GENDER DIFFERENCES IN STUDENT ATTITUDES TOWARDS SCIENCE IN SECONDARY SCHOOL CLASSROOMS WITH RESIDENT SCIENTISTS

By

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DEDICATION

This thesis is dedicated to the friendships and memories of those who have been my cornerstone. Among them are: my parents, Gwendolyn Maxwell and Milton Hanson, who have always given me love and admiration; the Bryce, family that has served as my family away from my home in Jamaica; Mrs. Etla Vanhorne who has been my mentor and friend and my bridge over troubled water; Ms. Lyn Hakeem, my friend, confidant, and prayer warrior.

I also dedicate this work to Jerusha Vas, a fellow Jamaican and my best friend at Texas State University who died prematurely due to cancer. She not only encourages me over the two years that I knew her, but also connected me with resources that proved invaluable to my study. She demonstrated strength and faith that have given me a new appreciation for the meaning and importance of friendship and sisterhood. She lived her life well, believed in helping others and faced her early death bravely. Her spirit of boldness drives me to become a catalyst for change for minority women in Science.

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ABSTRACT

The purpose of this two-year study was to examine secondary school students' attitudes about science in four different categories before and after being with PhD graduate students, *resident scientists,* in their classrooms every week. The study was based upon a National Science Foundation (NSF) program called *Project Flowing Waters,* a five-year NSF Graduate STEM Fellows in K-12 Education (GK-12) program. The program funded 26 doctoral students, known as NSF GK-12 fellows, who served as bi-weekly resident scientists in science classrooms in local schools. A newly developed science attitude survey, *My Attitude Toward Science Scale* (MATS) was used to survey students [n=111] Hillman, Zeeman and Tilbury (2016)

Student attitudes were surveyed in four categories (a) the subject of science, (b) the desire to become a scientist, (c) the value of science to the society, and (d) the students' perceptions of scientists. Matched pre and post student attitude surveys were obtained. Seventeen resident scientist/teacher partnerships were analyzed, involving 1111 students, in the 2011/12 and 2012/13 school years using a quantitative design. A control population of students that did not have resident scientists were surveyed in the 2015/16 school. Both pre and post surveys were administered at the beginning and again at the end of the school year. Results indicated significant gender differences male students and male teacher in attitude changes in some but not all of the four categories.

I. INTRODUCTION

The National Science Board for Science & Engineering indicator (2016) showed that in the last twenty years, women have made marginal improvements in the area of science. In 2013, women gained 50% of all college degrees, accounted for 39% of those hired in science at the highest degree levels, and overall, represented 29% of those hired in engineering and science fields. However, these figures reflected only a minor increase over the data available in 1993 when the study began. By 1993, women gained 43% of all college degrees, represented 31% of those hired in science at the highest degree level, and 23% overall of those hired in engineering and science fields.

Women are underrepresented in the STEM occupations. Researchers have attributed this to certain complex factors that include: gender discrimination, and inequity in manuscript reviewing, grant funding and opportunities available to study and work in the discipline (Ceci & Williams, 2011). According to Blickenstaff (2005), if women were given the opportunity, they could help to solve human problems like health care and climate change while contributing to a greater diversity of perspectives in finding solutions.

Researchers have noted gender bias in teachers towards their students as early as the elementary school years. In one study, by Gunderson, Ramirez, Levine and Beilock (2011), teachers praised their male students' successes and attributed them to the students' abilities. In the case of their female counterparts, the teachers attributed their successes to effort or luck. As a result, female students feared that they would do poorly on a math tests.

In 2005, Blickenstaff suggested having female role models in the classrooms to address the problem of female underrepresentation in science occupations. Having female role models could help to inspire talented young women to pursue science related studies. In the current study, the researcher looked at whether female role models would influence students' attitudes towards science. This could positively impact student attitudes in the two-year period covered by the study.

Background

The NSF Graduate STEM fellows in K-12 Education (Gk-12) program was created to support K-12 teachers and students in the STEM fields using inquiry-based learning activities. Students and teachers had opportunities in GK-12 programs to develop a broader knowledge in STEM fields. The purposes of the GK-12 programs were to prepare science graduate students to become future science professors and improve their communication and team building skills (National Science Foundation, 2007 p.6).

Texas State University's Biology Department selected PhD graduate student fellows in science to participate in the NSF GK-12 program, *Project Flowing Waters.* The program was a five-year study looking at students' attitudes towards science after they had spent an entire year with a resident scientist in their classroom. Resident scientists were trained in inquiry-based science teaching using the 5E instruction-teaching model. After the training, resident scientists partnered with science teachers in the local school district. The training was designed to help resident scientists develop 5E lessons that were aligned with Texas Essential Knowledge and Skills

(TEKS). These lessons met the criteria for specific grade levels and the resident scientists visited the classroom for 10 hours each week for the entire school year (Dame & Westerlund, 2015).

Within the first three years of *Project Flowing Waters*, student attitudes were examined in three main categories:

(i) Science and scientists

(ii) Student abilities in science

(iii) Importance and usefulness of science

The resident scientists provided students in the 6^{th}- 8^{th} grades with inquiry-based learning experiences and engaged them in-depth discussions. Learning took place indoors and outdoors in various locations, including Bastrop State Park and Blanco River (Dame & Westerlund, 2015). At the beginning and at the end of the school year, the resident scientists administered the Student Attitudes about Science (SASI) survey. The results indicated that in the category *science and scientists*, there were significant differences between the pre and post surveys in student attitudes.

In the category, *student abilities in science*, there was a positive change in students' attitude in only one of the partnerships. Lastly, in the category *importance and usefulness of science*, there were no significant changes in student attitudes. Overall, the Dame & Westerlund (2015) study indicated that having resident scientists in classrooms only changed students' attitudes towards *science and scientists* and not towards their *own abilities in science* or the *usefulness of science.*

To examine further the effects of resident scientists on student attitudes, our study used a different the survey tool, My Attitudes Towards Science (MATS).

(Hillman, et al. 2016) developed the MATS survey and it includes four categories:

1) *The subject of science* - how students feel about the subject of science

2)*The desire to become a scientist* -students' interest in a scientific career

3) *The value of science to the society* -students' attitudes toward the discoveries and technological advances that occur through STEM

4) *The student's perception of scientists'*-students' stereotypical attitudes toward who is a scientist is (Hillman et al. 2016).

We will examine gender differences using the MATS four categories to see whether the gender of teachers and resident scientists could influence students' attitudes. The literature suggested such a link between gender role models and student attitudes towards science. Further investigation could serve to strengthen findings based on the significance of gender on student attitude towards the subject of science, students' desire to become scientists, the value of science to society, and students' perception of scientists.

II. LITERATURE REVIEW

Definition of Student Attitude

Freeman (1997) defined student attitude as the students' perception of their own abilities to achieve in science. However, Schibeci (1983) noted that looking at student attitudes involved various factors: the environment of science classrooms, lab activities, the teacher's motivation, and the student's gender. Saleh & Khine (2011) agreed that various factors influence students' attitudes, but that motivation was one of the most significant influences. In their studies, they found that students were more motivated in project- based learning settings which improved student attitudes towards science.

According to Ryan & Deci (2000) student interest in science is largely based on motivation, intrinsic and extrinsic. Once the student is intrinsically motivated, the student's enjoyment and satisfaction in learning science comes naturally. However, when a student is extrinsically motivated, there is no desire or enjoyment in learning science. External rewards are then required for the student to participate fully in the learning experience.

Gender Factors Influencing Student Attitude

Historically, science has been a male dominated field (NSF, 1988). Females have had a negative mindset towards science and science careers mainly because mothers have influenced their daughters that science is not suitable for women (George, 2000). This has contributed strongly towards the

negative attitude that girls have towards science (George, 2000). In one study, researchers showed that boys got more frequent opportunities to answer questions and receive more positive feedback on their efforts in science classrooms than girls in the same classroom (Greenfield, 1996).

Studies have shown that gender and student interest in science as well as their negative attitudes began in the elementary grades. In these grades girls viewed science classes as "facts to memorize, and boring" (Kahle & Lakes, 1983). In another study with 1,200 students, researchers found that gender differences for positive attitudes towards science occurred more in middle school. This acted as a strong predictor of student attitudes towards science in general (Weinburgh, 2000).

Saleh & Khire (2011) note that students' negative perceptions of scientists can negatively impact their learning. They show that there is a common theoretical and practical stereotypical perception of scientists across "all grade levels, genders, ethnic groups and national boundaries." Debacker & Nelson (2010).The researchers gave students the task of drawing the picture of a scientist. Both male and female students portrayed scientists as males who worked in a lab and wore white coats and glasses. These results indicated that both males and females have stereotypic images of scientists. Nevertheless, Kahle & Lakes (1983) showed that in schools, males are "valued for thinking logically, independently, with self- confidence and an appropriate degree of risk taking (p.131)." Females are "valued for their emotional expressiveness, sensitivity to others, dependency and subjective thinking (p. 131)."

There is a close relationship between student attitudes toward science and the students' achievement in science. Also, the attitude of students toward science is vital to the health of the society (National Center for Education Statistics, 2012). Having a nation that is scientifically literate is crucial in solving world problems such as climate change and healthcare. Therefore, teaching science is critical to a nation's stability (National Center for Education Statistics, 2012).

Teacher Biases and Students Attitude by Gender

Teachers in classrooms have unwittingly shown unconscious gender bias towards their students and this has affected their teaching practices (Bailey,Scantlebury & Letts, 1997). According to Lavey & Sand (2015), teachers also see boys as having more financial value to the society, and therefore reinforce the concept that science is a subject for boys. The stereotypical attitude of teachers toward their male and female students where girls are treated differently affects students' self-images and confidence. Teachers with this bias give fewer opportunities for girls to participate in science classes, encourage boys to try harder and give more time for them to respond in class. This custom in the classroom has impacted negatively on female students' perceptions of science.

Lavy & Sand (2015) confirmed teacher gender bias in a study conducted in Israel and found that teachers were *conscious and unconscious* in their bias towards their female students. The teachers favored boys, and this led to their having a positive attitude towards math and science. Girls, on the other hand,

had negative attitudes towards math and science. During one classroom exam a anonymous person external to the classroom and classroom teachers served as graders. In instances where classroom teachers graded the exam, male students scored higher than the female students. However, when the anonymous person graded the same exam, female students actually scored significantly higher than boys (Lavy & Sand, 2015). This suggests an unconscious bias in the science classroom teachers against female students.

Secondary students who work with scientists can have a positive attitude towards science and scientists. In one research study, students in an after-school robotics program worked with scientists to build a robot for a competition (Saleh & Khine, 2011). Researchers compared the attitudes of students in the after- school robotics program with that of other students from the same school that did not participate in the after-school program. Pre and posttest measurements of student attitudes toward science using the Test of Science Related Attitudes (TOSRA) revealed that students that participated in the program showed a significantly more positive attitude toward scientists and science than those that did not participate (Saleh & Khine, 2011).

Research Questions

The following questions served to guide my research.

What is the significance of gender on student attitude towards:

(1) The subject of science?

(2) The students' desire to become scientists?

(3) The value of science to society?

(4) The students' perceptions of scientists?

Does the teacher's gender influence students' attitudes in any of the four categories of the MATS survey?

Does the resident scientist's gender influence student attitudes in the categories of the MATS survey?

Null hypotheses

1. The gender of teacher does not influence student attitudes in the four attitude categories.
2. The gender of the resident scientist does not influence students' attitudes in the four attitude categories.
3. The gender of the students does not influence their attitudes toward science in the four attitude categories.

III. METHODOLOGY

Research Design

Project Flowing Waters was an interdisciplinary National Science Foundation (NSF) Graduate STEM Fellows in K-12 Education (GK-12) program. STEM refers to Science, Technology, Engineering and Mathematics. The project represented a collaboration of two middle schools in the San Marcos Consolidated Independent School district (SMCISD) and Texas State University's Biology Department. The Institutional Review Board (IRB) granted IRB Exemption 13-59394 for human subject's research prior to the inception of the study. In accordance with IRB, all parents of the students involved in the study were provided with consent letters labeled with IRB approval number #2008-62370.

The backdrop of the project was the watershed of San Marcos River reflected in the name Project Flowing Waters. The watershed provided the resources for the interdisciplinary areas: such as aquatic biology, aquatic ecology, conservation biology, and river restoration. (NSF,2013)

Sample - Demographics

Goodnight Middle School and Miller School were the two schools participating in this GK-12 program. Goodnight Middle School had an enrollment of 1011 students in 2013. The economically disadvantaged population in this school was 72.9% with 7% being English language learners. Miller Middle School had a population of 725 students. The economically disadvantaged population of 69.8 % in 2013 with 3.7% being English-language learners. (Texas Education Agency,2013).

Goals of Project Flowing Waters

The main goals of Project Flowing Waters as stated in their annual reports to NSF were:

> (1) To improve the communication, collaboration teaching and team building skills of resident scientists, (2) to provide professional development for 6th to 12th grade school students through engagement in the resident scientist STEM research areas, (3) to increase student interest in STEM areas, (4) to strengthen the partnership between Texas State University and SMCISD, and (5) to instill a deeper understanding of inquiry-based science teaching into Texas State graduate programs and provide opportunities to practice these approaches (NSF 2013,p.1).

In this study, the focus was on a third goal that was different from those outlined in Project Flowing Waters. It concerned increasing student interest in the STEM areas.

Development of the Survey Instrument

Texas State University and University of England in Biddeford, Maine developed a valid and reliable instrument to analyze student attitudes towards science. There were 40 negative and positive statements in four categories. The resulting survey titled, *My Attitudes towards Science* (MATS) contained the following categories: (1) Attitude Towards the Subject of Science; (2) Desire to Become a Scientist; (3) Value of Science to Society; and (4) Perception of Scientists.

The MATS instrument (see Appendix A) was used to measure several aspects of students' attitudes towards science. This survey can also be used amongst varying grade levels and either hand or machine scored (Hillman,et al.2016).

Time frame of Projects Flowing Waters & Participant Selection

Projects Flowing Waters began in 2008 and ended in 2013. The grades that were served in this GK-12 program ranged from the middle school to high school. In this study, we examined student attitudes in the final two years of the program that served only at the middle school level. PhD biology students were selected to become GK-12 fellows (known as resident scientists) based on an application process. Their selection into the program was based upon numerous factors including publication within their scientific fields. Selected resident scientists were given a stipend and tuition assistance to serve as resident scientists in the program. Classroom teachers who participated in Project Flowing Waters also applied to the program and were provided with a stipend. Once the classroom teachers accepted the offer to participate in Project Flowing Waters, parents of their students received a letter requesting permission for their children to participate in the program.

Research Procedures and Data Collection

Resident scientists were trained in inquiry-based teaching using the 5E method in the summer prior to the school year. They were paired with classroom teachers that had a similar content area background so that the partnership would be richer. The resident scientist spent approximately 10 hours each week in the classroom and several hours outside preparing lessons. Lessons were developed with engagement in mind and designed for inside and outside of the classroom.

In year 4, eight teachers participated in Project Flowing Waters, four males and four females. Each classroom teacher was paired with residence scientists. The sample size that was collected in year 4 was 271. In year 5, there were five female teachers four male teachers. Each teacher was paired with residence scientists. The sample that was collected in year 5 was 809. In the control year, 2015 to 2016, four teachers from the original program participated. These includes two male and two female, there were no resident scientists in the control year

At the beginning of the school year, in September, students were given a pre-MATS survey. And at the end of the school year in April students were given a post survey. The survey was hand-scored to increase the quality of the data and provide more accurate responses. Data for the last two years was collected 2011 to 2012 and 2012-2013 with a sample size of 1111. Control data was collected in 2015 to 2016 compare whether or not the intervention of having resident scientists working with classroom teachers made a difference in students' attitudes. All of the teachers in the control sample were previous Project Flowing Waters teachers. Control data had a sample size of 367.

Statistical Analysis

The students' pre-and post-survey MATS surveys were analyzed with SPSS to evaluate whether the gender of the teacher, the resident scientist or the student affected students' attitudes toward science. An independent t-test, was conducted to analyze gender differences for teachers, students and resident scientists. A repeated measures ANOVA was conducted to analyze students and teachers' interaction at the highest level, and descriptive statistics was conducted for the overall means and standard deviation between teacher gender and student gender for the ANOVA test.

IV. RESULTS

The results are presented by years and by each of the four MATS categories in different gender analyses including: 1) male teacher versus female teacher, 2) male resident scientist versus female resident scientist and 3) male student versus female student. For each category, an independent t-test table and a bar graph showing 95% confidence intervals around the means are provided.

Table 1. Year 4 *Students' Attitudes towards Science*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 1 concerns *Students' Attitudes towards Science*. There were no significant differences in any of the gender analyses.

ATTITUDES	Gender	*N*	*M*	*SD*	*S.E*	*t*	*dt*	*p*
	Teacher							
Pre Attitudes	Male	115	3.48	0.74	0.69	2.06	266	0.43
	Female	153	3.67	0.75	0.61			
Post Attitudes	Male	115	3.61	0.79	0.74	-0.62	268	0.54
	Female	155	3.67	0.75	0.60			
	Resident							
Pre Attitudes	Male	158	3.52	0.73	0.05	1.74	266	0.84
	Female	110	3.68	0.77	0.07			
Post Attitudes	Male	158	3.58	0.80	0.63	1.673	268	0.95
	Female	112	3.74	0.72	0.68			
	Student							
Pre Attitudes	Male	144	3.64	0.69	0.58	1.15	0.266	0.25
	Female	124	3.53	0.81	0.74			
Post Attitudes	Male	145	3.73	0.76	0.63	1.99	0.268	0.48
	Female	125	3.55	0.78	0.69			

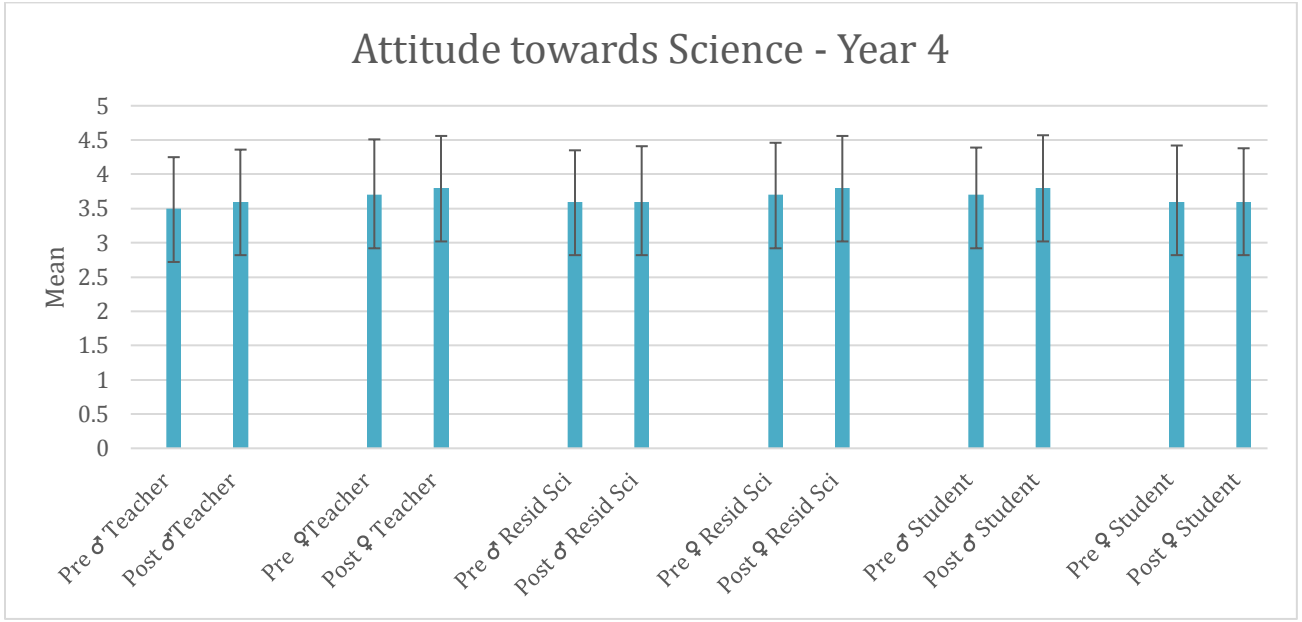

Figure 1. Year 4 *Students' Attitudes Toward Scienc*e: Dependent Samples Test

Figure 1 represents the category *Students' Attitudes Towards Science* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 2. Year 4 Students' Desire to Become a Scientist: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 2 concerns results within the category *Students' Desire to Become a Scientist*. The results indicated that there is no statistical significance in any of the gender analyses.

DESIRE	Gender	*N*	*M*	*SD*	*SE*	*t*	*dt*	*P*
	Teacher							
Pre Desire	Male	115	2.53	1.11	0.103	-1.24	269	0.217
	Female	156	2.69	1.10	0.881			
Post Desire	Male	115	2.59	1.05	0.098	-1.46	269	0.26
	Female	156	2.74	1.16	0.093			
	Resident							
Pre Desire	Male	158	2.61	1.09	0.086	-0.29	269	0.782
	Female	113	2.65	1.13	0.106			
Post Desire	Male	158	2.68	1.10	0.087	0.11	269	0.09
	Female	113	2.67	1.15	0.108			
	Student							
Pre Desire	Male	145	2.73	1.13	0.094	1.67	269	0.98
	Female	126	2.50	1.07	0.096			
Post Desire	Male	145	2.80	1.16	0.097	1.89	269	0.06
	Female	126	2.54	1.06	0.945			

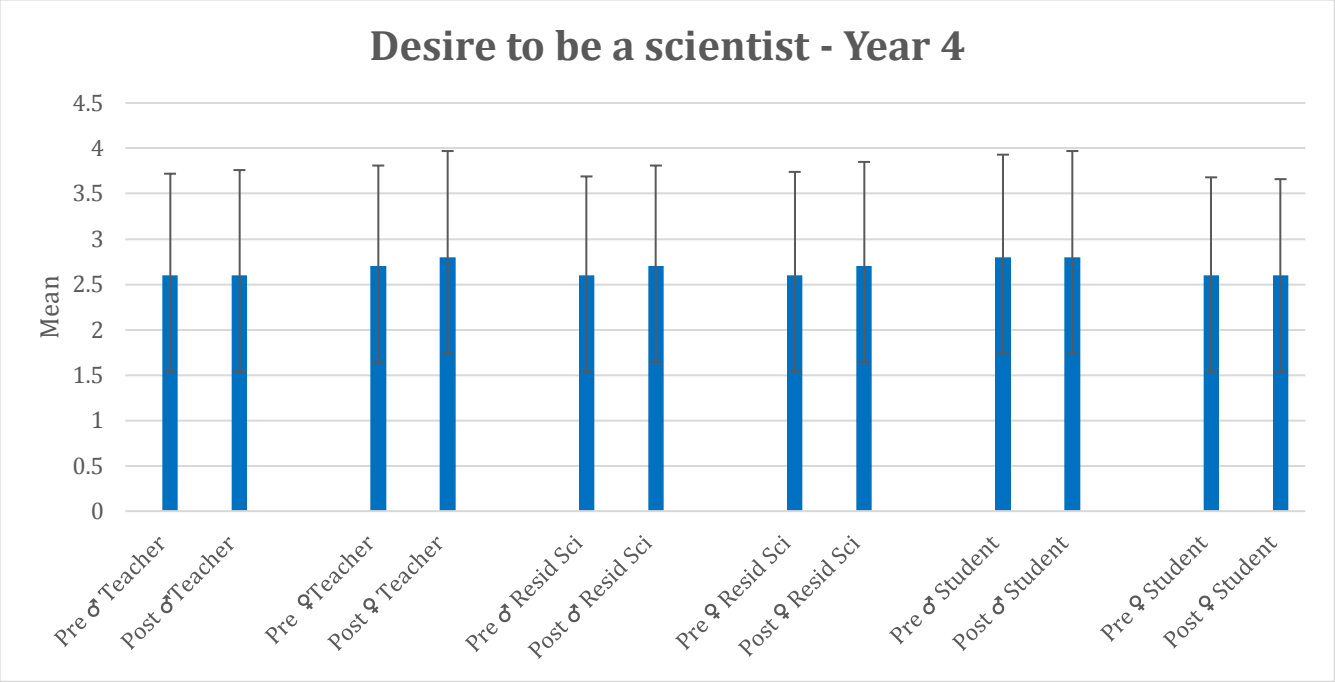

Figure 2. Year 4 *Students' Desire to Become a Scientist*: Dependent Samples t-Test
Figure 2 represents the category *Students' Desire to Become a Scientist* with pre and post survey means involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 3. *Year 4 Value of Science to Society*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 3 concerns results within the category *Value of Science to Society.* The results indicated that there is no statistical significance in any of the gender analyses.

VALUE	*Gender*	*N*	*M*	*SD*	*SE*	*t*	*dt*	*P*
	Teacher							
Pre Value	Male	115	3.84	0.57	0.053	-1.86	268	0.65
	Female	155	3.97	0.60	0.485			
Post Value	Male	115	4.04	0.62	0.581	-1.73	269	0.464
	Female	156	3.98	0.63	0.508			
	Resident							
Pre Value	Male	158	3.87	0.58	0.463	-1.52	268	0.131
	Female	112	3.98	0.60	0.567			
Post Value	Male	158	4.02	0.63	0.639	0.386	269	0.700
	Female	113	3.99	0.62	0.617			
	Student							
Pre Value	Male	144	3.95	0.595	0.496	1.07	268	0.282
	Female	126	3.87	0.586	0.522			
Post Value	Male	145	4.07	0.661	0.548	1.81	269	0.071
	Female	126	3.93	0.584	0.520			

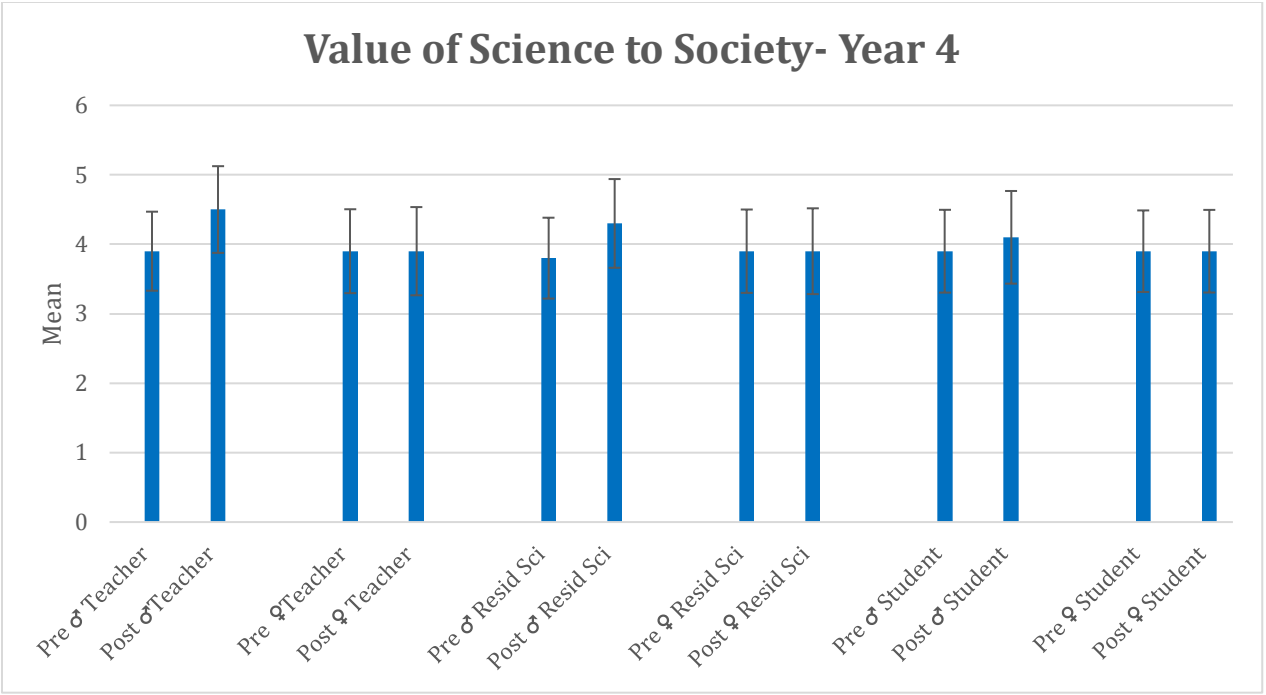

Figure 3. Year 4 *Value of Science to Society*: dependent Samples T-Test
Figure 3 represents the category *Value of Science to Society* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 4. Year 4 *Students' Perception of Scientist*s: Independent Samples T-Test
Statistical significance: *P ≤.05, **P≤.01. Table 4 concerns results within the category *Students' Perception of Scientists.* The results indicated that there is no statistical significance in any of the gender analyses.

PERCEPTION	***Gender***	***N***	***M***	***SD***	***SE***	***t***	***dt***	***P***
	Teacher							
Pre percept	Male	115	2.51	.4365	.4071	.750	269	.454
	Female	156	2.47	.5128	.4106			
Post percept	Male	114	2.29	.4916	.4605	2.48	267	.328
	Female	155	2.35	.5012	.4026			
	Resident							
Pre percept	Male	158	2.52	.4635	0.3688	1.494	269	.136
	Female	113	2.43	.5033	0.4735			
Post percept	Male	157	2.31	.4974	.03970	-.613	267	.541
	Female	112	2.35	.4982	.04708			
	Student					-		
Pre percept	Male	145	2.48	0.514	0.5135	0.221	269	0.826
	Female	126	2.49	0.444	0.4439			
Post percept	Male	144	2.29	0.526	0.5250	1.44	267	0.149
	Female	125	2.38	0.461	.04606			

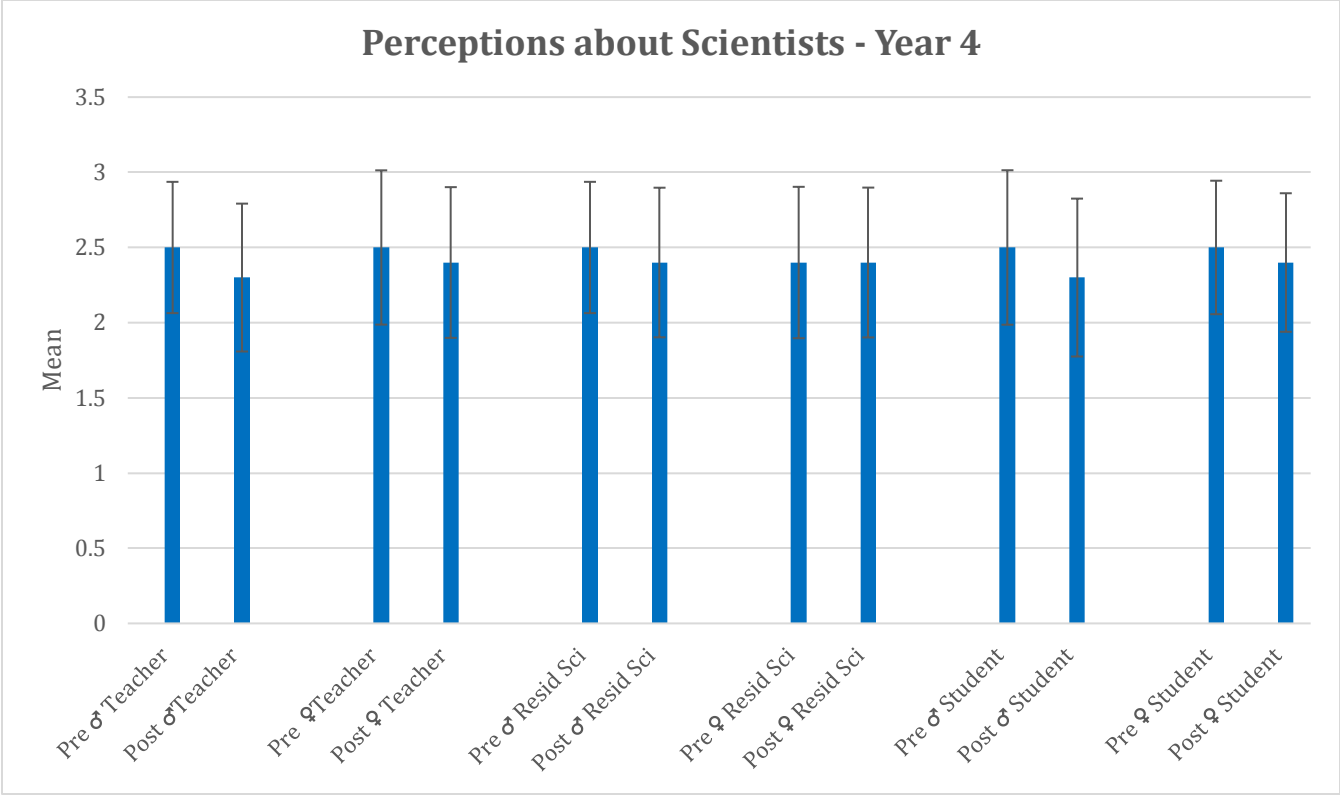

Figure 4. Year 4 Students Perception of Scientists: Dependent Samples T-Test

Figure 4 represents the category *Students Perception of Scientists* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 5. *Year 4 Students' Attitudes towards Science*: ANOVA Descriptive Statistics

Table 5 below is *Students' Attitudes towards Science:* ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

ATTITUDES	Teacher Gender M1 F2	Student Gender M1 F 2	M	SD	N
Pre Attitudes	Male	Male	3.5	.67	62
		Female	3.3	.82	53
		Total	3.4	.75	115
	Female	Male	3.7	.72	82
		Female	3.7	.81	70
		Total	3.7	.76	152
	Total	Male	3.7	.69	144
		Female	3.6	.82	123
		Total	3.6	.76	267
Post Attitudes	Male	Male	3.8	.75	62
		Female	3.5	.85	53
		Total	3.6	.79	115
	Female	Male	3.8	.78	82
		Female	3.7	.74	70
		Total	3.7	.76	152
	Total	Male	3.8	.77	144
		Female	3.6	.79	123
		Total	3.7	.78	267

Table 6. Year 4 *Students' Desire to Become a Scientist*: ANOVA Descriptive Statistics
Table 6 below is *Students' Desire to Become a Scientist*: ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

Desire	**Student Gender M1 F 2**	**Teacher Gender M1 F2**	**M**	**SD**	**N**
Pre desire	Male	Male	2.7	1.17	62
		Female	2.8	1.12	83
		Total	2.8	1.13	145
	Female	Male	2.4	1.04	53
		Female	2.7	1.09	73
		Total	2.6	1.08	126
	Total	Male	2.6	1.13	115
		Female	2.7	1.11	156
		Total	2.7	1.11	271
Post desire	Male	Male	2.8	1.03	62
		Female	2.9	1.26	83
		Total	2.9	1.17	145
	Female	Male	2.5	1.09	53
		Female	2.7	1.05	73
		Total	2.6	1.07	126
	Total	Male	2.6	1.06	115
		Female	2.8	1.17	156
		Total	2.9	1.13	271

Table 7. Year 4: *Value of Science to Society*: ANOVA Descriptive Statistics

Table 7 below is *Value of Science to Society*: ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

Value	***Student Gender M1 F 2***	***Teacher Gender M1 F2***	***M***	***SD***	***N***
Pre Value	Male	Male	3.88	.589	62
		Female	4.02	.598	82
		Total	3.97	.596	144
	Female	Male	3.81	.547	53
		Female	3.94	.612	73
		Total	3.88	.587	126
	Total	Male	3.88	.569	115
		Female	3.98	.604	155
		Total	3.92	.592	270
Post Value	Male	Male	4.14	.688	62
		Female	4.03	.643	82
		Total	4.08	.663	144
	Female	Male	3.93	.522	53
		Female	3.95	.629	73
		Total	3.94	.585	126
	Total	Male	4.05	.624	115
		Female	3.99	.637	155
		Total	4.01	.634	270

Table 8. Year 4 *Students' Perception of Scientists*: ANOVA Descriptive Statistics

Table 8 below is *Students' Perception of Scientists*: ANOVA descriptive statistics gives the overall mean and standard deviation between teacher and student gender.

Perception	***Teacher Gender M1 F2***	***Student Gender M1 F 2***	***M***	***SD***	***N***
Pre perception	Male	Male	2.5	.498	62
		Female	2.6	.354	52
		Total	2.5	.438	114
	Female	Male	2.5	.528	82
		Female	2.5	.499	73
		Total	2.5	.513	155
	Total	Male	2.5	.514	144
		Female	2.5	.445	125
		Total	2.5	.482	269
Post perception	Male	Male	2.2	.559	62
		Female	2.4	.386	52
		Total	2.3	.492	114
	Female	Male	2.3	.496	82
		Female	2.4	.509	73
		Total	2.4	.501	155
	Total	Male	2.3	.525	144
		Female	2.4	.460	125
		Total	2.3	.497	269

Table 9. Year 4 Students' Attitudes towards Science: ANOVA Tests of Within-Subjects Effects (Students/Teachers)
Table 9 below *Students' Attitudes towards Science:* The results indicate an ANOVA tests of within-Subjects effects between teacher and student gender. There is no statistical significance within subject's effects.

Measure: Attitude		***Type III Sum of Squares***	***df***	***MS***	***F***	***p***
Pre Post	Sphericity Assumed	.626	1	.626	2.34	.128
Pre Post TeacherGenderM1F2	Sphericity Assumed	.483	1	.483	1.80	.181
Pre Post StudentGenderM1F2	Sphericity Assumed	.127	1	.127	.473	.492
Pre Post TeacherGenderM1F2 Student Gender M1F2	Sphericity Assumed	.003	1	.003	.011	.916
Error (Pre Post)	Sphericity Assumed	70.497	263	.268		

Table 10. Year 4 *Students' Desire to Become a Scientist*: ANOVA Tests of Within-Subjects Effects (students/teachers) Table 10 below is *Students' Desire to become a Scientist*. The results indicate an ANOVA tests of within-Subjects effects between teacher and student gender. There is no statistical significance within subjects' effects.

Measure: Desire		***Type III Sum of Squares***	***df***	***M.S***	***F***	***P***
Pre Post	Sphericity Assumed	.379	1	.379	.456	.500
Pre Post StudentGenderM1F2	Sphericity Assumed	.025	1	.025	.030	.863
Pre Post TeacherGenderM1F2	Sphericity Assumed	.008	1	.008	.009	.924
Pre Post StudentGenderM1F2 TeacherGenderM1F2	Sphericity Assumed	.045	1	.045	.055	.815
Error(Pre Post)	Sphericity Assumed	1.649	267	.830		

Table 11. Year 4 *Value of Science to Society*: ANOVA Tests of Within-Subjects Effects (Students/Teachers)
Table 11 below is *Value of Science of Society*. The results indicate an ANOVA tests of within-Subjects effects between teacher and student gender, there is statistical significant difference in the overall Pre Post survey for both teacher and students gender interaction within subjects' effects and statistical significant difference for the interaction between teacher genders.

Measure: Value		***Type III Sum of Squares***	***df***	***MS***	***F***	***P***
Pre Post	Sphericity Assumed	1.334	1	1.334	5.56	*.019
Pre Post Student GenderM1F2	Sphericity Assumed	.167	1	.167	.697	.405
Pre Post Teacher GenderM1F2	Sphericity Assumed	1.116	1	1.116	4.65	*.032
Pre Post Student GenderM1F2 Teacher GenderM1F2	Sphericity Assumed	.172	1	.172	.716	.398
Error (Pre Post)	Sphericity Assumed	63.870	266	.240		

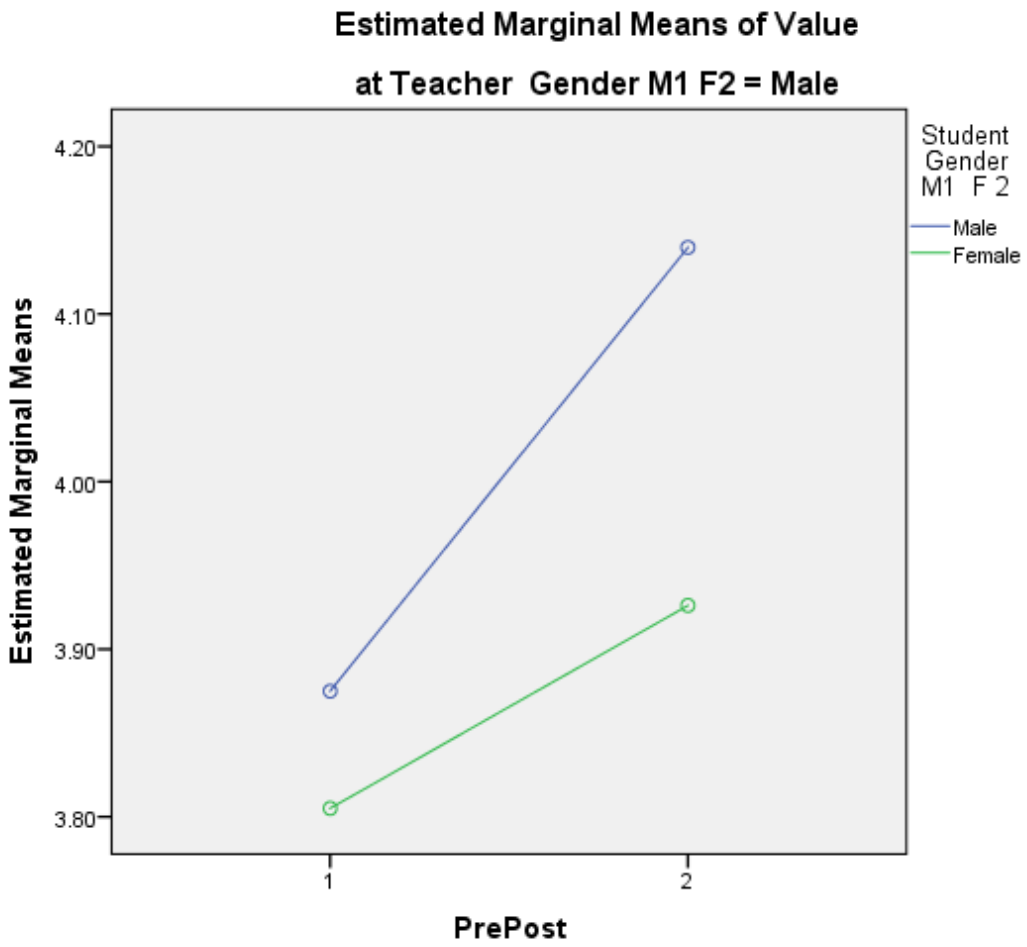

Figure 5. Year 4 *Value of Science to Society*: ANOVA Tests of Within-Subjects Effects (Male teacher).

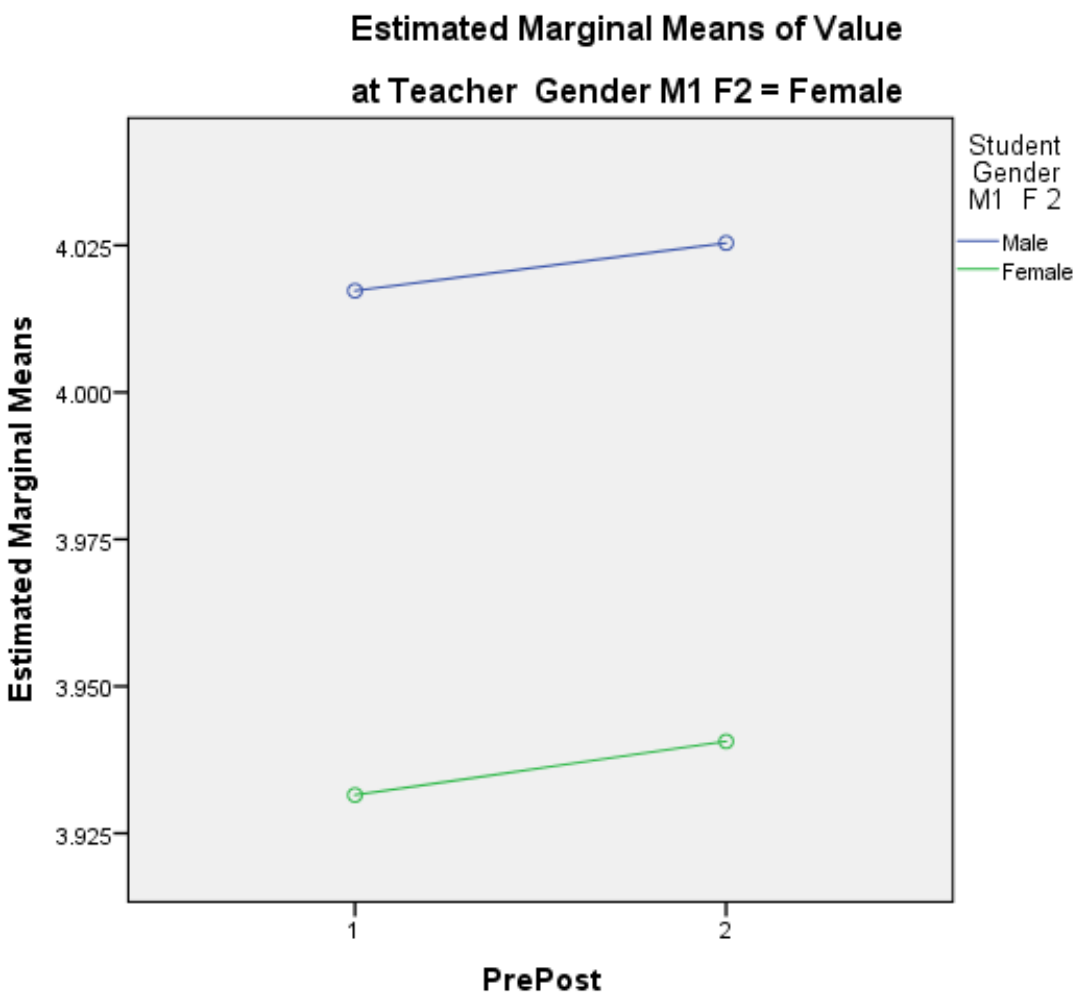

Figure 6: Year 4 *Value of Science to Society*: ANOVA Tests of Within-Subjects Effects (Female teacher). Note that males and female students had better attitudes about the value of science to society with female teachers.

Table 12. Year 4 *Value of Science to Society*: ANOVA Tests of Within-Subjects (Students/Resident Scientists) Table 12 below is by category *Value of Science of Society*. The results indicate an ANOVA tests of Within-Subjects effects between resident scientist and student gender, there is no statistical significance change in Pre Post survey for resident scientist and students gender at the highest interaction within subjects effects.

Measure: Value		***Type III Sum of Squares***	***df***	***MS***	***P***
Pre Post	Sphericity Assumed	.745	1	.745	3.064
Pre Post Student GenderM1F2	Sphericity Assumed	.076	1	.076	.312
Pre Post Resident GenderM1F2	Sphericity Assumed	.582	1	.582	2.397
Pre Post StudentGenderM1F2 Resident GenderM1F2	Sphericity Assumed	.009	1	.009	*.036
Error (Pre Post)	Sphericity Assumed	64.628	266	.243	

Table 13. Year 4 *Students' Perception of Scientists*: ANOVA Tests of within-Subjects Effects (Students/Teachers) Table 13 below is by category *Students' Perception of Scientists*. The results indicate an ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Perception		***Type III Sum of Squares***	***df***	***MS***	***F***	***P***
Pre Post	Sphericity Assumed	3.341	1	3.341	20.888	.*000
Pre Post TeacherGenderM1F2	Sphericity Assumed	.355	1	.355	2.220	.137
Pre Post Student GenderM1F2	Sphericity Assumed	.174	1	.174	1.090	.298
Pre Post TeacherGenderM1F2 Student GenderM1F2	Sphericity Assumed	.002	1	.002	.014	.907
Error (Pre Post)	Sphericity Assumed	42.385	265	.160		

Table 14. Year 5 *Students' Attitudes towards Science*. Independent Samples T-Test
Statistical significance: *P ≤.05, **P≤.01 The results in Table 14 concerns *Students' Attitudes towards Science*. The only significant difference was between male and female students in the post attitude survey. Male students had significantly more positive attitudes towards science than female students after their experiences with resident scientists.

Attitudes	***Gender***	***N***	***M***	***SD***	***SE***	***t***	***dt***	***p***
	Teacher							
Pre attitudes	Male	165	3.85	0.678	0.528	1.45	803	0.148
	Female	640	3.75	0.749	0.296			
Post attitudes	Male	165	3.46	0.705	0.549	-0.94	802	0.126
	Female	639	3.51	0.666	0.026			
	Resident							
Pre attitudes	Male	532	3.78	0.731	0.0317	0.73	803	0.467
	Female	273	3.74	0.747	0.0452			
Post attitudes	Male	532	3.54	0.685	0.0297	2.38	802	0.018
	Female	272	3.42	0.645	0.0392			
	Student							
Pre attitudes	Male	378	3.86	0.701	0.0360	3.6	803	.*0
	Female	427	3.68	0.758	0.0367			
Post attitudes	Male	377	3.59	0.644	0.3318	3.6	802	*.0
	Female	427	3.42	0.691	0.3344			

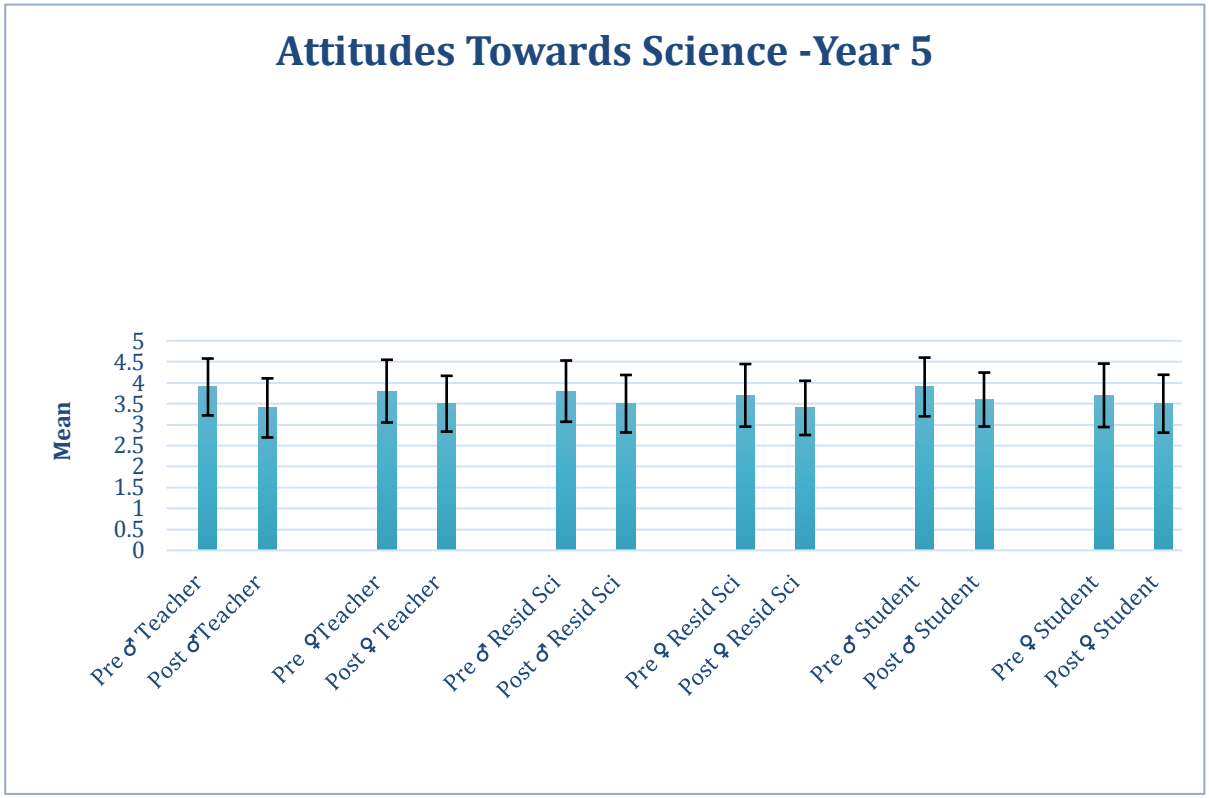

Figure 7. Year 5 *Students' Attitudes towards Science*: Dependent Samples t- Test
Figure 7. represents the category *student's attitudes towards science* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 15. Year 5 *Students' Desire to Become a Scientist*: Independent Samples T-Test
Table 15 *Students' Desire to Become a Scientist*. The results indicated that there was statistical significance in the post desire of the male student and female students. Male students were more positive about their desire to be a Scientist.

Desire	*Gender*	*N*	*M*	*SD*	*SE*	*t*	*dt*	*P*
	Teacher							
Pre Desire	Male	165	2.68	1.069	0.0832	0.95	806	0.344
	Female	643	2.77	1.113	0.0439			
Post Desire	Male	165	2.53	1.126	0.0876	1.07	806	0.282
	Female	643	2.63	1.146	0.0451			
	Resident							
Pre Desire	Male	533	2.77	1.088	0.0471	0.65	806	0.517
	Female	275	2.72	1.138	0.0686			
Post Desire	Male	533	2.65	1.150	0.0498	1.38	806	0.166
	Female	275	2.53	1.123	0.0677			
	Student							
Pre Desire	Male	380	2.82	1.076	0.0551	1.57	806	0.118
	Female	428	2.70	1.126	0.0563			
Post Desire	Male	380	2.70	1.107	0.0568	2.1	806	*0.028
	Female	428	2.53	1.165	0.0563			

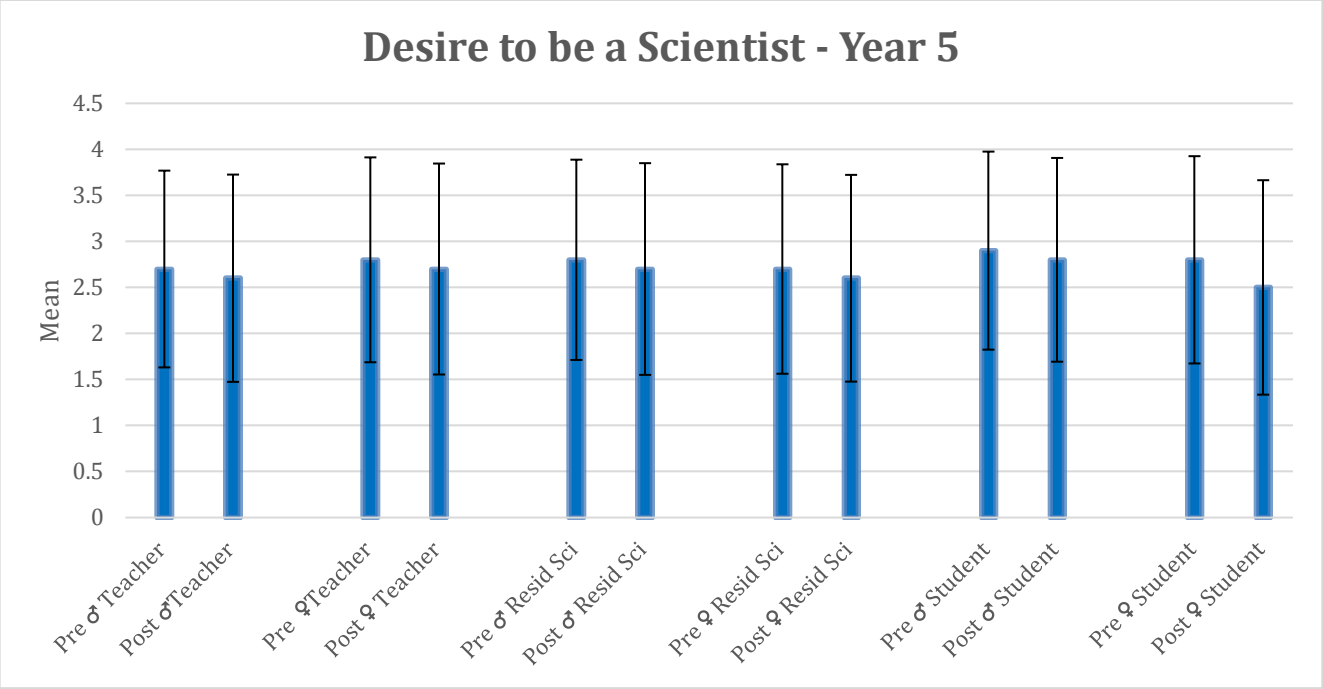

Figure 8. Year 5 *Students' Desire to Become a Scientist*: Dependent Samples T-Test
Figure 8. represents the category *Students' Desire to Become a Scientist* with pre and post survey means involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 16. Year 5 *Value of Science to Society*: Independent Samples T_ Test
Table 16 *Value of Science to Society* the results indicated that there was statistical significant differences between male and female teachers, and between male and female students in pre and post surveys.

	Gender	***N***	***M***	***SD***	***SE***	***T***	***dt***	***P***
	Teacher							
Pre Value	Male	165	3.90	0.583	0.0454	-3.34	803	*0.001
	Female	640	4.07	0.590	0.0233			
Post Value	Male	165	3.66	0.480	0.3743	-3.36	804	*0.001
	Female	641	3.71	0.451	0.1783			
	Resident Gender							
Pre Value	Male	533	4.05	0.598	0.0259	1.3	803	0.206
	Female	272	4.00	0.581	0.0353			
Post Value	Male	533	4.04	0.572	0.0247	1.9	804	0.029
	Female	273	3.96	0.568	0.3436			
	Student Gender							
Pre Value	Male	379	4.09	0.591	0.0304	2.6	803	*0.012
	Female	426	3.98	0.589	0.0286			
Post Value	Male	379	4.06	0.462	0.0238	3.4	804	*0.001
	Female	427	3.96	0.449	0.0218			

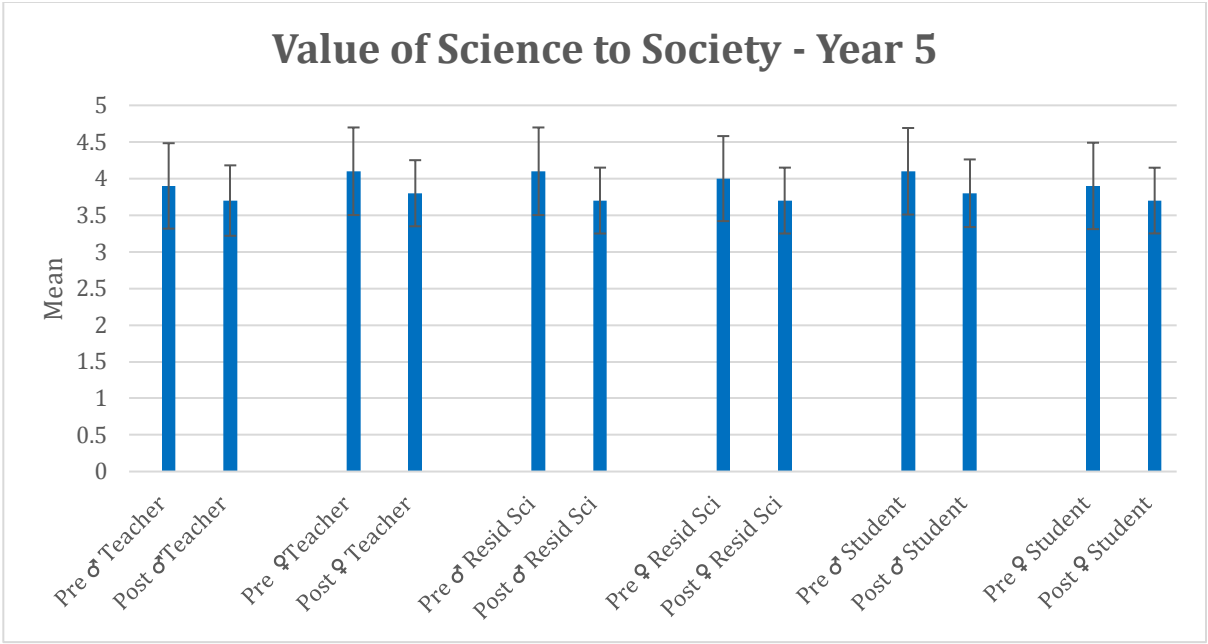

Figure 9. Year 5 *Value of Science to Society*: Dependent Samples T-Test

Figure 9 represents the category *Value of Science to Society* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 17. Year 5 *Students' Perception of Scientists:* Independent Samples T-Test
Table 17 *Students' Perception of Scientists* the results indicated that there was statistical significance in teacher and student pre and post perception of the gender analyses.

Perception	**Gender**	**N**	**M**	**SD**	**SE**	**t**	**dt**	**P**
Pre perception	Teacher Male	165	2.48	0.466	0.0363	3.3	804	*0.001
	Female	641	2.34	0.479	0.0189			
Post perception	Male	165	2.33	0.475	0.0369	3.4	805	*0.013
	Female	642	2.23	0.451	0.0177			
	Resident Gender							
Pre perception	Male	532	2.38	0.486	0.486	0.97	804	0.336
	Female	274	2.34	0.468	0.468			
Post perception	Male	533	2.26	0.0469	0.469	0.77	805	0.331
	Female	274	2.23	0.438	0.435			
	Student Gender							
Pre perception	Male	378	2.33	0.478	0.0246	1.8	804	0.07
	Female	428	2.39	0.479	0.0232			
Post perception	Male	380	2.21	0.457	0.235	2.5	805	*0.013
	Female	427	2.29	0.456	0.219			

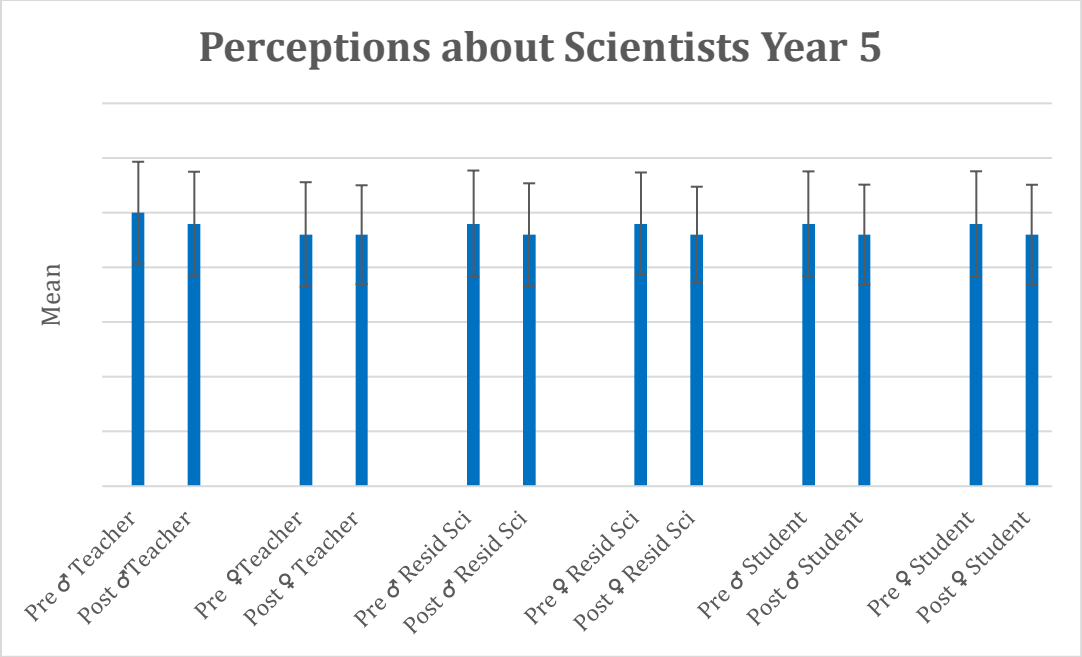

Figure 10. Year 5 *Students' Perceptions of Scientists*.

Figure 10. represents the category *Students' Perception of Scientists* with pre and post survey involving gender analyses between teachers, resident scientists and students in pre/post means with 95% confidence intervals (CI). Note there is an overlap in CI error bars in all of the gender analyses indicating lack of statistical significance between the means.

Table 18. Year 5 *Students' Attitudes towards Science*: Descriptive Statistics

Table 18 below is *Students' Attitudes towards Science* ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

Attitude	***Teacher Gender M1 F2***	***Student Gender M1 F2***	***M***	***SD***	***N***
Pre Attitude	Male	Male	4.0	.5904	75
		Female	3.7	.7196	90
		Total	3.8	.6783	165
	Female	Male	3.8	.7198	300
		Female	3.6	.7676	336
		Total	3.7	.7486	636
	Total	Male	3.9	.6987	375
		Female	3.7	.7570	426
		Total	3.9	.7352	801
Post Attitude	Male	Male	3.7	.6529	75
		Female	3.3	.7040	90
		Total	3.5	.7051	165
	Female	Male	3.6	.6419	300
		Female	3.5	.6845	336
		Total	3.5	.6664	636
	Total	Male	3.6	.6445	375
		Female	3.4	.6916	426
		Total	3.5	.6745	801

Table 19. *Students' Desire to Become a Scientist*: Descriptive Statistics
Table 19 below is *Students Desire to Become a Scientist* ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

Desire	Student Gender M1 F2	Teacher Gender M1 F2	M	SD	N
Post Desire	Male	Male	2.7	1.1249	75
		Female	2.7	1.1054	305
		Total	2.7	1.1078	380
	Female	Male	2.4	1.1062	90
		Female	2.6	1.1784	338
		Total	2.5	1.1655	428
	Total	Male	2.5	1.1258	165
		Female	2.6	1.1453	643
		Total	2.6	1.1414	808
Pre Desire	Male	Male	2.9	1.0686	75
		Female	2.8	1.0785	305
		Total	2.8	1.0758	380
	Female	Male	2.5	1.0439	90
		Female	2.7	1.1441	338
		Total	2.7	1.1269	428
	Total	Male	2.6	1.0697	165
		Female	2.7	1.1129	643
		Total	2.7	1.1042	808

Table 20. Year 5 *Value of Science to Society*: Descriptive Statistics
Table 20 below is *Value of Science to Society* ANOVA descriptive statistics gives the overall means and standard deviation between resident scientist and student gender.

Value	***Student Gender M1 F2***	***Teacher Gender M1 F2***	***M***	***SD***	***N***
Pre Value	Male	Male	4.1	.5592	75
		Female	4.1	.6008	303
		Total	4.1	.5923	378
	Female	Male	3.8	.5725	90
		Female	4.0	.5814	336
		Total	3.9	.5899	426
	Total	Male	3.9	.5833	165
		Female	4.1	.5908	639
		Total	4.0	.5929	804
Post Value	Male	Male	4.0	.5555	75
		Female	4.1	.5604	303
		Total	4.1	.5589	378
	Female	Male	3.8	.5669	90
		Female	4.0	.5752	336
		Total	3.9	.5785	426
	Total	Male	3.9	.5721	165
		Female	4.0	.5688	639
		Total	4.0	.5714	804

Table 21. Year 5 *Students' Perception of Scientists*: Descriptive Statistics
Table 21 below is *Students' Perception of Scientists* ANOVA descriptive statistics gives the overall means and standard deviation between teacher and student gender.

Perception	***Teacher Gender M1 F2***	***Student Gender M1 F2***	***M***	***SD***	***N***
Pre perception	Male	Male	2.5	.4722	75
		Female	2.5	.4625	90
		Total	2.5	.4655	165
	Female	Male	2.3	.4729	303
		Female	2.4	.4820	337
		Total	2.3	.4787	640
	Total	Male	2.4	.4773	378
		Female	2.4	.4796	427
		Total	2.3	.4791	805
Post perception	Male	Male	2.3	.4399	75
		Female	2.4	.5026	90
		Total	2.3	.4749	165
	Female	Male	2.2	.4602	303
		Female	2.3	.4391	337
		Total	2.2	.4506	640
	Total	Male	2.2	.4575	378
		Female	2.3	.4541	427
		Total	2.3	.4571	805

Table 22. Year 5 *Students' Attitudes Towards Science*: ANOVA Tests of Within-Subjects Effects (Student/Residents) Table 22 *Students' Attitudes Towards Science* ANOVA tests of within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Attitude		***Type III Sum of Squares***	***df***	***M.S***	***F***	***p***
PrePost	Sphericity Assumed	27.491	1	27.491	136.608	*.000
PrePost StudentGenderM1F2	Sphericity Assumed	.039	1	.039	.193	.661
PrePost ResidentsGenderM1F2	Sphericity Assumed	.472	1	.472	2.344	.126
PrePost StudentGenderM1F2 ResidentsGenderM1F2	Sphericity Assumed	.026	1	.026	.128	.720
Error(PrePost)	Sphericity Assumed	160.386	797	.201		

Table 23. Year 5 *Students' Desire to Become a Scientist*: Tests of Within-Subjects Effects (Student/Teacher Gender) Table 23 *Students' Desire to Become a Scientist* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Desire		***Type III Sum of Squares***	***df***	***M.S***	***F***	***P***
Pre Post	Sphericity Assumed	5.807	1	5.807	9.140	*.003
Pre Post Student GenderM1F2	Sphericity Assumed	.036	1	.036	.057	.812
PrePost TeacherGenderM1F2	Sphericity Assumed	.024	1	.024	.038	.845
PrePost StudentGenderM1F2 Teacher GenderM1F2	Sphericity Assumed	.179	1	.179	.282	.596
Error(PrePost)	Sphericity Assumed	510.784	804	.635		

Table 24. Year 5 *Students' Desire to Become a Scientist*: ANOVA Tests of Within-Subjects Effects (Student/ Resident Scientists) Table 24 *Students' Desire to Become a Scientist* ANOVA tests of Within-Subjects effects between resident scientists and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Desire		***Type III Sum of Squares***	***df***	***M.S***	***F***	***P***
Pre Post	Sphericity Assumed	8.317	1	8.317	13.110	*.000
Pre Post Student GenderM1F2	Sphericity Assumed	.555	1	.555	.874	.350
Pre Post ResidentsGenderM1F	Sphericity Assumed	.303	1	.303	.477	.490
Pre Post Student GenderM1F2 ResidentsGenderM1F2	Sphericity Assumed	.532	1	.532	.839	.360
Error (Pre Post)	Sphericity Assumed	510.081	804	.634		

Table 25. Year 5 *Value of Science to Society*: ANOVA Tests of Within-Subjects Effects (Students/Teachers) Table 25 below is *Value of Science to Society* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Value		***Type III Sum of Squares***	***dt***	***M.S***	***F***	***P***
Pre Post	Sphericity Assumed	.029	1	.029	.476	.490
Pre Post StudentGenderM1F2	Sphericity Assumed	.032	1	.032	.525	.469
Pre Post TeacherGenderM1F2	Sphericity Assumed	.126	1	.126	2.085	.149
Pre Post Student GenderM1F2 Teacher GenderM1F2	Sphericity Assumed	.086	1	.086	1.433	.232
Error(PrePost)	Sphericity Assumed	48.295	800	.060		

Table 26. Year 5 *Students' Perception of Scientists*: ANOVA Tests of Within-Subjects Effects (Students/Teachers) Table 26 *Students' Perception of Scientists* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Perception		***Type III Sum of Squares***	***df***	***M.S***	***F***	***P***
Pre Post	Sphericity Assumed	4.259	1	4.259	40.701	.*000
Pre Post TeacherGenderM1F2	Sphericity Assumed	.131	1	.131	1.250	.264
Pre Post Student GenderM1F2	Sphericity Assumed	.083	1	.083	.791	.374
Pre Post TeacherGenderM1F2 StudentGenderM1F2	Sphericity Assumed	.044	1	.044	.421	.517
Error (Pre Post)	Sphericity Assumed	83.822	801	.105		

Table 27. Control Year *Students' Attitudes towards Science*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 27 *Students' Attitudes towards Science*.
There were no significant differences in any of the gender analyses.

Attitudes	***Gender***	***N***	***M***	***Std.***	***Std.E.M***	***t***	***dt***	***p***
	Teacher							
Pre attitudes	Male	164	2.58	0.32	0.249	1.97	364	0.05
	Female	202	2.65	0.3382	0.238			
Post attitudes	Male	164	2.73	0.3504	0.275	-0.45	364	0.654
	Female	202	2.75	0.4152	0.292			
	Student							
Pre attitudes	Male	208	2.64	0.3068	0.307	1.49	364	0.138
	Female	158	2.59	0.3603	0.36			
Post attitudes	Male	208	2.75	0.3867	0.387	0.438	364	0.662
	Female	158	2.73	0.3886	0.388			

Table 28. Control Year *Students' Desire to Become Scientist*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 28 *Students' Desire to Become Scientist*. There were no significant differences in any of the gender analyses.

Desire	***Gender***	***N***	***M***	***Std.***	***Std.E.M***	***t***	***dt***	***p***
	Teacher							
Pre Desire	Male	164	2.52	0.671	0.671	0.276	364	0.783
	Female	202	2.505	0.6709	0.671			
Post Desire	Male	164	2.63	0.6274	0.627	1.027	364	0.305
	Female	202	2.56	0.6704	0.67			
	Student Gender							
Pre Desire	Male	208	2.53	0.6227	0.0432	0.654	364	0.513
	Female	158	2.48	0.7292	0.058			
Post Desire	Male	208	2.54	0.6344	0.0439	-1.78	364	0.076
	Female	158	2.66	0.6692	0.0532			

Table 29. Control Year *Value of Science to Society*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 29 *Value of Science to Society*
There were no significant differences in any of the gender analyses.

Value	*Gender*	*N*	*M*	*S.D*	*S.E*	*T*	*dt*	*p*
	Teacher							
Pre								
Value	Male	164	2.83	0.3974	0.031	0.014	364	0.988
	Female	202	2.83	0.3977	0.279			
Post								
Value	Male	164	2.83	0.3857	0.0301	0.468	364	0.64
	Female	202	2.81	0.4038	0.0284			
	Student Gender							
Pre								
Value	Male	208	2.86	0.4019	0.0278	1.739	364	0.083
	Female	158	2.79	0.3879	0.0309			
Post								
Value	Male	208	2.82	0.4111	0.285	-0.143	364	0.887
	Female	158	2.82	0.37504	0.298			

Table 30. Control Year *Students' Perception of Scientists*: Independent Samples T-Test
Statistical significance: *p ≤.05, **p≤.01. Table 30 *Students' Perception of Scientists*.
There were no significant differences in any of the gender analyses.

Perception	***Gender***	***N***	***M***	***S.D***	***SE***	***t***	***dt***	***p***
	Teacher							
Pre perception	Male	164	2.44	0.4154	0.4154	-0.891	364	0.373
	Female	202	2.48	0.4344	0.4344			
Post perception	Male	164	2.33	0.4747	0.4747	-0.099	364	0.921
	Female	202	2.34	0.51	0.51			
	Student Gender							
Pre perception	Male	208	2.504	0.4389	0.4389	-0.004	364	0.997
	Female	158	2.37	0.4094	0.4093			
Post perception	Male	208	2.36	0.5065	0.5065	0.854	364	0.394
	Female	158	2.29	0.4769	0.4769			

Table 31. Control Year *Students' Attitudes Towards Science*: ANOVA tests of within Subjects Effects.

Table 31 *Students' Attitudes Towards Science* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects

Measure: Attitudes		***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***p***
Pre Post	Sphericity Assumed	2.934	1	2.93	32.161	.000
Pre Post TeacherGenderM1F2	Sphericity Assumed	.096	1	.096	1.057	.305
Pre Post StudentGenderM1F2	Sphericity Assumed	.042	1	.042	.456	.500
Pre Post TeacherGenderM1F2 StudentGenderM1F2	Sphericity Assumed	.014	1	.014	.150	.699

Table 32. Control Year *Students' Desire to Become a Scientist*: ANOVA Tests of Within-Subjects Effects(Students/Teachers)

Measure Desire		***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***p***
PrePost	Sphericity Assumed	1.791	1	1.791	4.117	.043
Pre Post StudentGenderM1F2	Sphericity Assumed	1.008	1	1.008	2.316	.129
Pre Post TeacherGenderM1F2	Sphericity Assumed	.023	1	.023	.053	.818
Pre Post StudentGenderM1F2 TeacherGenderM1F2	Sphericity Assumed	1.306	1	1.306	3.002	.084

Table 33. Control Year, Value of Science to Society: ANOVA Tests of within Subjects Effects
Table 33 *Value of Science to Society* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey for both teacher and students gender interaction within subjects effects.

Measure: Value		***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***p***
PrePost	Sphericity Assumed	.013	1	.013	.152	.697
Pre Post StudentGenderM1F2	Sphericity Assumed	.108	1	.108	1.298	.255
Pre Post TeacherGenderM1F2	Sphericity Assumed	.027	1	.027	.331	.566
Pre Post Student GenderM1F2 TeacherGenderM1F2	Sphericity Assumed	.283	1	.283	3.401	.066

Table 34. Control Year Students' Perception of Scientists: ANOVA Test of within Subjects Effects (Students/Teachers) Table 34 *Students' Perception of Scientists* ANOVA tests of Within-Subjects effects between teacher and student gender, there is no statistical significance change in Pre Post survey.

Measure: Perception		***Type III Sum of Squares***	***df***	***Mean Square***	***F***	***p***
Pre Post	Sphericity Assumed	2.762	1	2.762	25.777	*.000
	Greenhouse-Geisser					
Pre Post Student GenderM1F2	Sphericity Assumed	.110	1	.110	1.029	.311
Pre Post Teacher GenderM1F2	Sphericity Assumed	.043	1	.043	.402	.526
Pre Post Student GenderM1F2 TeacherGenderM1F2	Sphericity Assumed	.073	1	.073	.683	.409

V. DISCUSSION

This study was based upon a collaboration between an NSF GK-12 program, Project Flowing Waters, and a local school district to provide inquiry science trained Texas State University Biology PhD students for secondary school science classrooms. The primary research question was to determine if there were differences in students' attitudes towards science based upon the gender of the student, the teacher and the resident scientist. The attitudes towards science were categorized in four areas based upon the MATS surveys:

(1) The subject of science

(2) Desire to become scientists

(2) The value of science to society.

(3) Perceptions of scientists.

Based upon the research question, null hypotheses were established to test the statistical significance of any gender difference in either the pre (September) or post (April) surveys.

Null hypotheses

4. The gender of teacher does not influence student attitudes in the four attitude categories.
5. The gender of the resident scientist does not influence students' attitudes in the four attitude categories.
6. The gender of the students does not influence their attitudes toward science in the four attitude categories.

Results for years 4 and 5 provides evidence that support and/or disputes the hypotheses. These will be described per category below.

Students' Attitudes towards Science

There was no significant difference in year 4 in student attitudes toward science, but there was a significant difference in year 5 between pre and post surveys towards improved attitudes towards science, with male students having more positive attitudes towards science than female students. Also in year 5, on the post surveys, students with male resident scientists had significantly more positive attitudes than with female resident scientists. Hence, there is not conclusive evidence indicating that having a resident scientist in the classroom may cause students to have move positive attitudes towards science.

With respect to gender, in year 5 (table 14), there was a statistical significant difference between male and female students on both pre and post surveys. Male students' had a better attitude towards science, which disputes null hypothesis iii that gender has no effect on students' attitudes. Also, in year 5, the ANOVA analysis revealed that male students had better attitudes towards science with male teachers and resident scientists disputing the hypotheses I, ii that the gender of the teacher and/or resident scientist has no effect on the students. In year 4 (table 1) there were no significant differences between male and female students regardless of the gender of teachers or resident scientists in both pre and post surveys (table 1).

It is not surprising that male students would have more positive attitudes with male teachers since the (1988 NSF) studies indicated that science is a male dominated field. In this study, it was evident that male students have more positive attitudes towards

science with male teachers or resident scientists. Despite the fact that female students have a role model with a female resident scientist in the classroom, female resident scientist pre and surveys were significantly lower than male resident scientists. This finding is supported by research by (George 2000) indicating that females have a negative mindset towards science and science careers.

Students' Desire to Become Scientists

Regardless of gender, there was no significant change in year 4,5and the control year between pre and post surveys. This suggests, that in year 5 that having a resident scientist in the classroom does not cause students to have an increased desire to become scientists.

Interestingly, there were significances differences in year 5, between male and female students, with male students having a greater desire to become scientists (table15). The results in year 4 showed that there were no statistically differences between male and female students (table 2). The result in year 5 have indicated that male students have a greater desire to become scientists which disputes null hypothesis iii that gender has no effect on students' attitudes. This is supported in the literature pertaining to students' desire to become a scientists. According to (Jones 2000), both males and females report that science is difficult, but that science is more suitable for boys.

The Value of Science to Society

There was a significant change, without respect to gender, in years 4 between pre and post surveys (table 12) in students understanding the value of science to society. This suggests that having a resident scientist in the classroom may cause students to increase their understanding of the value of science in society. This is further supported

since a significant change between pre and post surveys concerning the value of science was not seen in the control year when resident scientists were not present.

Again, as shown previously, in year 4, the male students saw the importance of science more so with male teachers and male resident scientists (tables 11&12). In addition, in year 5, both female and male students did better in this category with a male teacher (Table 16). This disputes hypotheses i that the gender of the teacher has no effect on the students. Furthermore, male students showed a significantly greater importance than female students to the values of science society. This disputes null hypothesis iii that gender has no effect on students' attitudes.

Perception of Scientists

Regardless of gender, there was no significant interaction change in years 4 and 5 between pre and post surveys (table 11 & 25). This suggests that having a resident scientist in the classroom does not cause students to have less stereotypical view about scientists.

In regard to gender between male and female students, female had less stereotypical views male students. Studies have showed that regardless of gender, male and female students view scientist as stereotypes. (Saleh & Chine, 2011). Nevertheless, in this study, the results indicated that over both year 4 and 5 and the control year, students has less stereotypical views of scientists by the end of the year.

Unexpected Results of the Study

This research has discovered unusual results in three of the four MATS categories that were examined during the control year. It is surprising that 1) student perceptions of scientists had improved with less stereotypical views within traditional classrooms without a resident scientist; 2) gender had no influence on the improvement of their attitudes towards science) male students had a greater desire to become scientist than female students and 4) students with female teachers had more positive attitudes towards the value of science to society. Perhaps the real world applications emphasized in Project Flowing Waters in their school curriculum may not have been implemented without resident scientists in the classrooms. In years 4 and 5 the resident scientists discussed every day environmental issues such as the protection of the San Marcos watershed, Texas blind salamander and endangered species and the importance of the ecosystem in San Marcos. As a result, students in those years, at least with female teachers, increased in their understanding of the value of science to society.

First Implication

The result from our study that male students were consistently higher than female student in the science attitude categories indicates plans should be implemented to overcome this gender disparity. It was not expected that gender would be play such a role in attitudes in our GK-12 program that placed female role models as female science PhD students in the classroom 10 hours a week. Even GK-12 type programs need to be more proactive in involving female students in science. Greenfield (1996) indicated that boys had more opportunities to answer questions and receive more feedback than girls.

Perhaps that gender disparity played a role in our Gk-12 program. Hence, it may be a good strategy to train teachers to call on girls more often or pair girls up to work with other girls. Teacher should mindful that girls are less positive about science and need lots more encouragement than boys.

Second Implication

According to (George 2000) female students have a negative mindset towards science and careers, because mothers have influenced their daughters that science is not suitable for women. Therefore, this implies that mothers may influences their daughters' career goals. Proactive strategies to excite female students about science in the home environment early in their development could be as simple as having parents read science books have parents read to their daughters' science books. Ford, Brickhouse, Lottero-Perdue, Kittleson,2006).

VI. CONCLUSION

The overall framework for this study was to identify if gender influenced students' attitudes towards the subject of science, their desire to become a scientist, the importance of science to society and their stereotypical views of scientists in a NSF GK-12 program. Overall, male students were more positive than female students about science, its value to society and their desire to be a scientist. Furthermore, the research provided evidence that male students do better with male teacher or resident scientists. This was not the case with female students. Female students had no significant differences with male students when female resident scientist that serving as role models for female students or with female teachers.

Future Research

Bias may be a factor that influenced the results of this study. Future research may involve training teachers in unconscious gender biases so they are not favoring the male students in their teaching practices. It is possible that gender bias training (Lavy & Sand, 2015) for teachers would improve girls' attitudes towards science as demonstrated with the pre and post MATS surveys.

Teachers should be more aware of their personal gender biases that impact their teaching practices. Further research may also explore single-sex classes in science (Parker & Rennie,2010) and whether that would improves girls' attitudes towards science and science careers. Educators and administrators could take more proactive steps to implement strategies such as gender bias training or single–sex classes in mathematics and science that may help improve female student attitudes towards science and science careers.

APPENDIX SECTION
APPENDIX A

Name of Science Teacher_____Class Period_____

My Initials _____I was born in the month of _____ I am Male or Female (Circle one) Read each sentence. Decide if you disagree a lot, disagree a little, have not decided, agree a little, or agree a lot. Circle the number answer that shows how you feel.

	Disagree a lot	Disagree a little	Have not decided	Agree a little	Agree a lot
1. Scientists do not criticize other scientists' work.	1	2	3	4	5
2. I usually understand what we are talking about in science.	1	2	3	4	5
3. Scientists work alone.	1	2	3	4	5
4. People do not need to understand science because it does not affect	1	2	3	4	5
5. No matter how I try, I cannot understand what the teacher is	1	2	3	4	5
6. It makes me nervous to even think about being in a science	1	2	3	4	5
7. Science is easy for me.	1	2	3	4	5
8.Discoveries in science do not affect how I live.	1	2	3	4	5
9. Studying science is something that I enjoy very much.	1	2	3	4	5
10. I do not do very well in	1	2	3	4	5
11. I would like a job as a	1	2	3	4	5
12. Our world is nicer to live in because of science.	1	2	3	4	5
13. Scientists work in labs.	1	2	3	4	5
14. You have to be old to be a	1	2	3	4	5
15. I often think, "I cannot do this," when science is being	1	2	3	4	5
16. You have to be at least a little bit crazy to be a scientist.	1	2	3	4	5
17. Scientists do not try to improve upon an explanation they have discovered about the world	1	2	3	4	5
18. Most students seem to understand science.	1	2	3	4	5
19. Science is not useful to anyone but scientists.	1	2	3	4	5
20. It scares me to have to study	1	2	3	4	5

	Disagree a lot	Disagree a little	Have not decided	Agree a little	Agree a lot
21. Scientists are males.	1	2	3	4	5
22. Scientists do not have enough time to have fun.	1	2	3	4	5
23. Science is one of my favorite subjects.	1	2	3	4	5
24. I have a good feeling toward science.	1	2	3	4	5
25. Only thinking is important to scientists, not how they feel about	1	2	3	4	5
26. Science discoveries do not help people live better.	1	2	3	4	5
27. A country could be strong even if it has no scientists.	1	2	3	4	5
28. I like science classes.	1	2	3	4	5
29. People should understand science since it is an important part of their	1	2	3	4	5
30. I don't want a job as a scientist, because I have no interest in it.	1	2	3	4	5
31. I feel upset when someone talks to me about being in a	1	2	3	4	5
32. The things scientists discover through their work does not affect	1	2	3	4	5
33. In their work, scientists report exactly what they observe.	1	2	3	4	5
34. Science helps solve the problems of everyday life.	1	2	3	4	5
35. Scientists wear lab coats.	1	2	3	4	5
36. Science is hard for most students to understand.	1	2	3	4	5
37. If one scientist says an idea is true, all other scientists will believe it.	1	2	3	4	5
38. Technology is an example of an important product of science.	1	2	3	4	5
39. A major purpose of science is to produce new drugs and save lives.	1	2	3	4	5
40. Science is helpful to understand the world	1	2	3	4	5

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