AC 2008-877: A MULTIPLE REGRESSION ANALYSIS OF THE FACTORS THAT AFFECT MALE/FEMALE ENROLLMENT/RETENTION IN ELECTRONICS AND COMPUTER ENGINEERING TECHNOLOGY PROGRAMS AT A FOR-PROFIT INSTITUTION

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A Multiple Regression Analysis of the Factors That Affect Male/Female Enrollment/Retention in Electronics and Computer Engineering Technology Programs at a For-Profit Institution

Abstract

Women are underrepresented in the science, mathematics, engineering, and technology (SMET) work-force and in the undergraduate SMET programs at the colleges and universities in the United States of America. Studying the enrollment and retention issues of electronics students at a for-profit institution could improve the female enrollment and retention rates and help other colleges and universities increase their female student population which would help meet the future SMET work-force needs. The objective of this paper was to explore how well the combination of self-confidence; self-efficacy; approachability, concern, and fairness of the electronics professors; pre-college mathematics/science interest and grades; years of mathematics/science in high school; parents' education; professors' use of teamwork; pre-college encouragement; pre-college consideration to apply for a career-oriented university; household income; genders of students; and program levels predict satisfaction with the electronics programs at a for-profit institution.

Surveys were administered to 576 students in electronics programs at two of the for-profit institution's campuses in the fall 2004 trimester. The response rate was 63.9%. The survey instrument asked for information on all the above-mentioned variables.

Multiple regression was conducted to in order to analyze the quantitative data. The correlation table showed the Pearson correlation coefficients, and significance levels. Simultaneous multiple regression analysis indicated that approachability, concern, and fairness of the electronics professors ($\beta = .51$, $p < .001$); self-confidence ($\beta = .26$, $p < .001$); gender of student ($\beta = .07$, $p < .05$), and program level ($\beta = -.20$, $p < .001$) combined to be the significant predictors of satisfaction with electronics programs.

The current findings were generally consistent with the previous research that self-confidence, positive influence of professors/advisors, and influence of SMET courses are positively correlated with persistence in SMET programs. The results generally agreed with previous research that professors' nonresponsiveness and their poor teaching styles are negatively correlated with the satisfaction of women and minority students in SMET programs.

I. Introduction

Background and the Statement of the Research Problem

According to statistics taken after September 11, 2001, The United States Bureau of Labor Statistics reports that the need for scientists and engineers is projected to increase at an annual rate of 6.4% between 2000 and 2010, with about 5 million jobs expected in 2010 in the fields of science, mathematics, engineering, and technology (SMET)[1]. Women, underrepresented minorities, and persons with disabilities represented only about 20% of the workers in the SMET fields in 1997, although they constituted about 70% of the total work force (Commission on the Advancement of Women and Minorities in Science, Engineering, and Technology Development [CAWMSET])[2]. Despite an increase of women in SMET programs to 20% of total undergraduate enrollment, this number still falls short of the projected demand.

One key issue is the low enrollment of female students in undergraduate SMET programs, stemming from deficiencies in mathematics and science as well as low interest in these subjects at the pre-college level[2]. In a high quality peer reviewed journal published by American Society of Engineering Education (ASEE), Felder, Felder, Mauney, Hamrin, and Dietz drew from empirical studies over five consecutive semesters to conclude that the poor quality of SMET professors' teaching techniques and dissatisfaction with the SMET programs are other major issues related to the enrollment and retention of female students in undergraduate SMET programs[3]. According to these researchers, parental discouragement, male dominance, and stereotyping could have been major contributors to women's lack of self-confidence. Socio-economic status (SES) differences in secondary education can also affect the enrollment of post-secondary students in the United States. Anyon describes how the unequal opportunities created by SES can result in unequal success in school, leading to unfair advantages in obtaining decent employment[4].

University A is one of the largest private higher education systems in North America and it offers career-oriented, technology-based undergraduate and graduate programs to 49,000 high school graduates and working adults through 65 locations throughout the United States and in Canada. In 1957, University A started granting associate degrees in electronics engineering technology (EET) and in 1969 it became a bachelor's degree granting institution in the same discipline. University A's second bachelor's degree program was introduced in 1979 as Computer Science for Business which was later renamed Computer Information Systems (CIS).

In order to meet the growing demand for business and technology programs, University A introduced its bachelor's degree programs in business and telecommunications in the 1980s. Technical Management curriculum, followed by the introduction of the Information Technology, Computer Engineering Technology (CET), and Network Systems Administration Programs (NSA) were introduced in 1994, 1998, 1999, and 2002. In 2003, University A started offering Biomedical Engineering Technology (BET), Biomedical Informatics, and Health Information Technology programs. Since 1987, University A's Graduate School of Management has been offering master's degrees in business programs. Today Business Administration, Accounting and Financial Management, Human Resource Management, Information Systems Management, Project Management, Public Administration, and Network and Communications Management are offered nationwide and online as master's degree programs.

Studying the enrollment and retention issues of University A’s electronics students could improve the enrollment and retention rates of female students and of students from other colleges and universities, and thus help meet the work-force needs of the 21st century. The researcher explored how well the combination of self-confidence; self-efficacy; approachability, concern, and fairness of the electronics professors; pre-college mathematics/science interest and grades; years of mathematics/science in high school; parents' education; professors’ use of teamwork; pre-college encouragement; pre-college consideration to apply for a career-oriented university; household income; genders of students; and program levels predict satisfaction with the electronics programs at University A’s Chicago area campuses.

Research Question

The following is the research question for the proposed study:

Is there a combination of self-confidence; self-efficacy; approachability, concern, and fairness of the electronics professors; pre-college mathematics/science interest and grades; years of mathematics/science in high school; parents' education; professors’ use of teamwork; pre-college encouragement; pre-college consideration to apply for a career-oriented university; household income; genders of students; and program levels that predict student satisfaction with the electronics programs at University A’s Chicago area campuses better than any predictor alone?

II. Literature Review

A review of the literature shows that the following issues are relevant to the enrollment and retention of undergraduate female SMET students: (a) self-confidence; (b) self-efficacy; (c) teaching environments of SMET professors; (d) pre-college experience; (e) SES; and (f) satisfaction[2,3,5,6,7,8,9,10,11].

Parental discouragement, male dominance, and stereotyping are related to women’s lack of self-confidence and self-efficacy[3]. Women’s self-confidence dropped significantly after their freshmen year ($p < .001$)[6]. Contrary to Brainard and Carlin’s findings, Huang et al. reported that self-confidence for women was not a statistically significant predictor for the completion of SMET degrees[7]. According to Huang et al., the retention of female students in undergraduate SMET programs is higher than that of males[7]. Although women’s self-efficacy suffers from a scarcity of mentors, insufficient academic advising, and poor instructional techniques, the women already enrolled in undergraduate SMET programs have enough self-efficacy to graduate. Insufficient formal education and apathy for mathematics and science in primary and secondary schools are primary reasons for the low enrollment rates of women in undergraduate SMET programs[2,7]. SES, politics, economics, family and social backgrounds, gender, culture, race, and ethnicity are interrelated subjects[12]. Unequal opportunities created by low SES can cause unequal educational success in secondary and post-secondary schools and lead to unbalanced employment opportunities[4]. Undergraduate female SMET students in the United States are a special population that is adversely affected by the inequality that SES creates.

Socioeconomic factors, including family background and financial aid, are important, but the women who do enroll in the undergraduate SMET programs manage their socioeconomic needs in order to graduate[8,9].

Professional societies present good role models, mentors, workshops, and activities that raise mathematics and science interest, as well as the self-confidence and self-efficacy of undergraduate female SMET students[2]. To optimize a service delivery system, instructors must develop student-centered teaching methods, such as cooperative learning and feminist pedagogy that are sensitive to diversity, including gender, ethnicity, race, culture, and SES[3,13,14]. CAWMSET recommends that the government intervene to increase the number of qualified women teachers in mathematics and science programs and that the majority of financial support come from grants and scholarships. Pre-college policy development for mathematics and science curricula that meet world standards should include striving for a proportionate number of female teachers and training counselors who are able to give sound advice on obtaining financial aid for undergraduate SMET programs.

The key to the success of CAWMSET's recommendations is the implementation of the nationwide accountability action plan[2]. Only when this action plan is implemented will more women and underrepresented minorities from lower SES enroll in and graduate from SMET programs. Only then will the goals of multicultural education be reached: all students regardless of race, gender, ethnicity, culture, or SES will have access to undergraduate SMET programs and the United States work force will be prepared for 21st century–needs in the fields of mathematics, science, engineering, and technology[15].

Student satisfaction seems to relate to self-confidence, encouragement, fulfillment of expectations and wishes, freedom from doubt or anxiety, flexible curriculum, competition, and challenge. During their first year of chemical engineering studies at NCSU, women showed more anxiety, less satisfaction, higher expectations, and less self-confidence than men did[3]. According to Felder et al., women predicted their grades significantly less accurately during their junior years than men did, which was probably the effect of an underestimation of their abilities related to female students' lowered expectations[3]. An empirical study was conducted in order to explain the reason for under representation of women in engineering curricula[16]. After the analyses of the responses to the open-ended questions and follow-up discussions with women, engineering faculty, and engineers, Henes, et al. reported that the reasons women get dissatisfied and leave SMET are psychological alienation, not being able to relate to basic theoretical courses, "chilly" classroom environments, and a lack of mentors[16].

Other reasons for women's dissatisfaction include their having more interest in majors other than SMET, stereotyping of SMET as male fields, a lack of academic advising, low faculty expectations, a fixed or rigid curriculum, and the competitive nature of science and engineering[10,11]. According to Brainard and Carlin, self-confidence, positive influence of professors/advisors, and influence of SMET courses are positively correlated with persistence in SMET programs[6]. An emphasis by SMET professors on grades and competition instead of on people, poor teaching styles, and the nonresponsiveness of faculty force women and minority students to become dissatisfied and leave SMET fields[8].

III. Method

Variables

Self-confidence; self-efficacy; approachability, concern, and fairness of the electronics professors; pre-college mathematics/science interest and grades; years of mathematics/science in high school; parents' education; professors' use of teamwork; pre-college encouragement; pre-college consideration to apply for a career-oriented university; household income; genders of students; and program levels were the twelve predictor variables that predict student satisfaction with the electronics programs.

Male and female were the two levels of gender, and program level had three categories: beginning (B), middle (M), and end (E) of the electronics programs. Table 1 displays that the B level was the first two trimesters of the ECT or the first three trimesters of the EET/CET programs. The M level was the third trimester of the ECT or the fourth through sixth trimesters of the EET/CET programs. The E level was the fourth and fifth trimesters of the ECT or the seventh through ninth trimesters of the EET/CET programs. The reason for separating B and M program levels was the leveling off of student attrition after the first two trimesters of the ECT or the first three trimesters of the EET/CET programs. Since ECT students start working on their senior projects during their 4^{th}, and EET/CET students during their 7^{th} trimesters, separating M and E program levels at these trimesters was logical.

Table 1

Program Level and Trimester of Electronics Programs in University A's Chicago Area Campuses

Program Level	ECT Trimester	EET/CET Trimester
Beginning (B)	1, 2	1, 2, 3
Middle (M)	3	4, 5, 6
End (E)	4, 5	7, 8, 9

Population

Surveys were administered to 576 students in electronics programs at University A's Area-I and Area-II campuses in the fall 2004 trimester. The members of the participating student population came predominantly from African-American, East-European, Hispanic, and Asian backgrounds. They were usually first- or second-generation American citizens. Since they were usually the first in their families who have had the opportunity to attend college, their family and educational backgrounds were similar.

Instrument

The instrument consisted of 26 items with Likert scales, and 9 items on personal and demographic information. These questions are attached as Appendix A. The researcher developed all the questions except for the ten questions related to self-efficacy that were taken directly from the General Self-Efficacy Scale (GSE) developed by Jerusalem and Schwarzer[17]. The researcher adapted five questions for self-confidence from the Women in Engineering Programs and Advocates Network (WEPAN) Student Experience Survey[18]. Table 2 shows the measures and the survey questions related to each measure.

Each measure was based on Likert scale and/or personal/demographic questions. The seven levels of the Likert scale were: 1 = Strongly Agree (SA), 2 = Disagree (D), 3 = Mildly disagree (MD), 4 = Neither agree nor disagree (N), 5 = Mildly agree (MA), 6 = Agree (A), and 7 = Strongly agree (SA).

Table 2

Measures and the Related Questions

Measures	Questions
Self-Confidence	1-5
Self-Efficacy	6-10, 19-23
Professors' Use of Teamwork	11
Approachability, Concern, and Fairness of Electronics Professors	12-14
Pre-college Mathematics/science Interest and Grades	15, 16, 27
Pre-College Encouragement	17
Pre-College Consideration to Apply for Electronics	18
Satisfaction with Electronics Programs	24-26
Years of Mathematics/science in High School	28, 29
Parents' Education	31, 32
Household Income	30
Gender, Trimester Enrolled, Age	33-35

The dissertation committee comprised a panel of experts who reviewed the questionnaire and established content validity of the instrument. The review involved feedback on how well the survey questions might measure the variables.

The researcher conducted a pilot test of the instrument at University A's Area-III campus, which is one of the three University A's Chicago area campuses. To determine the reliability of the instrument, Cronbach's alphas were calculated as the internal consistency coefficients for the summated scales. The researcher repeated the reliability test after the data collection. Table 3 is the summary of the summated scales corresponding alphas for the actual studies.

Table 3

Summated Scales and Related Cronbach's Alphas for Actual Studies

Measures	Cronbach's Alphas
Self-Confidence	.72
Self-Efficacy	.85
Approachability, Concern, and Fairness of Electronics Professors	.83
Pre-college Mathematics/science Interest and Grades	.65
Satisfaction with Electronics Programs	.86
Years of Mathematics/science in High School	.74
Parents' Education	.71

Data Collection Procedure

After the Human Research Committee's approval, Dean of Electronics sent the recruitment e-mail to electronics faculty at University A's Area-I and Area-II campuses requesting 10-15 minutes of their class time to administer the survey. After communicating with the faculty, the researcher administered the questionnaires to 576 electronics students at University A's Area-I and Area-II campuses. One class from each trimester in ECT, EET and CET programs per campus was selected in order to ensure an adequate number of female responses for data analysis. After the data collection, all data were entered into the SPSS data editor with the variables defined.

Data Analysis

Data analysis is composed of two parts: (1) descriptive statistics, and (2) quantitative inferential analyses. The first part is the descriptive statistics for the demographic data and the variables involved in the study. Frequencies and percentages were the methods used to report descriptive statistics as the first part of the data analysis.

To answer the research question, multiple regression was conducted to investigate which combination of self-confidence; self-efficacy; approachability, concern, and fairness of the electronics professors; pre-college mathematics/science interest and grades; years of mathematics/science in high school; parents' education; professors' use of teamwork; pre-college encouragement; pre-college consideration to apply for a career-oriented university; household income; genders of students; and program levels predict satisfaction with the electronics programs at University A's Chicago area campuses better than any predictor alone. The researcher used a Pearson correlation matrix of the 12 predictor variables to check for multicollinearity[19,20]. The correlation table showed the Pearson correlation coefficients, and significance levels.

IV. Results

Descriptive Statistics

Frequencies and percentages were the methods used to report descriptive statistics for demographic data and all the predictor variables that predict satisfaction with the electronics programs at University A's Chicago area campuses.

Demographic data of participants' gender, program level, and age was collected through questions 33-35 of the survey. Table 4 shows frequencies and percentages of gender and program level of the participants.

Table 4
Frequencies and Percentages of Gender and Program Level (N = 576)

	Male		Female		Total	
Program Level	*N*	%	*N*	%	*N*	%
Beginning (B)	168	84.8	30	15.2	198	100.0
Middle (M)	122	80.3	30	19.7	152	100.0
End (E)	183	82.1	40	17.9	223	100.0
Total	473	82.5	100	17.5	573	100.0

Table 5 shows frequencies and percentages of each gender, program level, and age group of the participants. There were 475 male and 101 females in the sample. Of the 576 participants, 82.5% were males, and 17.5% were females. Of those who reported their program level, 34.6% were at the beginning, 26.5% were at the middle, and 38.9% were at the end program levels.

The majority (85%) of participants were between the ages of 18 and 30, with approximately half (40.4%) in the first group (18-21 years), nearly one-third (29.7%) in the second group (21-25 years), and about one-sixth (14.9%) in the third group (26-30 years). Close to 15% of participants were between the ages of 31 and 40 (9.1%), or 41 and older (5.8%).

Self-confidence measures the student's self-perceived abilities in mathematics, physics, electronics and computer technology. On the summated scale, of the 576 students, 79% indicated that they had some degree of self-confidence in mathematics, physics, electronics, and computer technology, while 6.9% indicated they did not. The mean rating of 5.53 was about half way between "mildly agree" (5) and "agree" (6).

Table 5
Demographic Characteristics of Participants (N = 576)

Characteristic	N	%
Gender		
Male	475	82.5
Female	101	17.5
Program Level		
Beginning	198	34.6
Middle	152	26.5
End	223	38.9
Missing	3	
Age Group		
18-21	230	40.4
21-25	169	29.7
26-30	85	14.9
31-40	52	9.1
41 and up	33	5.8
Missing	7	

Self-efficacy measures the student's perception of his/her abilities to solve difficult problems, deal efficiently with unexpected events, accomplish goals, and remain calm when facing difficulties. On the summated scale, of the 576 students, 85.2% indicated some self-efficacy in mathematics, physics, electronics, and computer technology, while 1.2% indicated they did not. The mean rating of 5.68 was closer to "agree" (6) than "mildly agree" (5). The two highest mean ratings were "solve hard problems" ($M = 6.10$) and "solve most problems" ($M = 6.21$). The two lowest mean ratings were "calm facing difficulties" ($M = 5.39$) and "get what I want" ($M = 5.33$).

Professors' use of teamwork measures the level of teamwork or group/project work professors encourage where students support and assist each other. Of the 575 students, 74.4% indicated professors' use of teamwork, while 14.8% indicated they did not. The mean rating of 5.36 was closer to "mildly agree" (5) than "agree" (6).

Approachability, concern, and fairness of electronics professors measures the approachability of professors to the students, their levels of concern for student success, and their ability to promote equality in electronics classes. On the summated scale, of the 576 students, 75% agreed that the electronics professors were approachable, concerned, and fair, while 11.3% indicated they were not. The mean rating of 5.39 was closer to "mildly agree" (5) than "agree" (6). The mean rating on "professors are encouraging" ($M = 5.17$) is lower than the mean ratings on "professors promote equality" ($M = 5.50$) and "professors are approachable" ($M = 5.49$).

Pre-college mathematics/science interest and grades measure the student's pre-college interest and participation in mathematics/science projects, societies or interest groups, and pre-college mathematics/science average grades. The mean rating on "mathematics/science projects" (M = 3.92) is lower than the mean ratings on "mathematics/science interest" (M = 5.33).

Pre-college encouragement measures the influence role models such as family members, friends, and pre-college teachers had on the student's majoring in electronics and computer technology. Of the 575 students, 51.5% agreed that they had pre-college encouragement, while 32.5% indicated they did not. The mean rating of 4.29 was closer to "neither agree nor disagree" (4) than "mildly agree" (5).

Pre-college consideration to apply for electronics measures the level of pre-college consideration to apply for electronics or computer engineering technology programs at a career-oriented university. Of the 575 students, 59.8% agreed that they had considered applying for electronics, while 26.3% indicated they did not. The mean rating of 4.69 was close to "mildly agree" (5).

Satisfaction with electronics programs measures the student's satisfaction with electronics professors, electronics programs, and the career opportunities. On the summated scale, of the 575 students, 63.8% demonstrated some satisfaction with electronics programs, while 20.0% said they did not. The mean rating of 4.95 was close to "mildly agree" (5).

Of the 552 students, about one-third (33.2%) reported that their household income was "$50,000 or above", while 66.8% indicated "$49,000 or less." The mean rating of 2.05 was about "$30,000-49,000" (2).

Years of mathematics and science in high school measures the number of years of mathematics and science the student took in high school. Of the 572 students, over one-fourth (28.4%) of students indicated "4 years or more" of mathematics and science in high school, while 71.5% indicated "less than 4 years." On the summated years of mathematics/science in high school scale, the mean rating of 3.20 was closer to 3 than 4 years.

Parents' education measures the highest educational levels student's parents' achieved. Of the 568 participants, 35.5% reported that their parents' highest educational level was "some college" and more, while 64.4% reported less than "some college." On the summated parents' education scale, the mean rating of 2.42 was between "H.S. degree" (2) and "some college" (3).

Quantitative Inferential Analysis

Multiple regression was conducted to investigate the best predictors of satisfaction with the electronics programs. Table 6 shows the means, standard deviations, and correlation of satisfaction with electronics programs and predictor variables. Table 7 demonstrates intercorrelations of the 12 predictor variables. Only two medium to high correlations of .41 and .49 in table 7 indicated the presence of some but not much multicollinearity.

Table 6

Means, Standard Deviations, and Correlation of Satisfaction with Electronics Programs and Predictor Variables (N = 540)

Variable	*M*	*SD*	Satisfaction with Electronics Programs
Predictor Variable			
Self-Confidence	5.55	.94	.50***
Self-Efficacy	5.70	.68	.24***
Approachability, concern, and fairness of the professors	5.40	1.23	.64***
Pre-college mathematics/science interest and grades	4.08	1.22	.11**
Years of mathematics/science in high school	3.21	.76	.03
Parents' education	2.42	.96	-.02
Professors' use of teamwork	5.34	1.68	.21***
Pre-college encouragement	4.30	2.02	.15***
Pre-college consideration to apply for a career-oriented university	4.69	1.84	.13***
Household income	2.07	1.06	-.07*
Genders of students	.17	.37	-.00
Program levels	2.05	.86	-.20***

*$p < .05$; **$p < .01$; *** $p < .001$.

Table 7

Intercorrelations of the Twelve Predictor Variables of Satisfaction with Electronics Programs (N = 540)

Variable	2	3	4	5	6	7	8	9	10	11	12
Predictor Variable											
1. S-C	.41	.49	.17	-.00	-.04	.13	.07	.08	-.03	-.12	.03
2. S-E	-	.27	.24	.01	-.01	.13	.04	.03	-.00	.08	.05
3. A-C-F		-	.12	-.01	.04	.29	.13	.07	-.02	-.05	-.01
4. P-MS-I			-	.33	.04	.16	.22	.25	-.04	.01	.09
5. Y-MS				-	.20	.08	.10	.11	.11	-.01	-.01
6. P-Ed					-	.07	.06	-.03	.26	-.05	.03
7. P-U-T						-	.19	.15	-.04	-.01	.03
8. P-En							-	.35	.02	-.13	.00
9. P-C-A								-	-.05	-.09	-.01
10. H-I									-	-.11	-.02
11. G-S										-	.02
12. P-L											-

Note. S-C = Self-confidence, S-E = Self-efficacy, A-C-F = Approachability, concern, and fairness of the professors, P-MS-I = Pre-college mathematics/science interest and grades, Y-MS = Years of mathematics/science in high school, P-Ed = Parents' education, P-U-T = Professors' use of teamwork, P-En = Pre-college encouragement, P-C-A = Pre-college consideration to apply for a career-oriented university, H-I = Household income, G-S = Genders of students, and P-L = Program levels.

Table 6 displayed that there was a significant association between approachability, concern, and fairness of the electronics professors and satisfaction with the electronics programs, $r = .64$, $p < .001$. According to Cohen, this is close to a very large effect size[21]. The direction of the association was positive, which implied that students who had high ratings in approachability, concern, and fairness of the electronics professors were likely to have high satisfaction with the electronics programs, or vice versa. The r-squared (r^2) displayed that 41% of the variance in satisfaction with the electronics programs could be predicted from approachability, concern, and fairness of the electronics professors.

In addition, table 6 indicated that there was a significant association between self-confidence and satisfaction with the electronics programs, $r = .50$, $p < .001$. According to Cohen, this is a large effect size[21]. The direction of the association was positive, which implied that students who had high self-confidence scores were likely to have high satisfaction with the electronics programs, or vice versa. The r-squared (r^2) indicated that 25% of the variance in satisfaction with the electronics programs could be predicted from self-confidence.

Table 6 also showed that there were significant associations between self-efficacy, pre-college mathematics/science interest and grades, professors' use of teamwork, pre-college encouragement, pre-college consideration to apply for a career-oriented university, household income, program levels; and satisfaction with the electronics programs. The correlation coefficients (r) ranged from -.20 to .24, significances (p) ranged from .001 to .05, and the effect sizes varied from "close to small" to "close to medium." The r-squared's (r^2) indicated that .5% to 5.8% of the variance in satisfaction with the electronics programs could be predicted from self-efficacy, pre-college mathematics/science interest and grades, professors' use of teamwork, pre-college encouragement, pre-college consideration to apply for a career-oriented university, household income, or program levels.

Simultaneous multiple regression analysis for satisfaction with electronics programs from the predictor variables is presented in table 8. Table 8 also displays that the betas (β) for self-confidence; approachability, concern, and fairness of the electronics professors; genders of students, and program levels combine to be significant predictors of satisfaction with electronics programs. The other 8 variables do not add to the predictor. When all 12 variables are combined to predict satisfaction with electronics programs, F (12, 527) = 46.78, $p < .001$. The adjusted $R^2 = .51$ in table 8 indicated that 51% of the variance in satisfaction with electronics programs could be explained by the model. According to Cohen, this is a very large effect size[21]. The findings suggest that the student who reported high ratings on approachability, concern, and fairness of the electronics professors, who was self-confident, female, and at the beginning program level was satisfied the most with electronics programs. More details can be found in the discussion section.

Table 8

Simultaneous Multiple Regression Analysis Summary for the Variables Predicting Satisfaction with Electronics Programs (N = 540)

Variable	*B*	*SEB*	β
Self-Confidence	.40	.06	.26***
Self-Efficacy	-.02	.07	-.01
Approachability, concern, and fairness of the professors	.59	.04	.51***
Pre-college mathematics/science interest and grades	-.02	.04	-.02
Years of mathematics/science in high school	.06	.06	.03
Parents' education	-.03	.05	-.02
Professors' use of teamwork	.02	.03	.02
Pre-college encouragement	.04	.02	.05
Pre-college consideration to apply for a career-oriented university	.05	.03	.06
Household income	-.06	.04	-.05
Genders of students	.26	.12	.07*
Program levels	-.34	.05	-.20***
Constant	-.15	.46	

Note. $R^2 = .51$; $F\ (12, 527) = 46.78$, $p < .001$
*$p < .05$; **$p < .01$; *** $p < .001$.

V. Discussion

Summary of Research Question Findings

The research results showed that there was a significant positive association between approachability, concern, and fairness of the electronics professors and satisfaction with the electronics programs, and the effect size was large. Students who reported high ratings in approachability, concern, and fairness of the electronics professors were likely to have high satisfaction with the electronics programs.

The study also indicated that there was a significant positive association between self-confidence and satisfaction with the electronics programs, and the effect size was large. Students who reported high self-confidence scores were likely to have high satisfaction with the electronics programs.

In addition, findings revealed that there were significant associations between self-efficacy, pre-college mathematics/science interest and grades, professors' use of teamwork, pre-college encouragement, pre-college consideration to apply for a career-oriented university, household income and program levels and satisfaction with the electronics programs; and the effect sizes varied from "close to small" to " close to medium."

Simultaneous multiple regression analysis indicated that approachability, concern, and fairness of the electronics professors; self-confidence; gender of students, and program levels combined to be the only significant predictors of satisfaction with electronics programs. Thus, the student who reported high ratings on approachability, concern, and fairness of the electronics professors, who was self-confident, female, and at the beginning program level was satisfied the most with electronics programs.

Discussion of Research Question Findings

The current findings were generally consistent with the previous research that self-confidence, positive influence of professors/advisors, and influence of SMET courses are positively correlated with persistence in SMET programs[3]. The results generally agreed with previous research that professors' nonresponsiveness and their poor teaching styles are negatively correlated with the satisfaction of women and minority students in SMET programs[8].

Approachability, concern, and fairness of the electronics professors; and self-confidence combined to be the two most powerful predictor of satisfaction with electronics programs. Prediction of satisfaction became stronger with the addition of gender and program level as predictors. Self-efficacy and approachability, concern, and fairness of the electronics professors overlapped with self-confidence. Although self-efficacy was a good predictor by itself, it was not effective enough when combined with self-confidence in order to predict satisfaction with electronics programs. Gender was not strong enough predictor by itself, but with the combination of other variables it became a modestly good predictor.

Recommendations for Future Research

All the results in this study used students' self-perceptions of their self-confidence, self-efficacy, and other variables. Self-perceptions can be different than the real data. The researcher recommends a comparison of students' self-perceptions with their actual grades in college for a future study.

In order to explore further the difference between the males and females in terms of the dependent variables that affect enrollment and retention in electronics, the researcher recommends replication of the current study for technology and business programs at University A. Race can be included as the third independent variable or it can be considered in other studies. The research should include the comparison of females in electronics versus technology/business programs.

Further research is needed to compare the males and females in all SMET fields at other colleges and universities in terms of the dependent variables that affect enrollment and retention. The current study can be repeated for different SMET fields and universities. Race can be included as a third independent variable or it can be considered in other studies. The research should include the comparison of females in different SMET programs at different universities.

Finally, the researcher recommends further research on the retention of females versus males in the electronics programs at University A.

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APPENDIX A

Student Questionnaire

Thank you for taking the time to fill out this questionnaire. Your honest response is extremely important; all responses will be kept confidential and anonymous.

1 = Strongly disagree (SD)
2 = Disagree (D)
3 = Mildly disagree (MD)
4 = Neither agree nor disagree (N)
5 = Mildly agree (MA)
6 = Agree (A)
7 = Strongly agree (SA)

For questions 1-35, please circle the number that best describes your experiences.

	SD	D	MD	N	MA	A	SA
1. I am confident in my abilities in math and physics courses.	1	2	3	4	5	6	7
2. My self-confidence in math and physics has increased since I entered University A.	1	2	3	4	5	6	7
3. I am confident in my abilities in electronics or computer engineering technology courses.	1	2	3	4	5	6	7
4. My self-confidence in electronics has increased since I entered University A.	1	2	3	4	5	6	7
5. I am confident that electronics or computer engineering technology is the right major for me.	1	2	3	4	5	6	7
6. I can always manage to solve difficult problems if I try hard enough.	1	2	3	4	5	6	7
7. If someone opposes me, I can find the means and ways to get what I want.	1	2	3	4	5	6	7
8. It is easy for me to stick to my aims and accomplish my goals.	1	2	3	4	5	6	7
9. I am confident that I could deal efficiently with unexpected events.	1	2	3	4	5	6	7
10. Thanks to my resourcefulness, I know how to handle unforeseen situations.	1	2	3	4	5	6	7
11. I learn more from the electronics and/or computer engineering technology professors when they use teamwork or group/project work where students support and assist each other.	1	2	3	4	5	6	7
12. The electronics or computer engineering technology professors are very approachable.	1	2	3	4	5	6	7
13. The electronics or computer engineering technology professors are very encouraging and are concerned with my personal success.	1	2	3	4	5	6	7
14. The electronics and/or computer engineering technology professors promote learning environments where equality is achieved among males and females.	1	2	3	4	5	6	7
15. I was interested in mathematics and sciences during pre-college (before University A).	1	2	3	4	5	6	7

	SD	D	MD	N	MA	A	SA
16. During pre-college I participated in mathematics and science-oriented projects/programs, societies or interest groups.	1	2	3	4	5	6	7
	SD	D	MD	N	MA	A	SA
17. Role models such as family members, friends, and pre-college teachers had some influence on my majoring in electronics or computer engineering technology.	1	2	3	4	5	6	7
18. During pre-college I always considered applying for electronics or computer engineering technology programs at a career-oriented university.	1	2	3	4	5	6	7
19. I can solve most problems if I invest the necessary effort.	1	2	3	4	5	6	7
20. I can remain calm when facing difficulties because I can rely on my coping abilities.	1	2	3	4	5	6	7
21. When I am confronted with a problem, I can usually find several solutions.	1	2	3	4	5	6	7
22. If I am in trouble, I can usually think of a solution.	1	2	3	4	5	6	7
23. I can usually handle whatever comes my way.	1	2	3	4	5	6	7
24. I am satisfied with the overall electronics or computer engineering technology programs at University A.	1	2	3	4	5	6	7
25. In general I am satisfied with the electronics or computer engineering technology professors at University A.	1	2	3	4	5	6	7
26. I am satisfied with the electronics or computer engineering technology career opportunities that University A offers.	1	2	3	4	5	6	7

27. My average grade for pre-college (before University A) mathematics and science was:
□□ F □□ D □□ C □□ B □□ A

28. I took _____ year(s) of math in high school.
□□ 1 □ 2 □□ 3 □ □ 4

29. I took _____ year(s) of science in high school.
□□ 1 □ 2 □□ 3 □ □ 4

30. My total household income is:
□□ $29,000 or less □□ $30,000-49,000 □ $50,000-79,000 □□ $80,000 or above

31. My father's highest educational level is:
□□ Less than H.S. degree □□ H.S. degree □□ Some College □□ B.S./B.A. or more

32. My mother's highest educational level is:
□□ Less than H.S. degree □□ H.S. degree □□ Some College □□ B.S./B.A. or more

33. Gender
□□ Male □□ Female

34. I am a _____ trimester student at University A.
□□ 1st □ 2nd □ 3rd □ 4th □ 5th □ 6th □ 7th □ 8th □ 9th

35. My age category is:
□□ Under 18 □□ 18-21 □□ 21-25 □□ 26-30 □□ 31-40 □□ 41 and up