A Correlation Study of Project-based Courses Activities on STEM Engineering Technology Students' Enrollment

Prof. Ihab Habib P.E., Austin Peay State University

Ihab Youssef Habib Assistant Professor and Program Manager of Construction in Engineering Technology Department

PROFESSIONAL PREPARATION Doctorate of Education, Leadership & Professional Practice, Trevecca Nazarene University, (May 2012 – (Expected 2015) Masters of Engineering, Concentration in Civil and Environmental Engineering, Tennessee State University, August 2000 – April 2002 Bachelors of Science in Civil Engineering, concentration in Structures, Ain Shams University, Faculty of Civil Engineering, August 1985 – May 1990 TEACHING EXPERIENCE AUSTIN PEAY STATE UNIVERSITY, Clarksville, TN Assistant Professor and Program Manager of Construction in Engineering Technology Department, July 2011- Present Adjunct Faculty, Engineering Technology Department, 2002-2004 Tennessee Department of Transportation, Nashville, Tennessee Structural Supervisor Specialist I, April 2005– June 2011 AEC&I Design Group Inc., Nashville, Tennessee Founder & Construction Project Manager, March 2002 –July 2008 Tennessee Department of Transportation, Nashville, Tennessee Structural Specialist I & Structural Specialist II, January 2000- April2005 Graduate Transportation Associate, January 1999- January 2000 PBS&J, Nashville, Tennessee LICENSE AND PROFESSIONAL ORGANIZATIONS Professional Engineer Licensed in Tennessee. (License #106875, Inactive) General Contractor Licensed in Tennessee (License #00050709, Inactive) TAS Tennessee Academy of Science Engineering Section Chair 2013-14 ASEE American Society of Engineering Educators Member Leadership Clarksville member of class 2014 National Association Home Builder Student Chapter at Austin Peay 2013 Currently serving in Assessment Analysis Council HONORS AND AWARDS School of Technology and Public Management Outstanding faculty award 2012-2013 Construction Projects Institutional St Clement Elementary School Antioch Egyptian Evangelical Church L & E Market and Grocery Store St George Coptic Orthodox Church St Bishoy Orthodox Church Residential Brentwood Chase sub-division Fr. Boutrous residence Lot 94 (3,800sqft) The Faheem residence Lot 54 (3,000 sqft) The Leyons residence Lot 80 (3,000 sqft) The Private residence Lot 79 (4,200 sqft) The Jeff Goldstien residence Lot 69 (3,200 sqft) The Goldstien residence Lot 94 (3,000 sqft) The Gabous residence Lot 50 (2,800 sqft) Fr. Mina's residence Lot 53 (3,100 sqft) Bridges I-69 Ramp E over US-51 Obion Co. (Curved Steel Bridge Seismic) I-269 over SR86 Shelby-Fayette Co. (Steel Bridge Seismic) Park swain Rd over Indian Creek Hardman Co. (Seismic) SR 346 all 7 Bridges – Carroll Co. (Seismic) SR 70 over Clinch River – Hancock Co. SR 385 over Fletcher rd. in Shelby – Fayette Co. (Seismic) SR15 (U.S. 64) over Hardin Creek in Wayne Co. SR49 over Sycamore creek in Cheatham Co. SR15 over Choate creek in Giles Co. SR45 over I-65 in Davidson Co. (steel bridge) Jones Gap Rd over SR111 Hamilton Co. SR111 over Big Brush Creek in Sequatchie Co.

RECENT PUBLICATIONS 2011 Participated in the in-depth online Text Book review of Vogt, Carpentry 5/e published by Delmar Learning 2012 Chapter review,(Smyth, Volker) Enhancing Instruction with Visual Media: Utilizing Video and Lecture Capture, which is to be published by IGI Global (www.igi-global.com) and scheduled for release in the spring of 2013 "THE EFFECT OF PIER SLOPE SHAPE ON DEBRIS ACCUMULATION AT THE BENTS" (2002), [Ihab Youssef Habib, Unpublished Thesis] The Standard LRFD designs Box and Slab culvert for Tennessee Department of Transportation (2000) [Members from TDOT Structures Division]

PRESENTATIONS "A Study of Female Students Enrollment in Engineering Technology STEM Programs". Ihab Habib, Austin Peay State University, Clarksville, Tennessee. Tennessee Academy of Science presentation 2013

"The Engineering Technology curriculum faces challenges of instructional diversity and delivery methods that will lead to effectively using online and blended course delivery". Sue C. Evans and Ihab Habib, Austin Peay State University, Clarksville, Tennessee Academy of Science presentation 2012

"THE EFECT OF ADVANCED APPLICATION TECHNOLOGY ON CONSTRUCTION PROJECT

MANAGEMENT" Ihab S Habib, Abu Sarwar, Austin Peay State University, Clarksville, TN. Tennessee Academy of Science presentation 2011

Introduction

Scientists and Engineers in the United States analyzed work arrangements among women and men. The gender pay gap in science and engineering was poor because of a gender selection effect. Gender selection effects on women have been overrepresented in these employment opportunities but subject to much lower wages and benefits failed to explain the gender gap (Prokos, Padavic, & Ashley Schmidt, 2009). Burke (1994) indicated the inclusion of both genders was critical in doing business in an increasingly competitive environment. Difficulties faced by women in work were often explained by their numerical minority in the workforce (Ott, 1989). Henwood (2000) emphasized it was critical and constructivist discourse on technology to coexist in educational programs designed to promote gender equality. Boykin (2010) stated that the year 2010 might well be remembered as the year of a four-letter word usually associated with plant life made it into the national spotlight, *"STEM is suddenly everywhere"(*para.2). President Barack Obama (2013) said, "One of the things that I really strongly believe in is that we need to have more Women interested in math, science, and engineering.

The problem studied in this research project was the enrollment of female STEM Engineering Technology students and the impact of professional mentoring and financial incentives on their enrollment, retention, and completion of engineering curriculum. In 2011, the researcher joined a Middle Tennessee public university as a Program Manager for the Construction and Civil Engineering Technology Program. One of the tasks presented was to recruit more students to the Program. Female students, as a minority in the STEM ENGT curricula were a particular priority for the department recruitment. Other tasks were to make necessary changes to the curriculum standards and

improvement to mentoring for students that could lead toward improvement in enrollment, retention, and completion of the STEM ENGT Program.

The following were the research questions in this research project:

1. What factors influenced enrollment of female STEM Engineering Technology students' enrollment in undergraduate engineering curricula?
2. What were the impacts of professional mentoring and financial incentives on female STEM Engineering Technology students?
3. How a successful professional mentoring and financial incentive program is developed within the site university STEM engineering technology program?

This correlational study used a combination of qualitative and quantitative data from enrolled STEM ENGT Program university students' to study the research problem and help answer the research questions. This chapter included the research findings, summary of the findings, limitations, implications, conclusions, and recommendations after examining the statistical data, data analysis and correlations identified between the two study groups. The study took place over the course of the 2013-2014 academic year. The study site was a Middle Tennessee public university and the data was generated from the site's STEM ENGT students. The two groups of participants from the study site were the male and female students enrolled in the STEM ENGT Program. During the study, both groups from the STEM ENGT students involved in the study were asked to take a 20-question survey assessment designed by researcher specifically for this study. The survey can be found in Appendix (A) of this document.

Table 1
Demographics of Participants

Variable	ENGT Students n	%
Gender		
Male	110.0	90.2
Female	12.0	9.8
Total	122.0	100.0
Race		
African American	13.0	10.9
American Indian/Alaskan Native	2.0	1.7
Asian & Pacific	3.0	2.5
Latina/Latino/Hispanic	11.0	9.2
White American	88.0	73.9
Other	2.0	1.7
Total	119.0	100.0
Degree		
Associate Degree	21.0	17.4
Bachelor's Degree	100.0	82.6
Total	121.0	100.0
Student College Level		
Freshman	29.0	24.6
Sophomore	27.0	22.9
Junior	25.0	21.2
Senior	32.0	27.1
5th year or other	5.0	4.2
Total	118.0	100.0
Major		
Automotive	23.0	16.3
Civil/ Construction	24.0	17.0
Electrical/ Electronic	42.0	29.8
Manufacturing	12.0	8.5
Mechanical	12.0	8.5
Chemical	2.0	1.4
Other	6.0	4.3
Total	141.0	100.0

adf = 1.

cdf = 2.

bdf = 3.

Findings

The data for this research were obtained from the survey instruments administered to the STEM ENGT Program students. The findings from the data analysis were arranged and discussed in order of their production of data that helped to answer the three research questions for this project. The researcher organized, coded, and analyzed the data using SPSS v.21 software. All data were collected in March of 2014, and statistical analysis using SPSS v.21 software was performed in June and July of 2014.

Question 1: What factors influenced enrollment of female STEM Engineering Technology students' enrollment in undergraduate engineering curricula?

A Pearson *r* correlation was run to determine the relationship between male and female students ($M = 0.90$, $SD = 0.30$) on having an advisor or not made a difference in their choice ($M = 1.16$, $SD = 0.36$). Analysis showed no significant, $p > .05$. Students' enrollment in STEM ENGT curricula was not influenced by having and advisor or not based on gender.

A Pearson *r* correlation was run to determine the relationship between students' gender ($M = 0.90$, $SD = 0.30$) and their answer for question seven item (1, 3-14). Analysis showed no significant relationship was found between the two groups, $p > .05$. The factors listed were not a factor on students' decision to enroll in STEM ENGT curricula.

A Pearson *r* correlation was run to determine the relationship between students' gender ($M = 0.90$, $SD = 0.30$) and their answer for question seven item (MAJFACT2) (*M*

= 1.93, *SD* = 0.25). Analysis showed significance. A weak negative relationship was found between the two groups, r (120) = - .25, $p < .01$. Students with parents, other relatives or friend that were in Engineering Technology were shown to be factors acting upon students' decision to enroll in STEM ENGT curricula.

A Pearson *r* correlation was run to determine the relationship between students' gender (*M* = 0.90, *SD* = 0.30) and their answer for question 12 item (AGR LV 1) (*M* = 2.53, *SD* = 0.94) (or Table AGR LV 1-6). Analysis showed no significance negative relation between the two groups, $p < .01$. Students do not agree that STEM ENGT was a single gender dominated curricula.

A Pearson *r* correlation was run to determine if there was a relationship between students' response to question 17 (*M* = 4.44, *SD* = 1.68) and Gender (*M* = 0.90, *SD* = 0.30). Analysis revealed no significant between the two groups $p > .05$. Student answers for the open ended question did not reveal any relevant with significance responses.

A Pearson *r* correlation was run to determine if there was a relationship between students' response to question 19 (*M* = 3.13, *SD* = 1.78) and Gender (*M* = 0.90, *SD* = 0.30). Analysis revealed no significant between the two groups $p > .05$. The student opinion did not provide with a shared common recommendations that was relevant based on gender opinion.

Question 2: What were the impacts of professional mentoring and financial incentives on female STEM Engineering Technology students?

A Pearson *r* correlation was run to determine if there was a relationship between students' response to question five (ITEM 1) (*M* = 4.02, *SD* = 1.66) and Gender (*M* = 0.89, *SD* = 0.31). Analysis showed no significant. A weak negative relationship was

found between the two groups, r (48) = -0.23, $p < .05$. Student response to the open ended question did not reveal any significant answers to how the school can encourage females' students in STEM ENGT curricula.

A Pearson r correlation was run to determine if there was a relationship between students' response to question nine (ACAD LIST1-14) (M = 4.02, SD = 1.66) or list (Table 1-14) and Gender (M = 0.89, SD = 0.31). Analysis revealed no significance was found between the two groups, $p > .05$. Student responses revealed no significant relation between the genders on these questions nine (ACAD LIST1-14).

A Pearson r correlation was run to determine if there was a relationship between students' response to question ten (PROB ACT 1-4, 6-12) (M = 4.02, SD = 1.66) or list (Table 1-14) and Gender (M = 0.89, SD = 0.31). Analysis revealed no significance was found between the two groups, $p > .05$. Student responses revealed no significant relation between the genders on these questions ten (PROB ACT 1-4, 6-12).

A Pearson r correlation was run to determine if there was a relationship between students' response to question ten (PROB ACT 5) (M = 1.80, SD = 0.41) and Gender (M = 0.89, SD = 0.31). Analysis showed significance with weak positive relationship between the two groups, r (120) = 0.22, $p < .05$. Student responses revealed that it could help students to remain enrolled in STEM ENGT Program, if they talk to an engineering advisor when they have difficulty with the curricula.

A Pearson r correlation was run to determine relationship between students' response to question twelve (AGR LV 8-9, 11) and Gender. Analysis revealed no significance between the two groups $p > .05$. Student enrollment was not impacted by the

list of factors question twelve (AGR LV 8-9, 11) that impacted students' enrollment in STEM ENGT curricula.

A Pearson *r* correlation was run to determine relationship between students' response to question twelve (AGR LV 10) and Gender. Analysis revealed significance and a weak negative relationship was found between the two groups, $r\ (120) = -0.23$, $p < .01$. The students level of agreement for the statement of "At least one instructor had taken an interest in a student development was related to students" impacted the enrollment in STEM ENGT curricula, and revealed a significant correlation between STEM ENGT students based on gender.

A Pearson *r* correlation was run to determine if there was a relationship between students' response to question eighteen (FINANC 1) ($M = 4.02$, $SD = 1.66$) and Gender ($M = 0.89$, $SD = 0.31$). Analysis showed no significance. There was no relation found between the two groups $p > .05$. Students showed no interest in financial assistance. However, this could be due to the fact that most of the participants were getting benefits from the GI Bill or Bell Grant. This fact was noted by the researcher as a limitation and discussed in the corresponding section of this chapter.

A Pearson *r* correlation was run to determine relationship between students' response to question 20 (MENT 1) ($M = 1.90$, $SD = 0.30$) and Gender ($M = 0.89$, $SD = 0.31$). Analysis showed no significance. There was no relation found between the two groups $p > .05$. Students responded to the general APSU 1000, which is an introductory class to the university life.

Question 3: How a successful professional mentoring and financial incentive program is developed within the site university STEM engineering technology program?

A Pearson *r* correlation was run to determine relationship between students' response to question eight (ACTIV 1-8) (*M* = 3.76, *SD* = 0.77) or (table) and Gender (*M* = 0.90, *SD* = 0.30). Analysis revealed no significance. There was no relation found between the two groups $p > .05$. Students revealed they were not involved in the listed activities question eight (ACTIV 1-8).

A Pearson *r* correlation was run to determine relationship between students' response to question eleven (ENG INF 1-6) (*M* = 2.80, *SD* = 1.20), and Gender (*M* = 0.90, *SD* = 0.30). Analysis revealed no significance. There was no relation found between the two groups $p > .05$.

A Pearson *r* correlation was run to determine relationship between students' response to question twelve (AGR LV 10) and Gender. Analysis revealed significance. A weak negative relationship was found between the two groups, $r(120) = -0.23$, $p < .01$. The statement "At least one instructor had taken an interest in a student development was related to students" was the most significant and showed correlation to the impact of enrollment in STEM ENGT curricula based on gender.

A Pearson *r* correlation was run to determine relationship between students' response to question 20 (MENT 1) (*M* = 1.90, *SD* = 0.30) and Gender (*M* = 0.89, *SD* = 0.31). Analysis showed no significance. There was no relation found between the two groups $p > .05$. Students responded to an introductory class to the university life (APSU 1000 ENGT) based on an old class not he one produced by the researcher in fall 2014.

Summary of the Findings

In this study, several areas of statistical significance were identified by reviewing the data acquired and the resulting statistical analysis of those data. Areas of statistical significance and strong correlations were identified, the researcher's conclusions regarding those findings, the answers to the individual research question related to those data, and the researchers' conclusions are included in this section of this research project.

The research instrument produced data to help determine whether gender, presence of an advisor, and effect of mentorship was or was not a factor in whether gender and having an advisor, mentor, or not was a factor that influenced the students' enrollment in STEM ENGT curricula? The researchers' conclusions regarding the effects of these factors, based on gender of the participant student, were influenced by having an advisor not influenced by the participants' gender. The researcher concluded that neither gender, having an advisor, or mentorship had an influence on student enrollment in the STEM ENGT Program.

The researcher also analyzed the results of the data regarding academic activities and their correlation to enrolment of students' in the STEM ENGT Program. Analysis revealed no significance and there were no statistical correlation between students' academic activities listed may have influenced their choice of STEM ENGT Program enrollment based on gender. However there was a weak negative statistical correlation between the two genders groups on question seven (b), Parents, other relatives, or friend is in Engineering Technology. The conclusion from these data suggested that students

with relatives or parents in the STEM ENGT field had an influence on the students' decision to enroll based on gender.

Students were asked in the survey instrument to show their level of agreements in regards to questions twelve. Data revealed that there were no correlations between the students' gender responding to this item and its statement that STEM ENGT was a single gender dominated curricula. Also the open ended questions did not reveal any insight for the researcher regarding shared common recommendation that were relevant based on the students' gender. The conclusion from these data showed that students did not believe that STEM ENGT was a single gender dominated curricula which helped the researcher to answer the research question number twelve.

Analysis showed a trend of opinion and could be shown to have or not have significances between the two genders and their responses for the open ended question. No significance to the student response to the open ended question. Data analysis did not reveal any significant answers to how the school can encourage females' students in STEM ENGT curricula. When student were surveyed on how they resolve any academic problem that they faced with revealed significance in the statement in survey question 10: Talk to engineering adviser and/or advising staff. This was the only response found to show significant correlation between the genders and the response for this question. The researcher's conclusion was that the data showed that having a mentor or an advisor in the STEM ENGT field could help with students' academic challenges.

The data revealed a statistical significance and relationship between the students' level of agreement for the statement in survey question 12i: At least one instructor had taken an interest in a student development was related to students. This question and the

analysis lead the researcher to the conclusion that a positive interest and relationship in students by instructors positively impacted student enrollment in STEM ENGT curricula. There was also a significant correlation between STEM ENGT students based on their gender, leading to the conclusion that both male and female students were positively impacted by the interest of an instructor regarding their enrollment, retention, and graduation.

The Spellings Commission report named providing life-long access to higher education and giving individuals economic opportunity through higher education as goals for the institution of higher education (U.S. Department of Education, 2012). The researcher concluded that the described class APSU 1000 ENGT and the Scholarship Grant by NSF were not able to generate valid data for a conclusion that would indicate positive or negative impact on STEM ENGT students or to help answer research question three due to the timeframe parameters of this study. This factor was identified as a limitation and discussed in the Limitations section of this paper. The researcher adopted the idea from the data and the literature lead to the conclusion, that matching by race and gender matters.

Limitations

Several limitations were encountered in the research project. The researcher identified those limitation and their resulting effects on this research below. The first limitation identified was the number of participants available as enrolled student in the STEM ENGT Program during the implementation of the survey. A larger sample size would

have been more valid and a larger sampling of female respondents could have improved the results. This was revealed to the researcher after data was collected and the data of participants was revealed through the analysis in the descriptive statistics.

The second limitation identified was that the survey was carried out in each class offered by the STEM ENGT instructor for that class during the data gathering phase of this study. During the data gathering phase of this study, there was no method of determining the number of students who were absent or were enrolled in several STEM ENGT classes during the data collection phase. This limitation could have skewed the data and presented a potential bias to the results and conclusions of this study.

The third limitation identified was that there was no practical method of determining the number of students enrolled in several STEM ENGT classes during the data collection phase, those students' that had taken the survey more than once, or to detect whether students complete the survey if they were absent during the collection of data. The researcher did, however, announce before each class survey that students who had completed this survey in another class should not fill out another. This limitation could have skewed the data and presented a potential bias to the results and conclusions of this study.

A fourth and fifth limitations were identified. The fourth limitation arose from the fact that the introductory class, that would provide student support and reinforcement, (APSU 1000 ENGT). The introductory class (APSU 1000 ENGT) was offered after the survey instrument was administered and the grant applied for to fund STEM ENGT student scholarship assistance is still pending for decision in mid-2015. For future engineering students the researcher will administer the survey on an Annual Freshman Interest Survey, which will be as Internet based and linked to the core class (APSU 1000)

for orientation course developed by the researcher, starting fall 2014. The survey will determine how many were interested in pursuing degrees in STEM engineering technology curricula. The fifth Limitation was due to the fact that the grant proposal guidelines and strict deadlines prevented researcher from producing data to form a valid conclusion as to the positive or negative impact due to the financial support from scholarship to STEM ENGT students.

The final limitation identified in this research project was the difference in the true attitude toward gender role perception and what might be politically correct in the eyes of society, the student participants, and their peers. The nature of the questions in the survey required participants to admit attitudes that were less than desirable in the eyes of Society or even themselves. Additional questions might have been added to indicate whether students were receiving other financial benefits that might have influenced their need and the benefits effect on their enrollment, retention, and graduation.

Implications and Recommendations

The data, findings, and conclusions of this study could assist other programs across the State, Nation, and within STEM ENGT. The research revealed some of the strengths and weaknesses of a STEM ENGT Program. The implications identified lead the researcher to form the following recommendations based on the research, data, and analysis of those data.

The strength of this research was that it showed the responses of all STEM ENGT students' perception in regards on the STEM ENGT Program. That could be a valid tool

for further research topics. One of the weaknesses was that the survey didn't include Math and Science which is 50% of STEM.

The development component of the STEM ENGT field needs to be more serious about gender inequities and women's empowerment. When development organizations do not focus on women's empowerment, they neglect the fact that empowered women have the potential to transform their societies (Gates, 2014).

The research and its implications further lead the researcher to recommend that further research should be conducted for further research to include conducting the same research in other parts of the country, to eliminate regional gender role perceptions, and to conduct the same research procedure using only female participants. In addition, the development of a longitudinal research project following female participants from late elementary school through middle and high school could help determine if gender role perceptions changes as the participant grows older into college.

For future engineering students the researcher will administer the survey on an Annual Freshman Interest Survey, which will be as Internet based and linked to the core class (APSU 1000) for orientation course developed by the researcher, starting fall 2014. The survey will determine how many were interested in pursuing degrees in STEM engineering technology curricula.

Furthermore, the researcher recommends that additional quantitative assessment, of this problem would be helpful in making stronger conclusions regarding the topic and problem studied. Also, more use of social media targeted toward females in STEM ENGT programs, stronger mentoring programs and relationships for students, and offer strong scholarship programs could reinforce support for the minority of female STEM

ENGT students. Further research using interventions strategies as mentorship, job location and development as a component of female scholarships that might help change gender role perceptions could positively affect enrollment, retention and achievement of graduation by female students.

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