

## Training Future Scientists: The Key Secrets to Teaching Success

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**[Abstract]** What does it look like when an African American female public-school teacher shows her students on the first day of class that she loves them and believe they can learn? The Training Future Scientist (TFS) program began in an eighth-grade science class in a gifted middle school in the Midwest and was implemented for almost 17 years. The research question was, *How did participation in the TFS program with an African American female science teacher impact the 15-female students' future?* The rationale for this project was to share with the research community the benefits of the TFS pedagogy I implemented that produced future scholars. I added to the project to share how the TFS pedagogy is being implemented today to train future elementary and secondary teachers in the elementary and secondary science methods courses I implement at a predominately White university in the Midwest. The results from this study were from 15-female students who responded to a five-question survey distributed to them in person or virtually to determine how the TFS pedagogy impacted their life and future academic aspirations. The students realized the TFS skills were effective which they agreed will allow them to be successful in school and life.

**[Keywords]** science pedagogy, female adolescents, self-efficacy, African American female philosophy of teaching, Training Future Scientist (TFS)

### Introduction

I am an African American female, with a sincere love for each student that I motivate to learn beyond their own expectations. Using teaching strategies that provide *hands-on, minds-on* experiences daily help my students realize science is attainable. Summer vacation is finally over, and it is the first day of school. Over 100 students returned to their 7<sup>th</sup> grade advisories to receive their new 8<sup>th</sup> grade class schedules to see who their 8<sup>th</sup> grade advisor is. This is the moment most of these students have been waiting for because now they are the oldest students in the middle school, and they are able to work with the 8<sup>th</sup> grade team of teachers. Many of these students have worked with some of us in the past, either as a participant in our school's Black History Month program, a member of one of our sports teams or in one of our after-school programs. On the other hand, some of these students only speak to us in the halls, but they know we appear to be nice and care about adolescents because that is the message some of their older siblings have conveyed to them.

The bell rings and the students leave their old 7<sup>th</sup> grade advisors and start to file into their new 8<sup>th</sup> grade advisories. Only a few of the 8<sup>th</sup> students are assigned to my homeroom but all the 8<sup>th</sup> graders are assigned to be students in my science class. This was not always the case. In the past parents would write letters or call the principal asking if their child can be placed on my team or in my homeroom. Now, due to several budget cuts in urban public schools in the Midwest, I am the only eighth grade science teacher, so even though their child was not assigned to my advisory, at least their child is in my science class.

Most of the 8<sup>th</sup> grade students and parents are excited about their child being in my science class, because of the impact the TFS pedagogy had on their older siblings. Some of these former students still use the strategies they learned to succeed in high school and college. Therefore, the parents want to know if the TFS pedagogy can do the same thing for another child in their family. This study revealed some of my secrets to success, e.g., passion for science, teaching philosophy, best practices, and the philosophies of the key philosophers I follow. Most of all, I want to convey to my students that I am motivated to train our future citizens.

### **Genuine Love and Passion**

My best attribute that keeps me challenging my students, especially my female students year after year, is the fact that I interact with them as if they were my very own children. Secondly, I target the students' affective domain, using individual and group strategies to evaluate what each student really knows. Thirdly, I modeled the philosophy of Geneva Gay (2000) and Gloria Ladson-Billings (1995) who reports that culturally-relevant teaching serves to empower students to examine and critique educational content and processes. This approach includes asking how this material and teaching approach is truly impacting the meaning and understanding of the world they live in. Culturally-relevant teaching also supports social, cultural, and academic success which is usually missing in most schools when teachers are not trained on how to use this type of effective pedagogy when working with underserved students. Geneva Gay (2000) believes,

Culturally responsive teaching is defined as using the cultural characteristics, experiences, and perspectives of ethnically diverse students as conduits for teaching them more effectively (p. 106).

Finally, to succeed I focus my teaching on the student's individual cognitive domains and individual needs. These attributes were affirmed by Palmer (2006) as key components for a successful affective learning environment. Palmer (2006) stated that the emotional component that is created by the teachers when they create a supportive and pleasant class atmosphere that includes smiles, empathetic listening, voice regulation, use of the student's name and general attention. I also believe that students have a responsibility to be actively involved in the class. So, on the first day of school my students noticed the genuine respect, concern, and interest I had for them and my passion for science, since I am a scientist too. My approach creates an equitable and rich classroom environment with a teacher who believes all children can learn, and who is determined to implement effective curriculum and instruction for all adolescents.

This article shares the results of my research based on the reflective responses from 15-female students who experienced the TFS pedagogy in eighth grade under the leadership of this veteran African American teacher-science researcher. Each female received a five-question survey either in person or virtually via Face book and/or email to complete. The five questions were: 1) Was what she taught transferable to other subjects and/or peers? 2) How have you used the skills and practices she taught you since you left her leadership? 3) What year were you in her 8<sup>th</sup> grade class at your middle school? 4) What is your career choice or prospective career choice? 5) What would be your major if you are in college? If you are not in college yet, what do you plan to choose as your major?

### Accepting the Call to Teach

As long as I can remember, I had a genuine love for children of all ages. My decision to teach adolescents was motivated by the lack of a science teacher when I was in the 8<sup>th</sup> grade. In 1994, I worked in a research laboratory at St. Louis University, as a senior research assistant in pulmonary medicine. In this position, I maintained my own research projects, as well as trained all the new lab members. One day while working, I heard a small voice say, *I need you to train my people*. The voice was familiar, so immediately I responded to the call and returned to school part-time to obtain my teaching certification while working forty-hours a week as a non-traditional employee. In addition, I managed a family with a husband and two minor children serving as their first teacher, role model, and primary breadwinner.

I finished my course work and student teaching assignment in three years and was invited to an interview with a several principals in the spring of 1997. The principal of the only gifted middle school in the state hired her. This was the beginning of my journey as a teacher with the assignment to train and motivate urban students to become future scientists. Armed with fifteen years as a science researcher and several years of religious teaching experience, this was my springboard to perform my new job teaching 8<sup>th</sup> graders the 9<sup>th</sup> grade science curriculum. After several days, during the first week, I realized teachers needed to be equipped with multiple hats to be successful in an urban setting, because my students first wanted to know that I cared about them before I shared with them everything I knew about science.

### First Years of Teaching

The first year of teaching was probably the hardest year because normally new teachers are assigned a mentor inside their school to help with the transition from corporate America to the teaching profession. Unfortunately, my mentor was so overwhelmed with my credentials that she would not mentor me. Therefore, I began developing curriculum and instructional strategies based on what I had learned during my course work described in my philosophy of education. Eventually, I began participating in a variety of teacher professional development programs offered by the school district science community. These opportunities helped to mold me into the gifted teacher my students needed. My goal was to expose my students to the plethora of science experiences in the Midwest that I had been robbed of as a child. I wanted my students to use these experiences as springboards to motivate them to work in research laboratories or follow STEM careers if they so choose.

It was during my second year of teaching I realized that educating the youth of America was not my only job. As a teacher I was molding, counseling, as well as nurturing my gifted adolescents. My students were eager to learn science, but they were also able to participate in whatever tasks I asked them to perform. In my district the schools had endured budget cuts in the teaching staff, support staff, and custodial staff, so on select occasions my students would assist me in cleaning the classroom to prepare for parent-teacher conferences as well as volunteer to set-up and pack-up my classroom at the beginning and end of the school year. My students helped organize graded papers and set-up a student database to store student information, science vocabulary words, and other study tools. Providing my students with these opportunities increased their self-esteem and self-confidence in their role in society. Their parents expressed amazement because now these adolescents were volunteering to help out at home and in their communities. Each year several of these students served as peer leaders in the classroom and in after-school programs I developed and facilitated to help my struggling students. Now, as I reflect over the last

15-years of teaching, the impact I made on my students in the classroom made a huge influence on the design of my dissertation project implemented in an experiential after-school program. The passion and love for my students was a common thread shared by the teachers interviewed by Michelle Foster in her book *Black Teachers on Teaching* (1997). Lucy Laney Croft stated,

“... the educated Negro woman must teach the “Black babies.” These dull teachers fail to know their pupils – to find out their real needs, and hence had no cause to study methods of better and best development of the boys and girls under their care.” (Foster, 1997, xliv)

Just like Foster, I wanted the TFS program to be an example of what it takes to be a successful teacher working with diverse urban students in a time when the voice of the African American teacher is being marginalized and, in some instances, silenced completely.

### Philosophy of Teaching

It is my belief that all students can learn. Therefore, as their teacher, it is my responsibility to educate, motivate, and inspire them to reach their fullest potential regardless of their circumstances. I believe each student has specific needs and learning styles that need to be addressed for the transfer from potential to maximum kinetic energy. Students under my leadership experienced equitable treatment and their prior knowledge and experiences allowed them to connect to the new science knowledge. The learning environment motivated the students to learn and mature into responsible citizenry. Some of the teaching strategies can be attributed to the environment that fostered safety, curiosity, access to resources, nutrition, and nourishment, which were created with love and compassion for the students. Like Maslow’s Theory of Human Motivation (1971), this *home away from home* setting inspired risk-taking and a desire to share what they know with others to increase one another's knowledge. After many of my students leave, they realize that society is just a larger family that demands the same commitment and dedication fostered in my classroom.

The students’ self-efficacy and attitudes about science changed because now when I asks my students, *How many of them will chose math or science as a career path?* over 50 % of them raise their hands and say, *I will choose a STEM career.* This change comes from exposure to learning how to work in cooperative-learning groups to solve problems, implement, and analyze lab investigations. My students participated in short and long-term research projects and read and wrote about a variety of topics in science, math, technology, and engineering which helped to broaden their scope of science. The authentic experiences I engaged my students in are what made a difference and is evident in their formative and summative assessments. They realize assessments are just one method *to show what they know*, especially in a society that evaluates the teaching and learning in the classroom by the students’ scores on a test.

My primary goal was to inspire my students like an equilibrium chemical reaction. This was a perfect analogy because my students inspire me to be the best teacher just as much as I inspire them to be the best students. The relationships I have developed with my students serve as a *beacon of light* for others that observe how my students and I interact. Even though I give to my students, school, and community my all, my giving is not in vain, because my students give as much as they can back to the school, their families, communities, and me. The passion and love my students receive from me is passed on through their relationships as peer leaders and mentors in the classroom, school, family, and community members.

I believe teaching is to serve. Every opportunity I receive to teach fuels my passion to educate, motivate, and inspire others to be the best they can be. I served as a role model of a life-long learner and a prime example showing that it does not matter how or when you start the race but how you finish the race. I remind my students always to learn from every opportunity they encounter along life's journey, good or bad; use these experiences to the best of their ability. I believe it is the culmination of these combined experiences that propelled these 15 female students to pursue everything they set their hearts out to become.

### **Effective Curriculum and Instruction**

I realized when I began this research journey that my philosophy was in alignment with the information Ferreira (2002) cited in the publication *A Nation at Risk* (1983) and in the *Science for All Americans: Project 2061* which are two landmark publications that strive for equity in science education. I also agree with Allen (1998), cited in an excerpt from the recent report, *A Nation Still at Risk: An Education Manifesto*:

A dual system, separate and unequal, is being created, almost 50 years after it was declared unconstitutional. Equal educational opportunity is the next great civil rights issue. By this is meant the true equality that comes from providing every child with a first-rate elementary and secondary education, and to the development of human potential that comes from meeting intellectual, social, and spiritual challenges. (p. 70)

### **Meeting Students' Needs**

Maslow (1971) stated, "If basic needs are not met, then there is a tendency to ignore higher needs" (p. 2). I was confronted with this dilemma every year with at least 15% of my students daily. To ensure the higher needs of learning science content for my students, I made sure I maintained a generous supply of healthy snacks to distribute to my students even when just one student acknowledged they were hungry. I discovered after taking a poll, at least 75-80 % of my students raised their hands and said they were hungry. This brief delay did not stop instruction because the students immediately began the *daily opener* activity while I prepared and distributed a small snack to all the students. According to Maslow, if the physiological needs of an individual are not met, some people can die, but the people that live have a hard time moving to the next levels, which are security, social, ego (self-esteem), and self-actualization. Self-actualization is the level that is rarely met, but the other three levels are very important for an individual to maintain because these are the attributes that propel them to reaching their potential. Even though distributing a healthy snack was a small gesture, this motivated my students to complete the objectives for the day and recognize that I cared about their physical needs as well as their academic achievement.

This is an example of teacher behavior in a certain context with which teachers in affluent suburbs might not be confronted with; but this was a very common experience most urban teachers see, regardless of whether the school is labeled *Title I* (i.e., schools where more than 25% of the students receive free and reduced lunch) or not. My school was not a *Title I* school, but my students still had needs that many of their families could not meet. I felt it was my responsibility to meet these needs if I wanted my students to learn and continue to move through Maslow's Hierarchy of Needs.

### Teaching and Instruction

One method that can transform instruction in any classroom is the adoption of a differentiated classroom. Tomlinson (1999) described a differentiated classroom teacher as a teacher that allows the students to dictate where they start in the curriculum. Their goal is to meet individual student needs and engage all students, except the severely handicapped. They believe all students can learn and hold each child to the highest standards. They work diligently to make students work harder than they plan to, and the low, middle, and high-level students all achieve and learn more than they plan to accomplish. They do not force-fit a learning style on a student. Their goal is to design a learning environment that prescribes the best learning environment for students. Some examples of how to differentiate your classroom are centers, entry points using Howard Gardner's Multiple Intelligences, tiered activities, learning contracts, compacting, problem-based learning, group investigations, independent study, choice boards, 4MAT and portfolios (Tomlinson, 1999).

To serve all students, specific changes must be made in teaching strategies and techniques, teacher behavior, and the curriculum developed for economically-disadvantaged, inner city students, and economically advantaged suburban students. This contention is supported by three major learning theorists, which are Maslow's Hierarchy of Needs Theory (Maslow, 1971), Constructivism (Seimears, C.M., Graves, E., Schroyer, M.G., Staver, J., & Savasci, F., 2012), and Lev Vygotsky's Social Learning Theory (1978). The Naturalistic Education Theory (NET) (Granger, 1998). is another theory that supports this hypothesis as well. Each theory has a critical functioning role in student learning in urban public schools at every grade level but especially during the emotional adolescent years of middle school.

I also applied constructivism in the TFS program. The National Research Council (NCR) (1996, 2007, 2012) reported that current US science education reform needed to move to more constructivism practices instead of passive ones. Both the Next Generation Science Standards (NGSS) and NRC (1996, 2007, 2012) emphasize the need to engage all students in active science practice. Wheatley (1991) defined constructivism as a learning theory that promotes active learning that is constructed versus passive instruction. Passive instruction views the student as a receptacle and the teacher as a pitcher with all the information to fill this receptacle (Wheatley, 1991). Many teachers do not use the constructivism model, instead they use the *sage on the stage* approach. Now teachers become the *guide on the side*.

The construction of knowledge always makes sense to the individual because it helps them interpret and predict events in their learning environment (Seimears et al., 2012). Phillips (2000) stated that constructivism is a theory of *knowing* which has strong roots in philosophy, education, and anthropology. Cobb and Bowers (1999) also reported that learners do not just view knowledge as the truth because constructivists compare the new knowledge to hypotheses already established in their prior knowledge reservoir. This perspective is also compatible to Bandura's (1986) Social Cognitive Theory and many motivation theories (Bruning et al, 2004). Teachers that use constructivism in their classrooms witnessed a significant change in everyone's behavior, including their own. The students are more engaged and actively learning and the teaching strategies and techniques used to implement the curriculum are more coherent and flexible to address current content, misconceptions, and remediation.

The third theorist that supports my curriculum and instructional practices in urban public schools is Lev Vygotsky's Social Learning Theory. Vygotsky's (1978) theoretical framework is

that social interaction plays a fundamental role in the development of cognition. He believes that all learning is perceived on two levels. The first level is interaction with others, which leads to the integration into the individual's mental structure. The second level, which includes the *zone of proximal development*, determines a person's cognitive development. For a person to reach their fullest potential, help and social interaction with a teacher or knowledgeable and experienced peer is necessary. The scaffolding used to support the learners' understanding gradually develops their knowledge domain. The development of more complex skills is facilitated during peer-to-peer interaction and during cooperative-learning activities (Vygotsky, 1978).

Teachers that choose to adopt Vygotsky's Social Learning Theory in their classrooms first witnessed a significant change in their struggling students. Providing these struggling students opportunities to socialize and interact with mastery student leaders in pair-share teams and/or cooperative-learning groups provided these students another resource besides the teacher. Using this approach fosters leadership opportunities for all students, especially disadvantaged students. Teachers can tailor their lessons around the prior knowledge and experiences of these students and allow their personal experiences to become the catalyst into understanding the curriculum content. This method gave these teachers a glimpse into the lives of their students because regardless of your families' socio-economic status, everyone has something valuable to contribute to the learning environment in public education (Vygotsky, 1978).

### **Engaging Former Students in a Study**

After reading this research, I decided on a research project with former students by contacting some to see if what I taught them was still effective in their lives. I wanted to know if time had made a difference because, in my mind, I was still teaching and loving all of my students the same way I loved my students during my first few years of teaching. I designed a brief questionnaire with five questions that I distributed by hand delivery to the two high schools in the area that most of my students attended and as an attachment on Face book and/or Hotmail. The five questions I asked these students were: 1) Was what I taught transferable to other subjects and/or peers? 2) How have you used the skills and practices I taught you since you left my leadership? 3) What year were you in my 8<sup>th</sup> grade class at our middle school? 4) What is your career choice or prospective career choice? 5) What is your major if you are in college? If you are not in college yet, what do you plan to choose as your major?

### ***Participants***

There were 15 female students that served as participants. They were under my leadership from 1998-2012, spanning 14 years. All 15 of the participants responded to question number one, "*Was what I taught you transferable to other subjects and/or peers?*" Only 10 students responded to question number two, "*How have you used the skills and practices I taught you since you left my leadership?*"

### **Student Testimonials and Insights**

Table 1 shares the responses provided by the fifteen students to question one, *was what I taught transferable to other subjects and/or peers?* The responses to question one supported the hypothesis that what I gave my students had transpired for over fourteen years since this was the span of the data collected from the surveys, plus what I gave them was something they could use in their futures, and they could share with others.

**Table 1**Q 1: *Was What I Taught Transferable to Other Subjects And/Or Peers?*

Student #	Responses
1	“...laying my eyes on an African American female scientist for the first time that class day was amazing, it did not resonate then that I too would become a junior African American scientist in training while in Mrs. Hill’s classroom. We participated in labs. We learned great study techniques. We were exposed to real world instances of the science we were studying in the textbook. We went on field trips that stretched our minds even further and brought the concepts we were studying close to home. But most importantly, we were nurtured. We laughed. We were cared about. We learned about struggles. We were encouraged. In Mrs. Hill, we had a role model both inside and outside of the classroom. Although I would end up pursuing a career in policy, my time in Mrs. Hill’s class has had an everlasting impact on my life.” (1998 Lines 12-21)
2	“When Mrs. Hill introduced chemistry, this is when I realized how much further I wanted to take my science education.” (2000 Lines 7-9)
3	“I remember being able to use a lot of the things I learned in Mrs. Hill’s class in other classes. I remember learning skills that I used and continue to use in my daily life outside of school as well.” (2002 Lines 5-7)
4	“I think the skills that have been transferrable for me are organization and the ability to work well in groups. I knew that Ms. Hill always expected a lot from everyone. She never tried to be our friend, but I always looked up to her because she challenged me to do my best always. Ms. Hill had very high expectations for all students, class was fast paced, and there was always a lot of work in class to do. Even with that, I gained a deep appreciation for the sciences and was able to develop the ability to work well in challenging, fast paced settings. These skills have really helped me out in my college coursework.” (2002 Lines 2-8)
5	“You encouraged a lot of collaboration with others in and outside of the classroom, so I remember learning from you, teaching it to my peers the way I interpreted it, and then learning from the way they interpreted it. Generally, this really made sure we listened, but even understood it.” (2005 Lines 6-9)
6	“She built the foundation for the knowledge of science, which led me to a 26 or 21 (forgive my memory) score in the science section on my American College Test, or ACT.” (~ 2000 Lines 14-16)
7	“From Ms. Hill I learned how important it is to stay focus and study to make the grade. She also taught me the importance of being an African American woman in a science related field. I did not realize how important it was to excel and do well in science courses until I met Ms. Hill. She was always looking for different ways to adapt to every one of her students different learning styles and was constantly trying something new. It is because of this that I can adapt to different professors, no matter how they teach I am able to get the most out of the class.” (2007 Lines 5-12)
8	“...what I have learned in your class was infallible. It was instrumental to my decision to become a teacher. I try to take some Mrs. Hill’s teaching techniques and apply it to my tutoring.” (2008 Lines 5-7)
9	“The work was applicable to math & science classes, but the life lessons were applicable o everything.” (2010 Lines 4-5)



Student #	Responses
10	“Yes, I learned a lot during my middle school years. Everything that I was taught helped me help my friends with their HW and assignments. Having Ms. Hill has made me smarter and has more knowledge than most others. I was ahead of my class.” (2011 Lines 5-6 & 7-8)
11	“Yes, the knowledge I acquired from your teaching allowed me to progress in my current Chemistry 350 course at Metro. Taking your physical science class introduced me to identifying periodic trends. I have tutored fellow peers with Biology and Chemistry, and I believe that your teaching has given me a strong foundation for science.” (2011 Lines 4-7)
12	“I was able to apply precision and accuracy to chemistry as well as determining the number of significant digits in a number and putting it into scientific notation.” (2011 Lines 4-5)
13	“I was able to apply precision and accuracy to chemistry as well as determining the number of significant digits in a number and putting it into scientific notation.” (2011 Lines 4-5)
14	“I am 14 years old. Mrs. Robinson-Hill was a very valuable teacher and mother figure towards me. She taught me many skills. These skills include organization, teamwork, and study skills. These are three important skills that I still use today. I use it not only in all my classes at school, but at home as well. I can help my peers with certain things. Things that were taught to me by Mrs. Robinson-Hill. Before I was under Mrs. Robinson-Hill’s leadership, I was interested in politics and criminal justice. I am glad that I was given an opportunity to gain knowledge from Mrs. Robinson-Hill. Even though she is no longer my teacher, she has left a life changing mark!” (2012 Lines 4-11)
15	“I do think that what you taught me was transferable because it is something that is easy to explain to others to help them with their science classes.” (2012 Lines 5-6)

Table 2 shares the responses to question two, *How have you used the skills and practices I taught you since you left my leadership?* The strategies imparted to these students were transferred to other core subjects and their peers. Some students saw me as a role model and a few even thought of me as a mother figure. In all my different roles, all the students recognized my primary objective which was to teach science and motivate them to one day become a future scientist.

**Table 2**

*Q 2: How Have You Used the Skills and Practices I Taught You Since You Left My Leadership?*

Student #	Responses
1	“.....would you believe that I still have my science notebook from 8 <sup>th</sup> grade Biology? Well, it’s true, in fact, I used the same method of organization in preparing my study notebooks just recently for my Doctoral Candidacy Exams, which I passed with a unanimous decision from my committee. Perhaps, the best way to convey how I have used the skills and practices that were taught to me during my time with Mrs. Hill is to highlight the fact that I am writing about my experiences. I was a student in Mrs. Hill’s classroom in 1999, it is 2012. One high school diploma, two bachelor’s degrees, a master’s degree, and a PhD, I am still seeking out her leadership and guidance. After all that I learned and the analytical and educational support I received at such a young age, which would later come to influence various aspects of my life, I would be remiss if I did not continue to seek out her leadership.” (Lines 38-48)
2	“.... while a student I consistently tutored college chemistry, and currently I work as a classroom teacher, hoping to transform minds into future scientists as Mrs. Hill did for us. I strive for all of

	those I teach to have a thorough level of comprehension so that they too can feel confident to teach as I did when I transitioned from Mrs. Hill's 8 <sup>th</sup> grade class." (Lines 11-16)
3	"....I served as an AmeriCorps member where I tutored 3 <sup>rd</sup> graders in the SLPS district in reading and I used many of Mrs. Hill's teaching skills to help my students learn the essentials of reading and phonics." (Lines 11-13)
4	"The one thing that sticks out to me is the focus on organization. Ms. Hill made sure that we had very organized binders and folders and I have truly kept that with me throughout my time in high school and college. I just found my binder a few weeks ago and was amazed at how organized I was in 8 <sup>th</sup> grade. This was truly due to Ms. Hill's leadership and has been a huge component of my life ever since." (Lines 11-14)
5	"...school years that I begin to see science as actually interesting rather than just another required course. You showed me that as a female and minority I was able to succeed and even excel amongst my peers. That has helped me build confidence choosing the major that I'm in furthermore at a predominantly white institution." (Lines 14-19)
6	"She was very educated in the field of science, and I have forever embedded in my mind [the double helix] because of her." (Lines 10-11)
7	"Ms. Hill taught us a lot of different note-taking and study skills that I definitely used in high school, and I am now using in college." (Lines 4-5)
8	"Yes, I recall the scientific method during my Physics labs for the last two years." (Line 9)
9	"I still use Cornell Notes and your specialized headings in my notebooks because it is an effective note-taking system. I also tab sections of my binders and notebooks for organizational purposes. Like physical science journals PSJs, I never forget to bring my binder to school." (Lines 10-12)
10	"I am way more organized now and it helps me keep up with all my work and assignments. I have used the skills such as Cornell-notes that help us organize our notes." (Line 7)

Of course, each year I always told my students I was not only preparing them for high school, but for the real world. As you can see from most of the students' testimonials, they have used the skills I taught them in school as well as in their personal lives. What surprised the researcher the most in their comments was how many of them still use the Cornell note-taking model and their science notebook. This surprised me, because when I taught these skills in 8<sup>th</sup> grade many of these girls wanted to know why they had to use these skills, because it took so long to set-up. It is refreshing to know that many of them realized these skills were some effective strategies that taught them organizational skills and allowed them to be successful in school and life.

Table 3 (*see Appendices*) shared the responses to the final questions which focused on the career choices my female students chose beyond high school, since one of my initial goals when becoming a teacher was to motivate my students to become future scientists. The final three questions were: *What year were you in my 8<sup>th</sup> grade class at our middle school?*; *What is your career choice or prospective career choice?*; and *What is your major if you are in college?*

**Table 3***Codebook of Student Survey Data*

Student #	Year at school	Career
1	1999	BA Administration of Justice & Spanish Master's & Doctorate Criminal Justice
2	2000	BS Chemistry & Masters in Pharmaceutical
3	2002	B. S Audio production
4	2002	B.S. Geography, Sociology/Anthropology Master's Public Health
5	2006	B. S. in Civil engineering & Human Right Studies
6	NA	NA
7	2008	PreVet; Vet School & a Doctorate in Veterinary Medicine
8	2009	College professor
9	2010	Marine biology or Psychology
10	2012	Anesthesiologist
11	2011	Print journalism & Environmental studies
12	2011	Pediatrician or Medicine
13	2011	Psychology, Medicine, or Design
14	2012	Forensic scientist
15	2012	Anesthesiologist or Journalist

Eleven (73 %) of the female students pursued a degree in a science field. Some of the fields of study were chemistry & pharmaceutical, anthropology, public health, civil engineering, human right studies, pre-veterinary & a doctorate in veterinary medicine, marine biology, psychology, anesthesiology, environmental studies, pediatrician, and forensic science. One hundred percent of the female students graduated from high school and earned a college degree from a four-year college and/or university. Student Four earned her master's in public health and student Two earned her graduate degree in pharmaceuticals. She and her siblings currently fund a \$1000 scholarship for marginalized students pursuing a college career in STEM. Student One earned her master's and doctorate in Criminal Justice, which was funded by a full scholarship for both advanced degrees from Homeland Security. She is actively employed in helping to re-write the police curriculum in several Midwest cities to improve policing for marginalized citizens. Student Seven graduated from an Historically Black University majoring in pre-veterinary science and in 2023 graduated from a predominately White institution (PWI) as one of eight African American females with her doctorate in Veterinarian Science.

### Conclusion

Words cannot express how proud I am of the outcomes of these female scholars and the direction they have chosen for their future endeavors. Each year my goal was to be the best teacher my students needed and to make sure my students understood science so that science was a field

of study that they were motivated to choose. Through this study I fulfilled the five practices of exemplary leadership model espoused by Kouzes and Posner (2003) by modeling the way of a female scientist, inspiring an individual vision for each female, challenging the process of doing science, enabling others to act out their goals for their future and encouraging each female's heart to pursue their dreams. Fortunately, I discovered teaching science in a regular classroom can be accomplished, in addition to motivating my students to choose science careers.

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