***The following writing sample comes from a research paper that I wrote for one of my culminating courses in my master's program at The College of New Jersey. This sample includes a statement of the problem as well as the study's method and a brief discussion of the results.***

## Statement of Problem

The growing importance of STEM education, as emphasized by the previously noted studies, requires an analysis of growth trends regarding student composition. Identification of disparities based on student groups is important in order to understand how to promote the field to underrepresented populations. Recognition of both external institutional and internal student characteristics informs policy makers of the correct populations to target or provide assistance. The present study first seeks to obtain the percentages of STEM students from a sample obtained from the 2012 Integrated Postsecondary Education Data System. The percentages will be broken down by male and female students and identify whether or not differences exist between these groups with regards to representation in STEM pursuit. Further analysis will investigate the female student group and identify the percentages of STEM pursuers by race. Once these numbers are obtained, the study will then look at whether or not significant differences exist between females within various racial groups based on institutional degree of urbanization (rural, town, suburb, city).

## Research Questions

The following research questions will inform this study:

1. What are the mean percentages of male and female students partaking in STEM majors during the 2012 IPEDS reporting cycle based on the present sample?

2. Are there differences between mean percentages of male and female STEM major enrollments in this sample?
3. What are the mean percentages of female students partaking in STEM majors, by race, during the 2012 IPEDS reporting cycle based on the present sample?
4. Are there significant differences in the mean percentages of female STEM pursuers with reference to school degree of urbanization by racial group?

**Delimitations**

The study was delimited by the following parameters:

1. The study only included undergraduate students in its sample size. The study also delimited the student population to degree seeking students (associates, bachelors, etc.).
2. The study only included degree-granting institutions in the United States and removed any service schools.
3. The study removed any schools that had less than a total STEM population of 10 men and 10 women in order to only include institutions that actually had a measurable STEM program as well as exclude any single sex institutions and extreme outliers.
4. The IPEDS Data Center limits analysis of student major by the following Classification of Instructional Program (CIP) codes: 13.0000-Education; 14.0000-Engineering ; 26.0000-Biological Sciences/Life Sciences; 27.0000-Mathematics; 40.0000-Physical Sciences ; 52.0000-Business Management and Administrative Services; 22.0101-Law (LL. B., J.D.); 51.0401-Dentistry (D.D.S., D.M.D.); 51.1201-Medicine (M.D.). This study used the codes for Engineering, Biological Sciences/Life Sciences, Mathematics, and Physical Sciences to denote the fields of STEM. “The two-digit series represent the most general groupings of related programs” and therefore give an aggregated reference

to STEM fields (“Introduction to the CIP Codes”). Law, Dentistry, and Medicine were excluded because this study only focused on undergraduate students. The present study followed the basic National Science Foundation (NSF) definition of STEM to include Science, Technology, Engineering, and Math; however, it is noted that STEM invokes a “trans-disciplinary lens” (Teaching Institute for Excellence in STEM). Because of an “unclear” and “changing” definition of what constitutes STEM, the present study was limited to the aggregated, two-digit CIP codes within the IPEDS Data Center (Koonce et. al.).

## Limitations

The present study used data from the IPEDS Data Center and has considered the following limitations:

1. IPEDS data is reported by individual schools. Therefore, the study has assumed that schools have correctly reported their data.
2. The present study used the 2012 dataset from IPEDS. This was the most recent fully available survey in the Data Center due to the IPEDS reporting calendars.
3. The sample set included only data from schools that reported to IPEDS. Including data from other institutions that do not report to this dataset could change the results.

## Discussion of Results

The initial results indicate that females have statistically significant larger representations among STEM majors for the 2012 IPEDS reporting cycle analyzed in this sample. Because of this positive result, it was noted that an analysis of the composition of this group should be employed in order to recognize any within-group differences. The results of the MANOVA indicate that there are significant differences in the composition of female STEM majors by race.

Furthermore, some of the variability can be explained by the external factor of school urbanicity. Black female STEM pursuers, according to these results, have stronger representations in urban environments. This also held for Hispanic and Asian students. When comparing effect sizes of the individual univariate tests of difference for each racial group, it was noted that the effect size for Asian females was the strongest with differences in school urbanicity accounting for 10% of the variance in female STEM enrollment (partial $\eta^2 = 0.100$). Further analysis of univariate effect size reveals that urbanicity accounts for very little variability of enrollment by race for the other groups. The significant results suggest that differences do in fact exist, however, external factors such as school urbanicity do not necessarily predict or account for STEM enrollment incidence and that these differences are more attributable to other variables.

Analysis of pairwise differences reveals large disparities in enrollments for White students with a 71.75% mean STEM enrollment in schools located in towns compared to 54.81% in urban schools. For Black female STEM students, it was noted that no significant differences existed between the representation among urban (14.96%) and rural (13.71%) locales, however differences did exist between urban and suburban/town (10.84% and 9.79%, respectively) locations. This seems to negate Leanne Avery's earlier reviewed findings that rural students in STEM majors are less represented than urban counterparts. For Hispanic students, however, this theoretical model held with significant differences noted between city (10.41%) and town/rural communities represented at 5.87% and 6.59% respectively.

The overall percentage of White, female student STEM representation of 60.63% shows that there is a disparity between majority and minority groups. The present study has identified urbanicity as contributing to part of this variance and representing the effect of external factors on enrollment incidence; however, this study has also shown that urbanicity does not represent a lot of the variation in contrast to prior studies (Versypt and Versypt; Berger; Lankford and Wyckoff). Therefore, other variables such as school support, or availability of programming and its relation to student support, may be areas of external characteristics to concentrate on in follow-up analyses.

Because the results were still significant, it is still important to consider expanding STEM opportunities to reach students of all racial groups. Even though the initial percentage of female STEM students seems to be at parity to male students, it is evident that the composition of this enrollment is not representative of every group. Increases in female STEM major pursuit should therefore consider groups of women who are underrepresented in various locales. This study will now look at some of the current initiatives that have been taken in order to include students in STEM programming or promote STEM programming to different student populations and consider these initiatives within the context of the present study.

*Current Programs Aimed at Increasing Underrepresented STEM Pursuit*

The US Department of Education's 5 Year Plan for STEM (2013) seeks to focus on collaboration between departments of existing programs in order to boost STEM enrollments. Through "evidence-based approaches" the plan seeks to use benchmarking knowledge to improve programming at the P-12 grade level. Partnerships with school districts and universities (specifically Minority Serving institutions), science agencies, and businesses seek to involve students in experiential activities in order increase student interest within the field (Committee on STEM Education).

Currently, the Obama Administration has attempted to provide students with programs for increased STEM participation for women. The 2009/2010 Recovery Act was aimed at supporting summer job opportunities for women in low-income areas. Additionally, businesses were provided with subsidies for hiring women from underrepresented areas. As previously discussed, of the 3.4 million students who have received Pell Grants during the Obama Administration, and through 2012, approximately two thirds, or 2.3 million, were women (White House Council on Women and Girls). Despite this, it is important to remember that previous studies have noted that Pell Grant distribution has either not had an impact on minority STEM pursuit (Crisp et. al.) or had a negative impact as students have attempted to maintain higher GPAs in order to keep these grants by pursuing non-STEM fields (Zhang). For someone of a lower income or underrepresented status, these grants incentivize pursuing majors that are generally associated with higher GPAs and decrease STEM pursuit.

The Investing in Innovation Fund provides competitive grants to applicants who have a record of promoting student innovation (Investing in Innovation Fund). The goal of this fund is to increase student postsecondary pursuit as well as provide students with support that is needed in both the academic and professional fields in order to combat attrition, as seen in previous studies (Fouad and Singh). Critics of this particular program note that funding for the program has gone to professional development and "does little to advance student achievement" (Brownstein). Additionally, programs that have existed for a long time and receive most of the funding such as Teach For America, have led critics to call the program "The Investing in Tradition Fund." Because of the Administration's focus on evidence-based approaches, it can be noted that legacy programs would fall under this category if they have yielded results in the past. Therefore, it is important to consider augmenting these programs to providing grants for truly innovative approaches in order to see new results (Brownstein).

One innovative program that seeks to change the face of the transportation industry is Transportation You. This program is aimed at girls aged 13-18 and provides programming and activities with the hope that these girls will pursue careers in the transportation industry through STEM-related majors. These programs also focus on attracting girls from minority populations. This model is one that aims to attract girls at a younger age and therefore encourages girls to become a part of the industry prior to postsecondary matriculation. This is the type of program that the present study would recommend for the government's continued focus.

**Areas for Further Research and Conclusion**

The present study has rejected the null hypothesis that there are no differences by race for female STEM enrollments delineated by school urbanicity. Initial results also found no differences between male and female students which would cause misinformed optimism and negate the composition of this group. Current STEM programming should therefore focus on reaching groups of underrepresented females. While initial analysis reveals near parity representation of females to males, secondary analysis reveals differences among female racial groups. Because the independent variable of school urbanicity produced a smaller effect size, it is suggested that other school external characteristics such as school support or availability of programming need to be looked at.

With reference to the theoretical framework of the present study, an analysis of student enrollment composition based on an intersectional approach of racial and gender characteristics reveals discrepancies. Accepting parity to males would ignore groups of underrepresented students. Within this context, institutions that employ what Kevin Kumashiro calls "consciousness-raising" and empowerment for students can inspire and provide students with an understanding of oppression while providing oppressed students with the tools to become activists (48). Support is important for students, especially students from marginalized groups, in order for them to be successful. Understanding which exact group lacks representation is important for institutions as policies are created. Analysis of difference on a more granular level allows the scholar to properly interpret the appropriateness of current enrollment policies and strategies.