

# **Undergraduate Females' Viewpoints on the Challenges and Barriers Associated with Majoring in a Stem Program at Fayetteville State University**

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## **ABSTRACT**

The purpose of this study was to examine undergraduate female STEM majors' viewpoints on the (a) challenges and barriers (b) gender equity, (c) career attainment, (d) mentoring, (e) faculty expectations, and (e) program preparation at Fayetteville State University. The purpose was also to discover those factors that impede or promote female STEM majors' success in the STEM Workforce. The following themes were generated: (a) academic success, (b) career advancement, (c) gender equity, (d) early influences, (e) greatest obstacles, (f) faculty support, (g) mentors, (h) workplace support, and (i) career challenges.

The responses were enlightening and provided an insight on their perceptions of experiences as STEM majors. They mentioned as leading factors that influenced their choice to major in STEM program: job security, salary, career opportunities for women, and having a background in one of the STEM areas. Although, they encountered gender bias, they did not allow comments and prejudices to deter their motivation and drive to succeed. The lack of women role models appeared to be a barrier, but many were able to find the support from other students and family members. These are courageous and dedicated young women, determined to succeed against all odds, despite the challenges and barriers associated with being a female majoring in a male-dominated career.

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Women have made significant advancements in *academic* majors, such as business and medicine; however, they have made considerably less progress in the science, technology, engineering, and math (*STEM*) fields (Brainard & Carlin, 1997; Chang, 2002; Heller & Martin, 1994; Shanahan, 2006; Starobin, 2008). This means that a small percentage of females who graduate from institutions of higher learning are not prepared for careers in the STEM field and results to the absence of females in those areas of employment (Benson, 1998; Blickenstaff, 2005; Rosser & Lane, 2001; Tynan, 2004, Vogt, Hocevan & Hagedorn, 2007; Waite, 2003).

Numerous studies found that students' interested in STEM fields continue to decrease and there is a continued concern that women are significantly under-represented in STEM (Astin, Parrott, Korn, & Sax, 1997; Blickenstaff, 2005). According to Shanahan (2006), schools need to make the profession more appealing to women. Although, times have changed, there are still barriers that oppress women and favor men, even in the area of education. Seymour (1995) found that the activities, which occur in the classroom also, had a ripple effect, for example, biased faculty tended to tolerate open rudeness from male students directed toward women in their classrooms. Therefore, these and other common practices create institutional prejudices against females in male-dominated academic environments. Gender discrimination was more prevalent because of preconceived attitudes of male-dominated faculty within STEM programs. The typical classroom configuration can be intimidating for women discriminated against and singled out (McLoughlin 2005). The author stated that to avoid singling out women students, faculty should emphasize networking and team building. Agogino and Linn (1992) discussed implementing cooperative learning experiences as a means to retain women in engineering programs.

Universities are charged with recruiting a diverse population of students for their academic programs, and with exploring strategies to recruit females who have an interest in the STEM fields. Oftentimes, when this group is recruited and enrolled, the challenge to retain them becomes overwhelming. Therefore, the ultimate goal of most STEM programs is to show a significant increase in the number of highly skilled female graduates entering *STEM* fields. This becomes an issue for institutions of higher learning to focus more attention on how they recruit and retain females in the STEM. The rationale for conducting this study is to discover finding to alert high school educators on the importance of identifying those female students who express an interest in the STEM fields and to encourage and support their success.

This qualitative research study explored the perceptions of undergraduate female STEM majors' on the challenges and barriers associated with their career of choice. The study also examined undergraduate female STEM majors' perceptions of (a) challenges and barriers, (b) gender equity, (c) career attainment, (d) mentoring, (e) faculty expectations, and (f) program preparation. Finally, examinations into those factors, which impede or promote female STEM majors' success in the STEM Workforce, were explored. The participants were 10 undergraduate females who were majors in the fields of science, technology, engineering, and mathematics for at least two academic years at Fayetteville State University. They completed an online open-ended questionnaire describing their viewpoints of the challenges and barriers they encountered because of being STEM majors.

The results will assist in the collaborations between high schools and higher education leaders, as they recommend and recruit females. This study is beneficial to educational institutions in their recruitment and retention of female students for the STEMs. Diversity in the selection process in higher education, especially in the STEM field is essential to those students who are contemplating choosing careers in science, technology, engineering, and mathematics. Oftentimes, females are not encouraged to pursue careers that are male dominated; therefore, this study explored those students who despite the lack of encouragement, still pursued a career choice in a STEM field.

### **Methodology**

Permission was granted from the Institutional Review Board at Fayetteville State University (see appendix A). The researcher collaborated with the Registrar's office for the email addresses of those junior and senior female students who were majoring in science, technology, engineering, and mathematics programs (see appendix B). Once the researcher secured students' email addresses, an email invitation went to each student in the population. Those students who accepted the invitation received a link through Qualtrics to complete an online open-ended questionnaire. The researcher asked each participant questions about their experiences as a university STEM female student, their preparation for a career in STEM, their perceptions of faculty enthusiasm, their mentoring availability and use of mentors' support in their decision choice for the STEM fields. Participants discussed their personal thoughts on the challenges and barriers they encounter or expect to encounter as females in a STEM career.

Data were coded for recurring themes and patterns to generate grounded theory on the challenges and barriers female STEM majors encounter as they matriculate through their undergraduate programs. The data formed the basis for thematic interpretation to understanding female STEM majors' viewpoints on their higher education experiences. The research protected the confidentiality of the participants. Consequently, the most effective method to discovering the underpinnings that influences individuals' sense of reality is a qualitative approach. Qualitative research is the most appropriate means to understanding individuals' feelings and experiences through their voices and viewpoints (Creswell, 2003).

### **Research Questions**

The following research questions guided this study:

1. What are female STEM majors' perceptions of the factors that influenced their choice to major in STEM university programs?
2. What are the challenges or barriers female STEM majors encounter during their matriculation through their university courses?
3. How does the university curriculum prepare female STEM majors for the workforce?

4. What influence did high school grades have on females' choice to major in STEM fields?
5. What influence does mentoring have on females' choice to major in the STEM fields.

### **Interview Protocol**

The researcher designed the interview protocol for the purpose of this study (see appendix C). The interview protocol was administered electronically through Qualtrics. Qualtrics is an electronic program designed to disseminate research questions to participants and is useful for data storage, and is an advanced interpretative and analytical tool. This program allows for confidentiality.

### **Results of the Study**

The purpose of this study was to examine undergraduate female STEM majors' viewpoints on the (a) challenges and barriers (b) gender equity, (c) career attainment, (d) mentoring, (e) faculty expectations, and (e) program preparation at Fayetteville State University. The purpose was also to discover those factors that impede or promote female STEM majors' success in the STEM Workforce. The following themes were generated from the responses of those female STEM majoring: (a) academic success, (b) career advancement, (c) gender equity, (d) early influences, (e) greatest obstacles, (f) faculty support, (g) mentors, (h) workplace support, and (i) career challenges.

#### **Academic Success**

Participants discussed the grades they have earned in their STEM courses. The majority proudly expressed and highlighted their grade point averages (GPA) as 3.5 and above. They did express that although their grades were high, when compared to other students, those grades did not come easy. Many mentioned earning grades below a "B". One remarked,

I have earned A's and B's in all stem courses except Organic Chemistry.

Another proudly said that she had all A's in all of her STEM courses. In summary, those female students worked hard, reflected by their grades. One explained,

I feel that what you put into your classes is directly related to what you get out of them. People, who study hard, regardless of gender, will see the benefits of that hard work. I do feel that dedicated female STEM majors work hard because we want to make sure we are taken seriously.

## Career Advancement

When asked whether they felt that females were succeeding in the STEM industry, the responses were positive. The majority's viewpoints were that women were indeed progressing and successful in the STEM field after graduation. One comments:

I feel that we are progressing especially African American women.

Although the majority felt that females majoring in the STEM industry were succeeding excellent, several pointed out that the field is still male-dominated and that the majority of national recognition continues to be directed toward men. She remarked:

The STEM industry is definitely male-dominated. There are women who succeed in these areas, but it seems like the majority of successful scientists (Nobel Prize winners, etc.) are still men.

Although, many mentioned that the industry is male-dominated, their classes contained fewer males than females, which increases the competition among females in many area. One stated:

It seems like there are more females in the STEM industry. The competition is higher now, for example, in most of my STEM classes, there is one male for every six or seven females in several of my classes.

When asked if they felt females are given a fair chance to succeed in the STEM industry, the responses were almost unanimous that they felt optimistic about their future. The majority agreed that although, there continues to be biases in the STEM area, overall they felt that females were given a fair equity in the career market. However, one comment reflects that she felt sure that African American males had more career opportunity than females. She commented:

I feel that more opportunities are given to African American males more so than females, but I do see an increase of female in stem industry.

Contradictory, another stated:

I believe females have an equal opportunity and face similar challenges as males in the STEM industry.

Another felt the reason females are progressing in the industry was due to the increased graduation rates of females and the decline of male graduates. She stated:

Females are given a fair chance to succeed in the STEM industry because females are outpacing males as college graduates.

Another commented:

I do not feel necessarily that there is an obvious bias towards women. Women are graded on the same scale as men.

Another's viewpoints were notable. She stated:

I believe women are more competitive in this area and we have fair chance to succeed. Again, I really do feel like anyone who puts in the effort is going to get a good job at fair pay. If you are being unfairly treated for any reason in any industry, I believe you need to take personal responsibility of the situation. Playing the role of victim does not benefit anyone.

### **Gender Equity**

When asked whether they encountered barriers or obstacles on their path toward success, the majority said that they experienced no barriers or obstacles as STEM majors. The female STEM majors said their treatment was fair and they encounter no personal biases.

Contrary to the majority, one felt men received promotions quicker than females. In their opinion, the belief among the majority working in the STEM industry was in their positive and they felt females were supported through promotions, raises, and praise for jobs well done. However, a few did not voice the same perceptions. One said:

I do not believe workplaces make an effort to support women in the STEM industry.

Yet others felt that STEM females should not receive preferential treatment, she replied:

There should not be any special treatment for females. If females want to be competitive, we should not expect special support.

### **Early Influences**

They also mentioned that their high school science and math grades greatly influenced their choice to major in STEM. On the most part, the majority said that they maintained these high grades throughout high school and totally influenced their decision to major in STEM. Several commented:

I maintained good grades in both math and science. These grades were usually always higher than say my grades in English or history. I just took that as a sign that math and science were my strengths and that it interest me the most. It was something that I felt like I needed to look into.

I have loved the subjects of science and math since I was a little girl. There was no other subject I found more interesting.

I decided to be Chemistry major because of my interest in math and science. I wanted to participate in a science that was more math based since math is one of my strengths.

When I got to FSU, I took a few chemistry classes since I was pre-med. Those classes seemed very interesting, almost magical, and that is why I changed my major.

Another expressed what influenced her to major in STEM.

I love space and fascinated by medicine (though I do not want to be a doctor). I like it when things light up, explode, or when science and nature create awesomeness.

Others on the contrary said that their high schools were not influential in their decision to major in STEM. One remarked:

I did not think it [high school] has much influence. I was ok in high school but later in college, I found out that I love these subjects more.

Another said:

I was actually a high school dropout and my junior year I failed Calculus and AP Biology. My high school grades had little influence on what I decided to do in college.

Overall, the vast majority reported that their interest in science and math stemmed back to their early public school years.

### **Greatest Obstacles**

When asked to describe the barriers and obstacles, most replied that they experienced feelings of inadequateness in the knowledge base and therefore, had to study extremely harder to compete. One remarked:

Course workload was an obstacle I experience while studying. I overcame this obstacle by obtaining a tutor as well as establishing study groups.

Another said:

My main obstacle is the limited time I spend with my family and friends, due the high volume of homework. I have not really overcome this obstacle, and I am still struggling with this.

They felt that the greatest obstacles were funding and technology resources. The female STEM majors reported that although the university did provide limited equipment, they felt that they needed more technology capabilities. They are anticipating the establishment of a new science and technology building, and the new building they hoped this would give more hands-on equipment.

### **Faculty Support**

They mentioned that the university provided research opportunities and faculty who are readily available and helpful. They reported variety of opportunities for undergraduate research, which they seemed to enjoy. One replied:

I have participated in Optimum, McNair scholar, and received funding through both of those programs. I have done research with two professors, and I have never wanted or needed for anything related to the Chemistry and Physics department.

The female STEM majors responded to how their science and math faculty showed enthusiasm in their pursuit of a STEM degree. The overall responses were positive and many felt their professors were supportive and kept them motivated and enthused. However, several reported that only a few professors gave options on how to use their STEM degrees. One stated:

In the math area, there is little enthusiasm from professor, especially foreign professors.

Others reported their professors showed great interest and encouraged graduate school. They applauded their advisors and instructors who meet with them throughout their matriculation. One replied:

By offering opportunities in their [professors] labs, introducing me to materials relevant to my interests, and being available the majority of time needed shows how much they care about my career.

They said that the departments prepared them for careers in the STEM industry, but could have done more. Their experiences described as rollercoaster, supportive and great advisement attributed to their success. One stated:

Department of Chemistry and Physics in FSU is supportive of my goal. By offering fantastic advisement and making sure, I am taking advantage of all opportunity both at FSU and globally.



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## **Mentors**

The female STEM majors all reported supportive and proud parents. Many felt that parents would have been supportive regardless of academic majors. Although parental support was important, their mentor relationships rated equal and sometimes more important to their success in the STEM. One however mentioned that she did not have a mentor, and felt that this privilege would have been most beneficial beginning during the first year. She replied:

No, but I would like to have one [mentor]. If I had a mentor starting my first year, I think I would have done better had I received advice about classes, programs, support, etc.

Others said their mentors were their faculty advisors and worked closely with them each semester keeping them on track taking the right courses. They mentioned exposure to various career opportunities and given directions to their chosen career paths. One replied:

My mentor is my faculty advisor and works very closely with me every semester to make sure I am on track and taking the right classes. He [mentor] has shown me several opportunities in pharmacy [my chosen field] I would not otherwise know about, and seems genuinely interested in my path and my success.

Besides mentors, they [female STEM majors] reported many programs that supported females in STEM, many at the university, such as FSU RISE, OPTIMUM, etc. As far as their career opportunities, many felt they had advanced opportunities, but felt the opportunities were a little harder for females than males. They also seemed aware of successful and prominent female scientists and believed females receive rewards for their hard work.

## **Workplace Support**

The participants' perceptions of what the workplace could do to better support females working in the STEM industry varied. There were an array of responses; however, the majority felt that the work environment could best support women by accommodating family issues, such as daycare and teacher conferences. Many felt employers should always hire the most qualified candidate regardless to gender. Several stressed not singling them out as having a handicap in their qualifications in the STEM. One replied:

Not single them out for being women! I honestly believe a large part of the cloud hanging over women in STEM is due to the lingering belief that even some women hold, that we are not as good at math or science as men. Ignoring that perceived handicap and working to persevere in the face of it seems like the best course of action to me.

They also mentioned that the university could better prepare them by offering more enrichment programs geared towards female students and by providing flexible opportunities for female students. These students also mentioned the importance of the university connecting them to female role models and having more programs for women (specifically women of color). The majority said that the university could provide funds to send deserving female students to conferences, which highlight great female role models in the STEM industry. On a similar note, one stated:

The university could make sure that women in STEM are aware of the myriad of opportunities available to them, and that they take advantage of them. They could also offer more enrichment programs geared towards female students.

### **Career Challenges**

When asked about the factors that attract females to the STEM industry, several felt that it was due to (a) job security, (b) salary (c) career opportunities and (d) STEM background. The benefit of doing well in higher school was another factor mentioned as an attraction. They mentioned that the field is quite rewarding, despite the career area. One said that STEM majors are attracted to their profession as any other professional, because of the love for the profession. She replied:

The factors that attract women to STEM are no different from the factors that attract men. It is the reason teachers become teachers and cops become cops. To succeed you have to love what you do. Sure, there is going to be people in it for the money or the expansive job market, but you cannot be the best at something and exceed expectations if you do not want to be doing it, and that applies for women and men alike.

They expressed that the factors that lead females away from the STEM industry are associated with (a) time management, (b) lack of inspiration, (c) delay in having children, and (d) fear of not succeeding. One stated:

The preconceived notion that females just won't be as successful, won't find as good of a job, aren't good at math, can't drive, are emotional harpies -- pick your stereotype. The first thing that any female STEM major should be told is that all of the above is only true if you let it be true. This is sort of a sore subject for me and I choose to ignore the idea that women are not as strong when compared to men. I have a loving and supportive husband, a supportive family, and several faculty members that go out of their way to help me anyway they can.

### **Summary**

The responses from these females were enlightening and provided an insight on their perceptions of their experiences as STEM majors. They mentioned as leading

factors that influenced their choice to major in STEM programs were, job security, salary, career opportunities for women, and having a background in one of the STEM areas. Although, their courses and jobs are demanding and sometimes stressful, none regretted their choice to major in STEM.

They faced challenges and barriers in positive and productive manners, with the attitudes of not being quitters. They identified course load, limited time for family and funding as leading barriers to their success. Although, they encountered gender bias, they did not allow comments and prejudices to deter their motivation and drive to succeed. Their mentors served as bridges during difficult times, and the most influential mentors were women, however, oftentimes, their professor mentors were men. The lack of women role models appeared to be a barrier, but many were able to find the support from other students and family members.

Their university choice was just as important as their career choice. Many felt that the university could be more sensitive to their needs and provide more technological support and resources. In essence, they reported having a positive and meaningful experience. They all appeared to hold many of their professors in high esteem and their professors and advisors encouraged them to continue their educational and career goals. Although, they mentioned that the curriculum was challenging and rigorous, the courses and class experiences prepared them for a competitive global career. These were courageous and dedicated young women, determined to succeed against all odds, despite the challenges and barriers associated with being a female majoring in a male-dominated career.

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## **Appendix C: INTERVIEW PROTOCOL**

1. What grades have you attained in STEM courses?
2. How do you feel that females are succeeding in the STEM industry?
3. Do you feel that females are given a fair chance to succeed in the STEM industry?  
Explain
4. Have you noted any barriers or obstacles to success females have encountered in their attempts to major in STEM?
5. Are you personally aware of any biases females experience or have experienced in the STEM industry?
6. In your opinion, do you believe that the workplace support females working in the STEM industry?
7. Do you believe females are enthusiastic about working in STEM? Explain
8. Did your high school grades in science and math influence your choice of majoring in STEM?
9. How did your interest in science and math affect your decision to major in STEM?
10. Did you experience any barriers or obstacles in studying STEM? If so, how did you overcome them?
11. How has the college/university provided the appropriate resources in your pursuit of a STEM degree?
12. How has the science and math faculty shown enthusiastic in your pursuit of a STEM degree?
13. How has the department adequately prepared you to enter the STEM industry?
14. Were your parents/guardians enthusiastic about your pursuing a degree or career in STEM?
15. Do you have a mentor?
16. How has your mentor prepared you for a major/career in STEM?
17. Are you aware of any organizations or associations that support and encourage female participation in STEM?

18. What are the opportunities for females to succeed in the STEM career field?
19. Do you think that the workplace sufficiently promotes deserving females in the STEM field?
20. What can workplaces do to better support females working in the STEM industry?
21. What can the university do to better prepare female students for a major/career in STEM?
22. What factors do you think attract females to the STEM industry?
23. What factors do you think lead females away from the STEM industry?