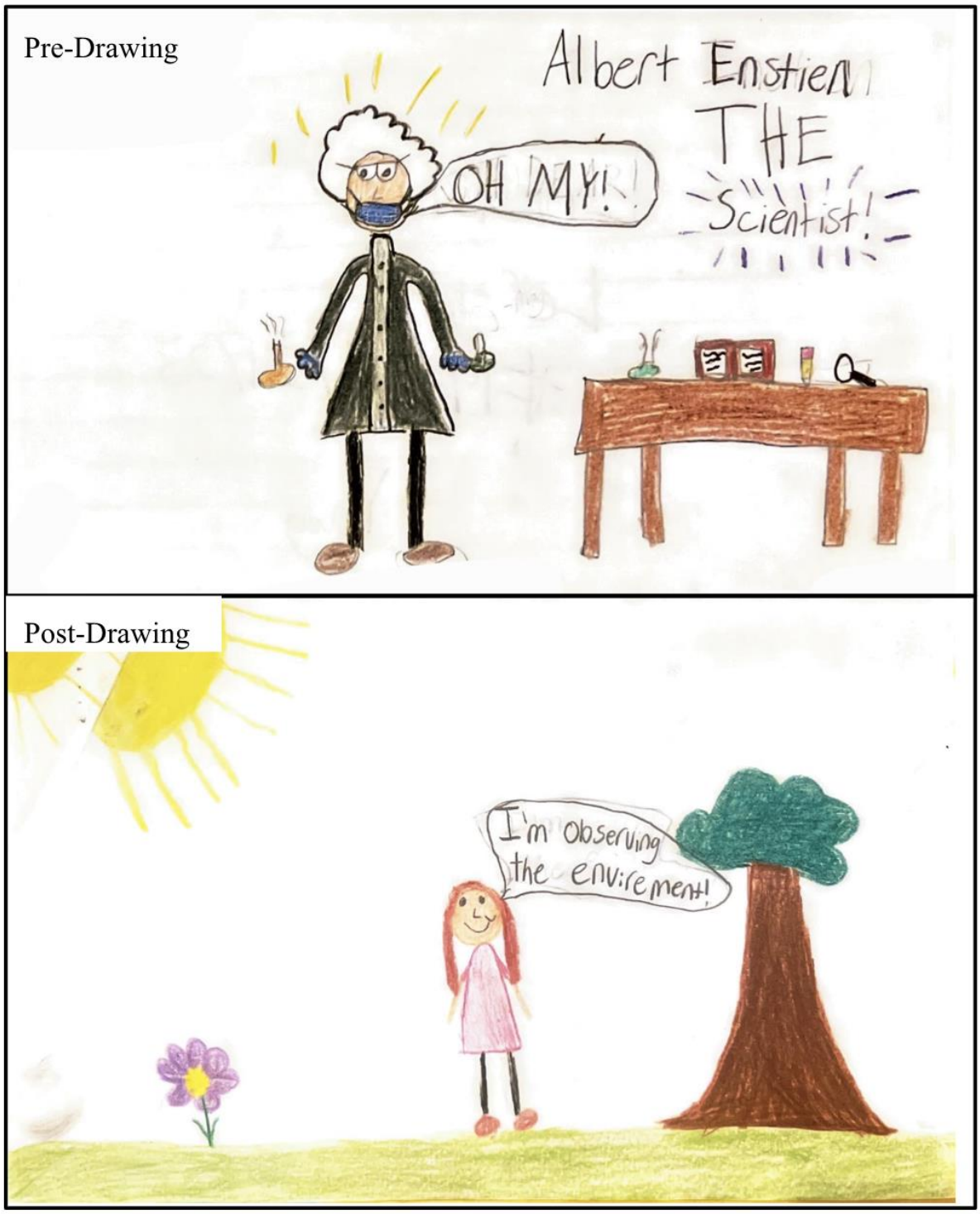

Figure 20. Student D. Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist. Student E's Pre-Draw-A-Scientist to Post-Draw-A-Scientist model a theme of student drawing changing ages.

The results of the Post-Draw-A-Scientist Drawing revealed a shift in students' perceptions across different science disciplines. The bar graph below highlights the results from the Pre-Draw-A-Scientist results to the Post-Draw-A-Scientist results (Figure 21). Fifty percent of students drew a Physical Scientist for their Post-Draw-A-Scientist Drawing, marking a 10% decrease compared to the Pre-Draw-A-Scientist Drawing. Nineteen percent of students drew an Earth Scientist, reflecting a 12% increase from the Pre-Draw-A-Scientist Drawing. The average number of students who drew an Other Scientist remained at 14%. However, the representation of Life Scientists decreased by 2%, with 12% of students drawing them. Five percent of students drew a Space Scientist, showing a 3% increase from the Pre-Draw-A-Scientist Survey. When comparing each student's Pre-Draw-A-Scientist Drawings to their Post-Draw-A-Scientist Drawings side by side to identify the type of scientist depicted, 31% of students changed the initial type of scientist from their final depiction Student C's Pre-Draw-A-Scientist to Post-Draw-A-Scientist modeled a theme of student scientist drawings changing disciplines (Figure 22).

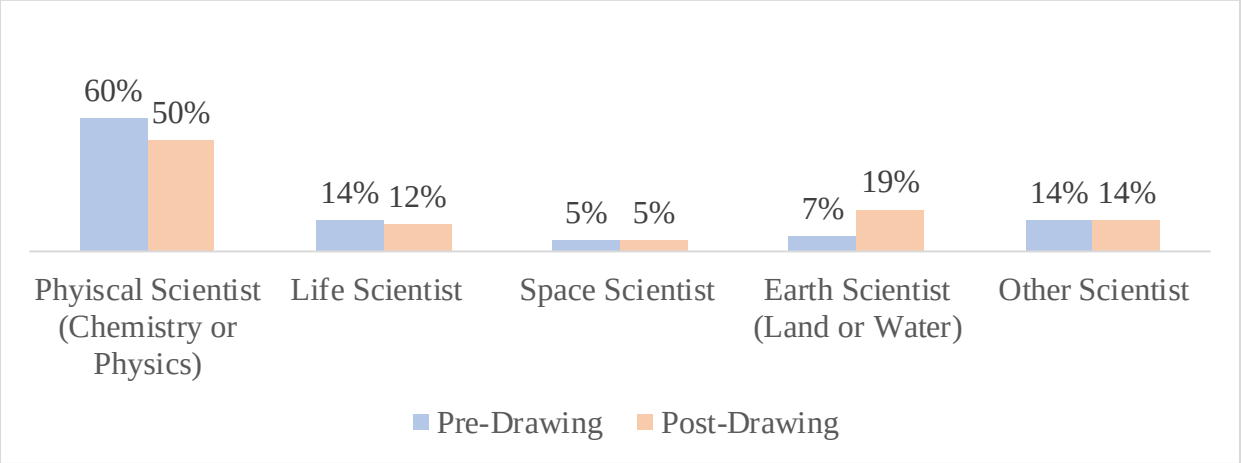

Figure 21. Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist. Students were asked what type of scientist they drew, (*N*=42).

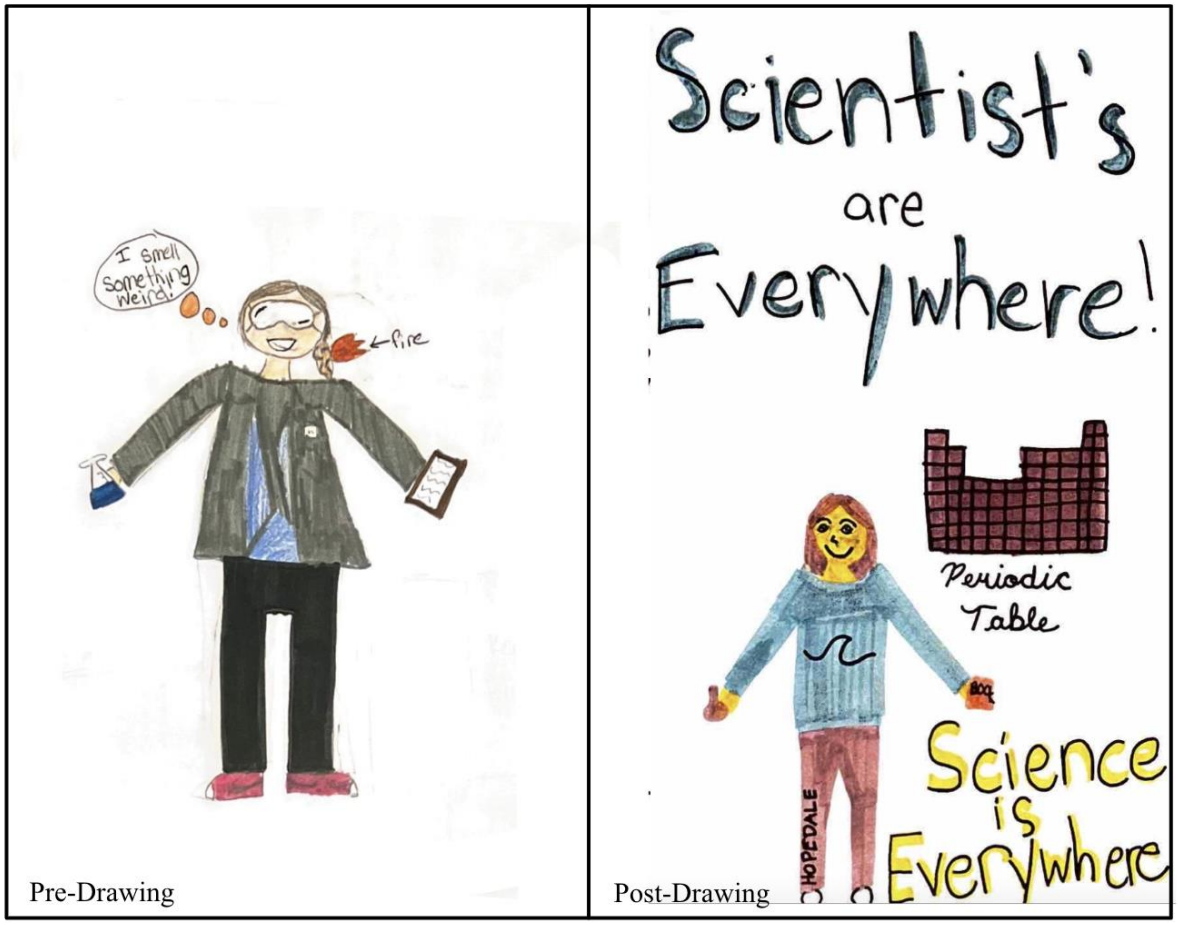

Figure 22. Student C Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist. Student C's Pre-Draw-A-Scientist to Post-Draw-A-Scientist model a theme of student drawing changing disciplines.

The results of the Post-Draw-A-Scientist revealed a shift in students' perceptions of the setting of their drawings compared to their Pre-Draw-A-Scientist. In the Pre-Draw-A-Scientist drawings, 51% of students included stereotypical descriptors like danger signs, depictions of science gone wrong, or mythical creatures. Upon comparing each student's Pre-Draw-A-Scientist and Post-Draw-A-Scientist drawings, it was found that 43% of students no longer included these stereotypical features in the setting of their drawings. Student E's Pre-Draw-A-Scientist to Post-Draw-A-Scientist model a theme of student drawing change in the setting (Figure 23). Also, when examining the Post-Draw-A-Scientist drawings closer, 49% of students included

something to do with my science class. For instance, some drawings had illustrations of science labs in the past, science equipment we used in the classroom, such as a triple beam balance scale, or a setting of my science classroom.

Figure 23. Student E Pre-Draw-A-Scientist compared to Post-Draw-A-Scientist. Student E's Pre-Draw-A-Scientist to Post-Draw-A-Scientist model a theme of student drawing change in the setting.

When a student who drew herself was asked what made you decide to draw your scientist this way, she said, “One of our guest speakers, said you don't have to have a degree to be a scientist, all you have to do is find something to learn about and then research it, It doesn't matter who you are or what age.” Other students, who drew a chemist, when asked what made them decide to draw their scientist that way said, “It was the first type of scientist that popped into my head.”

Final Thoughts Survey

The results of the Final Thoughts Survey showed that the STEM guest speakers had an impact on sixth-grade students. Seventy-six percent of students felt that at least one of the guest speakers changed their minds about who could be a scientist, whereas 24% did not. Students said, “I said yes because they taught me different ways that you can be a scientist.” and “I chose yes because I used to think you had always to want to be a scientist or be very smart to be one but they taught me that you can just do anything you want as long as you put your mind to it” and “I kind of realized that scientist is like everyone who studies science and I think they showed me the DIFFERENT examples of those people.” Sixty-two percent of students felt inspired to think about becoming scientists by at least one of the guest speakers, whereas 38% did not. Students said, “Yes because now I know that I can do science, but I can do science with multiple things” and other students said, “I do not really have an interest in being a scientist.” One hundred percent of students agreed they would like to see more guest speakers.

CHAPTER FIVE

CLAIM, EVIDENCE, AND REASONING

Claims From the Study

After the treatment of the STEM guest speakers, I can make the following claims:

1. Students grew a larger understanding of the diversity of the appearance of STEM professionals.
2. Students began to see themselves as scientists.
3. The involvement of STEM guest speakers positively influenced my students to learn and explore science more and to see themselves in a STEM career.

Students grew to understand the diversity of the appearance of STEM professionals. At the start of this treatment, the stereotypical scientist drawing provided in Chapter Three resembled many of my students' Pre-Draw-A-Scientist drawings. Yet, most of my students agreed that if they were to bump into a scientist in society, they would look like anyone else. Additionally, when students were asked on the Reflection of Guest Speaker survey if the guest speaker changed their mind on who a scientist could be, a lot of students said similar statements such as, "Anyone can be a scientist" or "I already knew a scientist would look like them." When I received these data points, I wondered where my students became exposed to these notions. I met with some of the younger elementary-grade teachers in my school, who said they had briefly discussed the diversity of the scientific community. Despite this, many students drew stereotypical drawings for their pre-drawings.

The first Predictions of the Guest Speaker Survey data revealed that students expected the STEM professionals to look like their stereotypical scientist drawings, such as older males in lab coats. As the Predictions of the Guest Speaker Survey continued for the following guest

speakers, the age and attire expectations changed, but the gender of the guest speaker did not. This was also shown in the Mid-Draw-Scientist Drawings, where the male gender dominated over the female gender. I believe that students held onto the preexisting gender belief of males being scientists due to the media and the inaccurate representation of scientists, with popular TV hits such as Bill Nye's The Science Guy. Many of my students told me they loved watching Bill Nye.

In the middle of the treatment, students began to see themselves as scientists. In the Post-Draw-A-Scientist drawings, the percentage of female scientists dominated male scientists. I believe this is because students started to see themselves as scientists by that point in the year. At the start of the school year, I shared with my students that they are scientists every time they step into my classroom, and I challenged them to think of themselves as scientists every day. Additionally, to foster a better understanding of what science is and what scientists do, I introduce them to the Science and Engineering Practices (SEPs). I shared with my students that doing and identifying the SEPs makes someone a scientist. I taught the students each one of them and helped them recognize them when we were performing them in class. Once students became comfortable identifying SEPs themselves, they reflected weekly on what SEPs we met for the week.

When looking at the Post-Draw-A-Scientist drawings closely, many students referenced things from my science class, such as drawing themselves doing a lab we had done in the past or using certain science classroom vocabulary like SEPs or phenomena (Figure 24). Not many drew the STEM guest speakers. This is not to say the guest speakers did not impact my students because I am strongly confident that they did positively impact my students. Still, it is to say that

the students' data from the Pre-and Post-Draw-A-Scientist could have resulted from what we did in the science classroom.

Figure 24. Student F, Post-Draw-A-Scientist, showed herself in my sixth-grade science classroom using Science and Engineering Practices.

The involvement of STEM guest speakers positively influenced my students to learn and explore science more and to see themselves in a STEM career. After every interview, students reported learning something new from each of the guest speakers, whether it was about the discipline of science we were exploring or if it was something to do with how the guest speaker became a scientist. All the guest speakers talked to my students in appropriate ways to connect with them. They all made sure to take the time to explain things to my students that they would

understand. Each guest speaker gave my students advice, and some of my students held onto that advice. For instance, the Ocean Chemist shared that when she was their age, she was interested in so many things to do with science, like bugs, weather, and the ocean, and was never sure what she wanted to do. She then became interested in chemistry because it connected all those things. She told my students to stay curious and never let anyone take away their excitement. Other guest speakers, like the Paleontologist, connected with the students by sharing that he enjoyed playing video games. So many of my students connected and respected him for that, which made my students more interested in hearing about what he did for a living. The results from the Final Thoughts Survey showed that these direct interactions with the STEM guest speakers inspired students to consider careers in STEM fields. Students explained that the guest speakers helped them understand what a job in science may look like.

When reviewing student drawings selected for this paper, I chose the neatest and most colorful drawings that matched the themes of my claim. Those drawings were all from female students, but male students' drawings still matched the findings of the female students. Student G, a male student, initially drew a stereotypical scientist and ended with a more accurate representation of a young boy in a science classroom (Figure 25).

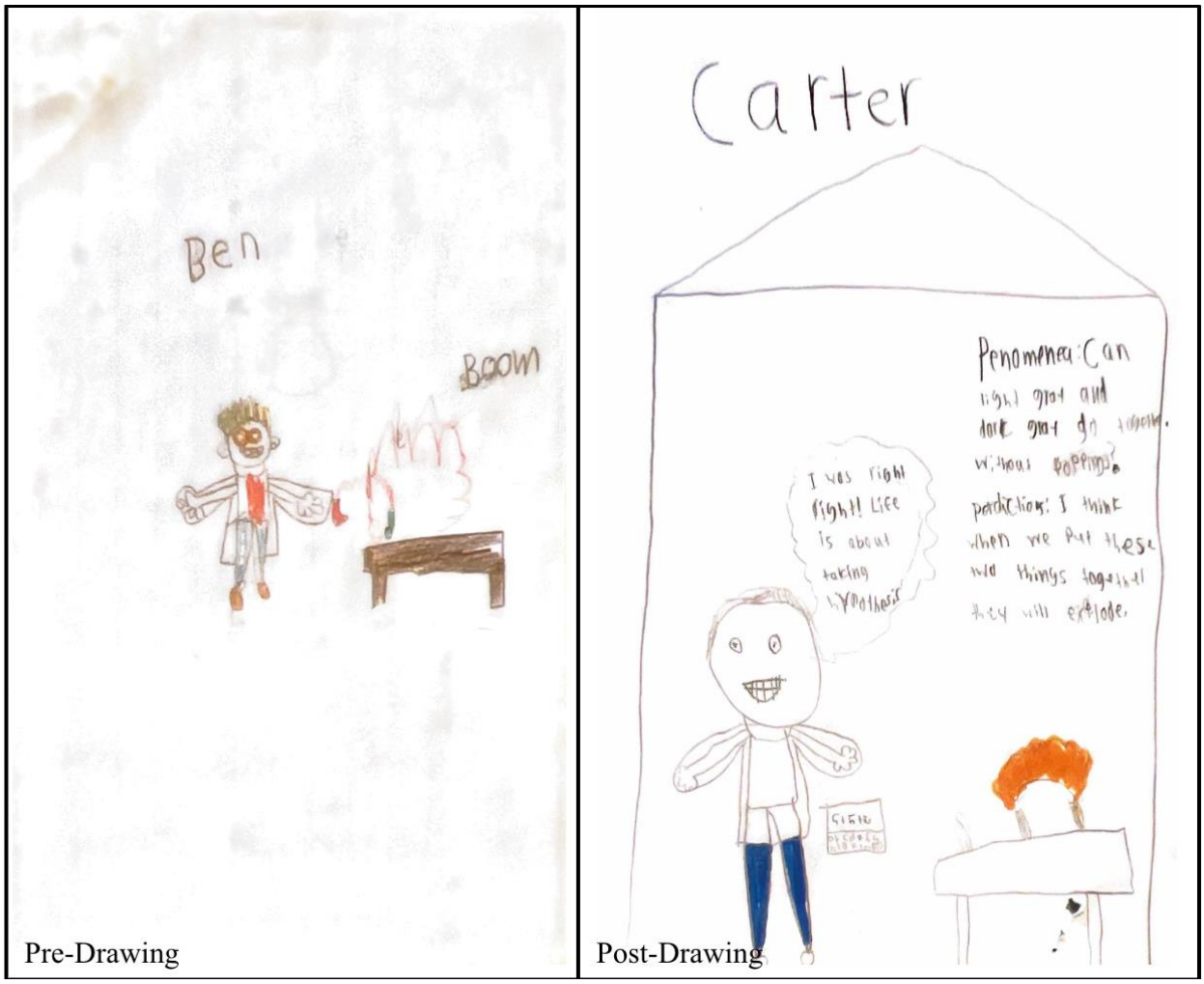

Figure 25. Student G is a male student whose drawings match the same claims as the female drawings.

Value of the Study and Consideration for Future Research

Since starting my teaching career in 2022, I have been motivated to provide a well-rounded education to my students. To achieve this, I incorporate hands-on learning experiences and encourage my students to explore science daily. Introducing guest speakers into my teaching approach has furthered my educational philosophy. I believe it is not just about hands-on learning but also accurate representations. Not only should my lessons be hands-on, but they also

should have connections to the real world with professionals to learn from. Incorporating guest speakers into my classroom will give students an understanding of how the concepts we cover can translate into real-world jobs.

If I were to start this action research project process again, I would try to broaden the diversity of scientists by including people with various ethnic backgrounds, races, and cultures. When choosing my guest speakers for this action research, I tried to find guest speakers from various ethnic backgrounds, races, and cultures, but unfortunately, I could not come across any of these diversities. Additionally, I would focus on changing my students' initial perceptions of scientists solely being chemists. To achieve this, I believe I would need to continue involving diverse representations of other scientists and consistently encourage my students to reflect on different scientific careers within the discipline we are exploring and learning about.

Impact of Action Research on the Author

When I chose this topic for my action research project, I was excited to begin. I had high expectations for myself to change my students' perception of who a scientist is. Based on my undergraduate research, I was sure my students would hold the same stereotypical view of a scientist. I was not ready for many students to start the treatment with the idea that anyone could be a scientist. However, my pre-data showed students still drew those stereotypical scientist drawings. I envisioned that the guest speakers and the Mid-Draw-A-Scientist drawings would help students change those perceptions, which, when looking at the Mid-Drawings, many students did change how their scientists looked. I wanted my students to change those perceptions, especially regarding how scientists look and the discipline of science. The post-data showed that students did change the look of a scientist, but students still envision scientists as

chemists. I was disappointed with this data point but extremely proud of my students' growth in their notion of a scientist's looks.

As this class of students moves forward, I hope they carry the impact of the guest speakers and understand that they can continue to feel inspired by the people they connect with. Additionally, I hope they continue to recognize the diversity of the scientific community. This action research project has impacted me as an early-career teacher. It has shown me the importance of outside representation and what it can do for young students. Moving forward, I will continue to utilize guest speakers to show my future students the diversity of the scientific community in hopes of having the same impact as this treatment group of students. In addition, I will utilize the Draw-A-Scientist throughout the year for students to reflect on a scientist's looks and career. To conclude, I am thrilled with the turnout of my action research and its impact on my students.

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APPENDICES

APPENDIX A

IRB EXEMPTION FORM

Your protocol was reviewed by the IRB and has been approved.

PI: Young, Angela
Approval Date: 11/14/2023
Title: USING GUEST SPEAKERS TO IMPROVE THE UNDERSTANDING OF SCIENCE-FOCUSED CAREERS

Protocol #: 2023-1043-EXEMPT
Review Type: Exemption
Expiration Date: 11/14/2028

APPENDIX B

DRAW-A-SCIENTIST SURVEY

Draw-A-Scientist Survey

Directions: After completing your drawing of a scientist, please highlight the following descriptions that are included in YOUR drawing. Please note, that this will NOT affect your grade.

26. The scientist looks:
    a. (Select as many as you want)
    b. Friendly
    c. Scary
    d. Scared
    e. Mean
    f. Cannot tell
    g. The scientist is:
    h. Male
    i. Female
    j. Cannot tell
27. The scientist:
    a. Has facial hair
    b. Does not have facial hair
28. The scientist is wearing a:
    a. White lab coat
    b. Colored lab coat
    c. No lab coat
29. The scientist looks:
    a. Infant (0-1 year)
    b. Toddler (2-4 years old)
    c. Child (5-12 years old)
    d. Teenage (13-19 years old)
    e. Adult (20-39 years old)
    f. Middle-aged Adult (40-59 years old)
    g. Senior Adult (60 years old plus)
30. The scientist is wearing:
    a. Specific clothing
    b. Everyday clothing
31. The scientist is:
    a. Outdoors
    b. Indoors
32. The scientist:
    a. Has something in their coat
    b. Do not have something in their coat
33. The scientist is:
    a. Using test tubes
    b. Is not using test tubes

34. The scientist is:

    a. Near a computer
    b. Not near a computer
35. The scientist:
    a. Has books and notebooks near them
    b. Does not have books and notebooks near them
36. The scientist:
    a. Is doing math
    b. Is not doing math
37. The scientist is working with:
    a. (Select as many as you want)
    b. Chemicals
    c. Plants
    d. Animals
    e. Rocks
    f. Data (letters and/or numbers)
    g. Other
38. The scientist is working with:
    a. Something that can explode
    b. Something that cannot explode
39. The scientist is or is with:
    a. A non-human creature
    b. Not a non-human creature
40. The scientist is:
    a. Using machines
    b. Not using machines
41. The scientist is:
    a. Using technology
    b. Not using technology

APPENDIX C

THOUGHTS ON SCIENTIST PRE- AND POST-SURVEY

Thoughts on Scientist Survey

Directions: Please read the following statements. After, decide whether you agree or disagree with the statement.

1. Scientists usually like to go to their labs on their days off.
    a. Agree
    b. Disagree
2. Scientists are about as fit and healthy as other people.
    a. Agree
    b. Disagree
3. Scientists do not have enough time to spend with their families.
    a. Agree
    b. Disagree
4. Scientists like sports as much as other people do.
    a. Agree
    b. Disagree
5. Scientists are less friendly than other people.
    a. Agree
    b. Disagree
6. A job as a scientist would be boring.
    a. Agree
    b. Disagree
7. A job as a scientist would be interesting.
    a. Agree
    b. Disagree
8. If I met a scientist, they would look like anyone else I might meet.
    a. Agree
    b. Disagree
9. Few scientists are happily married.
    a. Agree
    b. Disagree

APPENDIX D

PREDICTIONS OF GUEST SPEAKER SURVEY

Prediction of Guest Speaker Survey

Directions: Read each question carefully. Answer as you feel. Please note that this will NOT affect your grade.

1. I think the guest speaker will be:
    a. Male
    b. Female
2. I think the guest speaker will be:
    a. Older
    b. Younger
3. I think the guest speaker will be wearing:
    a. Business attire (suit, collared shirt, button-down shirt, blazer, blouse, etc.)
    b. Lab coat
    c. Casual (t-shirt, sweater, sweatshirt, etc.)
    d. Other
4. I think the guest speaker will be:
   (Select as many as you want)
    a. Confident
    b. Knowledgeable
    c. Friendly
    d. Approachable
    e. Enthusiast
    f. Patient and willing to answer questions
    g. Well-prepared
5. I think the guest speaker will:
    a. Inspire me to explore the science field
    b. Not inspire me to explore the science field
6. I think the guest speaker will make me:
    a. Enjoy science more
    b. Not enjoy science more
7. Are there any other predictions you have?

8. What questions do have for the guest speaker?

APPENDIX E

REFLECTION OF GUEST SPEAKER SURVEY

Reflection of Guest Speaker Survey

Directions: Read each question carefully. Answer as you feel. Please note, that this will NOT affect your grade.

1. On a scale of 1-5, how much did you like the presentation? (1 is not at all, 5 is very much).

   1 2 3 4 5

2. The guest speaker was a:
   a. Male
   b. Female
3. The guest speaker was:
   a. Older
   b. Younger
4. The guest speaker was wearing:
   a. Business attire (suit, collared shirt, button-down shirt, blazer, blouse, etc.)
   b. Lab coat
   c. Casual (t-shirt, sweater, sweatshirt, etc.)
   d. Other
5. I expected the guest speaker to look like that.
   a. Yes
   b. No
6. If you chose no, please explain why.

7. The guest speaker was confident and well-prepared.
   a. Yes
   b. No
8. If you choose no, explain why.

9. The guest speaker was knowledgeable and knew what they were talking about.
   a. Yes
   b. No
10. If you choose no, explain why.

11. The guest speaker was nice and friendly.
    a. Yes
    b. No
12. If you choose no, explain why.

13. The guest speaker was:
    a. Exciting
    b. Boring
14. The guest speaker was patient and willing to answer questions.

a. Yes
b. No

15. If you choose no, explain why.

16. The guest speaker:
    a. Inspired me to explore the science field
    b. Did not inspire me to explore the science field
17. The guest speaker made me:
    a. Want to explore science more
    b. Not want to explore science more
18. Did the guest speaker change your mind in any way?
    a. Yes
    b. No
19. If you chose yes, please explain why.

20. Did the guest speaker change your mind on why could be a scientist?
    a. Yes
    b. No
21. Please explain your answer above.

22. Is there anything else you would like to share with me about the guest speaker?

APPENDIX F

FINAL THOUGHTS SURVEY

Final Thoughts Survey

1. Please rank the Astrophysicist on a scale of 1-5, with 1 being the lowest and 4 being the highest.
    a. 1
    b. 2
    c. 3
    d. 4
2. Please rank the Space Science Educator on a scale of 1-5, with 1 being the lowest and 4 being the highest.
    a. 1
    b. 2
    c. 3
    d. 4
3. Please rank the Paleontologist on a scale of 1-5, with 1 being the lowest and 4 being the highest.
    a. 1
    b. 2
    c. 3
    d. 4
4. Please rank the Ocean Chemist on a scale of 1-5, with 1 being the lowest and 4 being the highest.
    a. 1
    b. 2
    c. 3
    d. 4
5. Considering all four guest speakers, please rank the Astrophysicist, with 1 being your favorite guest speaker and 4 being your least favorite guest speaker.
    a. 1- My favorite guest speaker!
    b. 2
    c. 3
    d. 4 – My least favorite guest speaker.
6. Please explain your reasoning for this ranking.

7. Considering all four guest speakers, please rank the Space Science Educator, with 1 being your favorite guest speaker and 4 being your least favorite guest speaker.
    a. 1- My favorite guest speaker!
    b. 2
    c. 3
    d. 4 – My least favorite guest speaker.
8. Please explain your reasoning for this ranking.

9. Considering all four guest speakers, please rank the Paleontologist, with 1 being your favorite guest speaker and 4 being your least favorite guest speaker.
    a. 1- My favorite guest speaker!
    b. 2
    c. 3
    d. 4 – My least favorite guest speaker.
10. Please explain your reasoning for this ranking.

11. Considering all four guest speakers, please rank the Ocean Chemist, with 1 being your favorite guest speaker and 4 being your least favorite guest speaker.
    a. 1- My favorite guest speaker!
    b. 2
    c. 3
    d. 4 – My least favorite guest speaker.
12. Please explain your reasoning for this ranking.

13. After the four guest speakers, did any of them inspire YOU to become a scientist?
    a. Yes – One or more of the guest speakers inspired me to think about becoming a scientist.
    b. No – One or more of the guest speakers did not inspire me to think about becoming a scientist.
14. Please explain why you chose the answer above.

15. After the four guest speakers, did any of them change your mind about who can become a scientist?
    a. Yes – One or more of the guest speakers changed my mind about who could become a scientist.
    b. No – One or more of the guest speakers did not change my mind about who could become a scientist.
16. Please explain why you chose the answer above.

17. Would you like to see more guest speakers in the future?
    a. Yes – I loved them!
    b. No – I did not enjoy them.
18. Is there anything else you would like to share with me about the guest speakers or the experience of the guest speakers?