Journal of College Access

Volume 3
Issue 2 *Special Edition: School Counseling and Postsecondary Success*

Article 5

7-3-2017

English Language Learners' (ELLs) Science, Technology, Engineering, Math (STEM) Course-Taking, Achievement and Attainment in College

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ABSTRACT

Using data from the Educational Longitudinal Study: 2002, the present study examined the effects of demographic variables, high school math course-taking and high school GPA on ELL students' STEM course-taking, achievement and attainment in college. Regression analysis showed female ELL students were more likely to take more STEM courses and get higher GPAs in STEM, but less likely than males to earn a STEM college credential. Race was found to be a significant predictor of STEM GPA and attainment. The number of years taking trigonometry and pre-calculus in high school and high school GPA were predictive of the number of STEM courses taken in college. High school GPA also strongly predicted ELL college students' STEM GPA. Implications and future research are discussed.

Keywords: ELL students, STEM course taking, STEM achievement, STEM attainment in college.

Introduction

A continuing challenge for educators in the United States is to produce America's future scientists and engineers. Although the world is becoming more dependent on advances in science, technology, engineering, and mathematics (STEM) to support its technology-based economy, fewer American students are entering STEM fields of study in higher education compared with other developed countries (National Academy of Science, 2010). This results in a diminishing pool of STEM graduates with the expertise necessary to promote economic and technological advancement. According to the President's Council of Advisors on Science and Technology (2012), the United States would need to increase its yearly production of undergraduate STEM degrees by 34 percent over current rates to match the demand forecast for STEM professionals. Thus, it is urgent to recruit more students to STEM majors in order to secure STEM human capital for the U.S. labor pool.

Although educational leaders, policy makers, and researchers have long emphasized the importance of STEM for the country's continued prosperity, increasing participation in STEM has remained a challenge for both the education and scientific communities (National Academies of Science, 2010; President's Council of Advisors on Science and Technology, 2012). A historic imbalance in STEM participation persists where proportionately fewer female and minority students enroll in STEM courses and seek employment in STEM professions (National Academy of Sciences, 2010). In terms of racial disparities among those who held a STEM Bachelor's degree in 2010, Whites and Asians together took 88.4 percent of STEM jobs while

Blacks and Hispanics only took 9.9 percent (Landivar, 2013). Another underrepresented group in STEM are English Language Learners, a sizable subgroup (5.3 million) among the country's elementary and secondary (PK-12) students and a subgroup whose growth is outpacing that of the overall PK-12 student population (The National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs, 2010). In 2011, the U.S. Department of Education Office of English Language Acquisition (OELA) published a report, entitled *High-Quality STEM Education for English Learners*. This report strongly suggests that the perceptions about English Learners need to change. Rather than perceiving them as academic underachievers, they must be seen as an untapped resource for developing a multi-lingual STEM workforce that has the potential to keep the U.S. relevant in an increasingly competitive global economy. Thus, ELL students can be an important target group to increase the STEM workforce in the U.S.

However, the current literature on ELL students' STEM major enrollment and attainment is quite scarce. Specifically, the predictors of these outcomes among the ELL population are virtually nonexistent. The purpose of this study is to investigate what background variables and high school academic preparation variables could predict English Language Learners' course-taking, achievement and attainment in STEM majors in postsecondary institutions.

Review of the Literature

Despite the importance of preparing more ELL students for considering a college major in a STEM field, the academic performance gap between English-proficient and ELL students continues to be substantial. For example, National Assessment of Educational Progress' (NAEP) 2015 math results revealed that only 11 percent of ELL fourth graders scored "at or above proficient" in math as compared to 89 percent of their non-ELL counterparts. Next, the achievement gap continues with 6 percent of eighth grade ELL students scoring "at or above proficient" in math as compared to 33 percent of non-ELL counterparts (NAEP, 2015). The most up-to-date NAEP results in science are equally disparate. For instance, in 2011, 34 percent of eighth grade non-ELL students scored "at or above proficient" in science while only 3 percent ELL students achieved the same level (NAEP, 2011).

Coupled with these statistics, the literature on ELL students' math and science education that does exist has mostly focused on curriculum development and teachers' pedagogical practices in K-12 schools (Martinez et al., 2011). Previous studies using qualitative (e.g., Radinsky, Oliva, & Alamar, 2010), quantitative (e.g., Kim & Chang, 2010), and mixed methods designs (e.g., Martiniello, 2009) all have sampling limitations. The main limitation includes most studies taking place in only one or two schools (Martinez et al., 2011).

Predictors of STEM Participation and Attainment

A large body of literature (e.g., Crisp, Nora, & Taggart, 2009; Engberg & Wolniak, 2013; Ackerman, Kanfer, & Calderwood, 2013; Kokkelenberg & Sinha, 2010; Rohr, 2012) focused on the predictors of STEM education participation and attainment. These studies addressed a range of factors that were found to be predictive of STEM major choice: demographics, academic preparation, attitudes, high school disposition, college choice considerations, postsecondary experiences and academic environment. Most studies addressed one of these areas and targeted either pre-college or postsecondary education and experiences. Among the studies that focused on pre-college academic preparation and experience, it was found that GPA was the strongest predictor of STEM retention (Rohr, 2012) and gender, race/ ethnicity, math/science course-taking and high school GPA were the strongest predictors for choosing STEM majors (Crisp et al., 2009; Engberg & Wolniak, 2013). Some studies were conducted with only students from one institution. For example, Rask (2010) examined the attrition in STEM fields at a liberal arts college and found pre-college preferences/intended major is a strong and consistent predictor for both men and women. Kokkelenberg and Sinha (2010)'s study was done with Bringhamton University undergraduate students and found that Advanced Placement (AP) coursework, math ability, gender, ethnicity, high school GPA and college experience are all significant indicators of success in STEM majors. Besides, a study by Ackerman et al. (2013) also found AP course credits earned and the number of AP courses taken were the most important predictors of STEM major persistence. However, none of these existing studies have used ELL students as their targeting population. Therefore, there is an obvious gap in the literature on ELL students' STEM education.

Given this developing body of research and the sampling limitations, the proposed study aims to make a significant contribution to the literature by using a nationally representative sample of ELL students to explore the following research questions:

1. What background variables (SES, race and gender), and high school academic preparation variables (math course taking and high school GPA) are predictive of ELL students taking STEM courses in college?

2. What background variables (SES, race and gender), and high school academic preparation variables (math course taking and high school GPA) are predictive of ELL students' STEM achievement in college?

3. What background variables (SES, race and gender), and high school academic preparation variables (math course taking and high school GPA) are predictive of ELL students' STEM attainment in college?

Methods

Data Source

The Educational Longitudinal Study: 2002 (ELS: 2002) public-use data was used in the present study. The ELS: 2002, a longitudinal study conducted by the National Center for Education Statistics (NCES), started in 2002 with a nationally representative sample of over 15,000 tenth graders from 750 randomly selected schools. Students were followed from the time they were in 10th grade in 2002, until they were in 12th grade in 2004 (first follow-up). A second follow-up occurred in 2006 (Ingels et al., 2007), and a third follow-up was conducted in 2012, eight years after the students' scheduled high school graduation (Ingles et al., 2014). Survey questionnaires are available on the NCES website.

The ELS: 2002 research instruments encompass three basic elements: basic background information, process information (e.g., information about the student in the home, school, and community environment, as they move through secondary school and beyond), and outcome information, (e.g., information about achievement and attainment) (Ingels et al., 2007). Data were collected from students, parents, teachers, and school administrators. The ELS: 2002 is an appropriate data source for the present study because it presents the most current longitudinal data at a national level and provides information on the educational trajectories and career pathways of ELL students.

Participants

The participants had to meet the following criteria in order to be included in the present study: 1) participated in all four waves of ELS: 2002, as well as the postsecondary transcripts data; 2) English was not their native language; 3) ever enrolled in English as Second Language (ESL) program. This procedure yielded a total of 258 ELL students to be included in this study.

Among the final sample of 258 ELL students, there were 114 male and 144 female. In terms of racial ethnicity, there were 39 White, 55 Asian, 26 Black, and 132 Hispanic students. A very small sample of American Indians students (n=1) and mixed race/ethnicity students (n=1) were excluded from the analysis due to problems with model convergence. We looked at two different variables for students' socio-economic status (SES): a continuous variable (M=-0.50, SD=0.75) was used in the data analysis and a categorical variable that could tell exactly in which quartile students' SES was located compared to non-ELL students. A majority of ELL students (n=131, 50.8%) were in the lowest SES quartile; 23.6% were in the second quartile (n=61) and a similar number of students were in the third quartile (n=38, 14.7%) and the highest (n=28, 10.9%) quartile.

Predictor Variables

Two sets of predictor variables were included in the study: (1) demographic background variables (gender, SES and ethnicity/race), and (2) high school math course-taking variables and a high school academic achievement variable.

Demographic variables.
Three demographic variables were included in the analysis since they were consistently found in the literature to have an impact on students choosing STEM majors in college (Moakler & Kim, 2014): gender, SES, and race/ethnicity. Gender was a categorical variable with 1 coded as male and 2 as female. Race/ethnicity was also a categorical variable and was recoded as 1=White, 2=Asian, 3=Black and 4=Hispanic. Both categorical and continuous SES variables were available in the data but this study only included the continuous SES variable in the analysis.

High school math course-taking variables.
Students were asked a question "From the beginning of ninth grade to the end of this school year, how many years of math coursework will you have completed in each of the following subjects?" Students could only count courses that meet at least three times a week for at least one-half year, including summer school and advanced placement classes. For this study, four advanced level high school math courses as have been commonly used in previous research were included (Trusty & Niles, 2003): Algebra II, Trigonometry, Pre-Calculus, and Calculus. There were four choices students could choose from: 1=None or less than ½ year, 2= ½ year, 3=1 year, and 4=More than 1 year. This variable was treated as continuous.

High school academic achievement variable.
There was only one variable in the ELS: 2002 data that measured the academic achievement in high school: GPA for all the courses taken in the 9th through 12th grades. It was a categorical variable in the ELS data. In this study, we treated it as continuous since it was measured on a seven-point scale, with each point representing a bracket of GPA.

Outcome variables.
Outcome variables in this study include (1) STEM course-taking in college; (2) STEM achievement in college; and (3) STEM attainment in college. All three outcome variables came from the postsecondary transcripts data that was collected in 2013.

STEM Course-Taking in College.
In this study, we used a variable that asked students "number of known STEM courses taken in college (using NSF definition)." It is a continuous variable in the data.

STEM achievement in college.
In this study, a variable that asked students' "GPA for all known STEM courses (using NSF definition)"was used. It is a continuous variable in the data.

STEM attainment in college.
In the present study, we used a variable from the postsecondary transcripts that asked if students ever earned a postsecondary (PS) credential in a STEM field as of June 2013 using NSF grant definition, to measure students' STEM attainment. Students had three options to choose: no PS credential in a

STEM field, undergraduate credential in a STEM field, and undergraduate and graduate credential or graduate only credential in a STEM field. In this study, this variable was recoded into having only two categories in the answer: 0=no PS credential in STEM, and 1=PS credential in STEM.

Weight

Analytic weights were used in the ELS: 2002 to account for the complex survey design and to produce estimates for the target population with appropriate standard errors. Based on the guidelines provided by Ingles et al. (2014), the panel weight variable (F3BYPNLPSWT) was used in this study because the present study included the analysis of the base year data in combination with the third follow-up data, as well as the postsecondary transcripts data. However, since F3BYPNLPSWT is raw weight, design effect adjusted weight was created in the present study to account for the complex multistage sampling design in the ELS: 2002. The design effect adjusted weight was calculated by dividing the normalized weight (product of the raw weight and the ratio of the sample size to the population size) by the design effect (DEFF) of a similar variable to the outcome variable in the study (Hahs-Vaughn, 2005). We used the design effect of the variable "ever attended a postsecondary school" (DEFF=2.12), which was the closest to our outcome variables related with STEM attainment and achievement, in the computation of the design effect adjusted weight (Ingel et al., 2014).

Sample Size

A power analysis was conducted using an online sample size calculation software by Soper (2015). With an anticipated effect size of 0.15, desired statistical power level of 0.8, and a probability level of 0.05, the minimum required sample size was 108 for the present study with three predictors in the first stage hierarchical regression analysis and five predictors in the second stage, above and beyond the first stage. With listwise deletion to treat missing data in this study, the final analytic sample size was 202 in the multiple regression analysis and 212 in the logistic regression analysis, which was considered sufficient to yield meaningful results.

Data Analysis Procedure

All data in this research were analyzed using SPSS v23.0 (IBM Corp, 2013). Prior to conducting any data analysis, we created a master dataset including only selected variables this study used from the ELS: 2002 and also the variables created by the researchers. First, we ran descriptive statistics, including getting the frequencies for all the categorical variables and means and standard deviations for all the continuous variables. Then, we conducted two multiple regressions with STEM course-taking and STEM achievement in college as the criterion variables and a binary logistic regression with STEM credential attainment as the criterion variable.

In the regression analysis, we entered predictors in two different stages. At stage one, we entered gender, SES, and race/ ethnicity. At stage two, we entered high school math course-taking variables and high school academic achievement variable (high school GPA). This way of conducting regression analysis allows for gauging indirect effects in the models (Trusty & Niles, 2003). That is, it is likely that demographic variables have effects on the high school math course-taking patterns and high school academic achievement, which in turn have effects on students' STEM course-taking and attainment in college.

For the missing data, we used the default missing data treatment method in SPSS v23- listwise deletion (Grace-Martin, n.d.), because of the larger sample size available in the dataset. Therefore, all the results in this study were based on the original data.

Results

Descriptive analyses were first conducted with all the predictor variables and dependent variables. Results for each research question begin on page 57. Table 1 (page 57) presents descriptive statistics results. Table 2 (page 58) includes all the regression results.

Research Question 1:

What background variables (SES, race and gender), and high school academic preparation variables (math course taking variables and high school GPA) are predictive of ELL students taking STEM courses in college?

As shown in Table 2, for Model 1 with the STEM course-taking as the criterion variable, gender stayed statistically significant in both stages, meaning gender had largely a direct impact on the number of STEM courses taken in college by ELLs. Since female was coded the value 2 and male was coded the value 1 and the regression coefficient was positive, female ELL students were more likely to take a larger number of STEM courses than male ELLs. The other two demographic variables (race and SES) were not significant in the model. Therefore, gender itself contributed significantly to the criterion variable, $F(3, 201) = 3.86$, $p < .05$. After controlling for students' gender, SES, and race, the following three predictors were found statistically significant: years of taking trigonometry, years of taking pre-calculus, and high school GPA in the 9th-12th grades. The regression coefficients for these three predictors were all positive, indicating students with more years of taking trigonometry and pre-calculus and a higher GPA in high school were more likely to take more STEM courses in college.

Regarding effect sizes, the R^2 in the first stage regression model (with only the demographic variables) was .06 and the R^2 in the second stage regression model (with the high school math course-taking and high school GPA variables) was .29. Therefore, gender alone explained 6% of the variances in the number of STEM courses taken in college by ELL students. Years of taking trigonometry and pre-calculus and high school GPA together explained an extra 23% of the variances in the number of STEM course taken in college.

Research Question 2:
What background variables (SES, race and gender), and high school academic preparation variables (math course taking variables and high school GPA) are predictive of ELL students' STEM achievement (STEM GPA) in college?

In both stages of Model 2 (with the STEM GPA in college as the criterion variable), three demographic variables stayed statistically significant, indicating their effects on STEM GPA in college were largely direct. Gender had a positive regression coefficient, while SES and race/ethnicity's regression coefficients were negative. This meant that female ELLs were more likely than male students to have a higher STEM GPA. ELL students who were from a higher SES were more likely to earn a lower STEM GPA. With one-way ANOVA, we found that Hispanics (M=2.25) earned a statistically lower GPA than White (M=2.67) and Asian (M=2.61). After controlling for demographic variables, only high school GPA was statistically significantly predictive of STEM GPA in college.

Regarding effect sizes, the R^2 in the first stage of the model was .11 and the in the second stage of the model was .26. Therefore, all three demographic variables (gender, race and SES) together explained 11% of the variances in the criterion variable and high school GPA alone explained an extra 15% of the variances in STEM GPA above and beyond the variances explained by demographic variables.

Research Question 3:
What background variables (SES, race and gender), and high school academic preparation variables (math course taking variables and high school GPA) are predictive of ELL students' STEM attainment in college?

See Table 3 (page 59) for results of the logistic regression model examining the effects of demographic variables, high school math course-taking variables and high school GPA variable on STEM attainment in college. A test of the full model against a constant only model was statistically significant, indicating that the predictors as a set reliably distinguished between ELLs who earned STEM credentials and those who did not (chi-square=25.334, p<.01 with df=10).

The effects of race/ethnicity and gender variables were statistically significant in both stages. Black ELL students were significantly more likely than ELLs from other ethnic groups to earn a STEM credential in college; while Hispanic ELL students were significantly less likely than students from other ethnic groups to earn a STEM credential in college. Interestingly, in this model, the regression coefficient for gender became negative, which indicated that in college male ELLs were more likely to earn a STEM credential than females. However, none of the math course-taking variables or high school GPA were found significant in this model.

Pseudo effect size, Nagelkerke R^2 in stage 1 was .11 and in stage 2 was .17. Therefore, demographic variables alone explained 11% of the variability in the criterion variable; adding math course-taking and high school GPA only explained an additional 6% of the variances in the criterion variable above and beyond demographic variables. Of the 212 ELL students in the logistic regression analysis, 62.26% had attained a STEM credential and 30.19% had not. The full logistic regression equation correctly classified 93.2% of the students who did not earn STEM credentials and 29.1% of the students who earned STEM credentials. The overall percentage of correctly classified participants was 72.4%.

"In this study, the impact of gender was significant in all three models meaning gender was influential to the amount of STEM courses taken, STEM GPA and final STEM degree attainment for ELL students."

Discussion

The present study used a nationally representative sample to examine the effects of demographic variables, high school math course-taking and high school GPA on ELL students' STEM course-taking, achievement and attainment in college. In this study, the impact of gender was significant in all three models meaning gender was influential to the amount of STEM courses taken, STEM GPA and final STEM degree attainment for ELL students. However, previous research indicated gender was not a significant predictor for choosing an engineering major (Tyson, 2011) or for STEM persistence among high-achieving students (Anderson & Ward, 2013). A possible explanation for this contradictory finding could be that the population for this study is ELL students, while previous research focused on either general student population or high-achievers. When interpreting this result, it is important to consider the differences between ELL students and general student population. In a recent longitudinal study (Hao & Woo, 2012), among those best students and later the most successful young adults were born in foreign countries and came to the U.S. before reaching their teens. Hao and Woo (2012) also suggested a greater sense of community and more inspiration among immigrant community could explain the more positive trajectory for foreign-born children. Other resilience factors that previous research found to play an important role in ELL students' academic achievement included self-regulation, religious faith, and parental support (Kumi-Yeboah, 2016).

Another interesting finding from this study regarding gender was that in the first and second model, we found female ELL students were more likely to take more STEM courses and get higher GPAs in STEM. However, in the third model, females were found to be less likely than males to earn a STEM credential in college, which was consistent with previous research (Kokkelenberg & Sinha, 2010; Whalen & Shelley, 2010). Then the question is, what caused female students who took more STEM courses and also did well in STEM courses to leave or drop from STEM majors in the end? Several factors might play a role in this phenomenon: college experience and college environment (Espinosa, 2011) and female students' math/science self-concept (Ackerman, Kanfer & Beier, 2013). Additionally, it is important to consider the cultural expectations and gender roles of ELL female students. In Asian and Hispanic cultures, women are expected to devote themselves to the satisfaction of everyone else's needs and complete denial of their own and women are not expected to wish for more than being a housewife (Comas-Diaz, 1988). These cultural expectations might have shaped female students' views, perceptions and decision-making process. However, there is no previous literature that has directly identified the impact of cultural expectations of female students on their STEM achievement or attainment in college. Although race was not a significant predictor of STEM course taking, the ANOVA result indicated that Black ELL students were taking significantly more STEM courses than Hispanic ELL students. Race was found to be a significant predictor of STEM GPA and attainment. Hispanic ELL students were more likely to earn a lower GPA than White and Asian ELLs. In terms of STEM credential attainment, Black ELL students were the first and Hispanic ELLs were the last in the ranking. The research findings in the literature about STEM persistence among different race/ethnicity groups were quite inconsistent because previous studies used different populations and focused on different criterion variables. However, in this study, it seems to be consistent that Hispanic ELLs tended to earn lower grades in STEM courses and were also least likely to get a STEM degree from college. This finding could be explained by the commonly identified predictive power of STEM GPA, especially in the last registered term (Whalen & Shelley, 2010).

In this study, ELL students from higher socio-economic status were more likely to earn lower GPA in STEM, which implies that low SES students do not necessarily achieve at a lower level than other students. Furthermore, in the present study, SES was not a significant predictor of the number of STEM courses taken by ELL students and STEM credential attainment. This result is consistent with previous research conducted by Anderson and Ward (2013) that found SES was not a significant predictor of STEM persistence for high-ability students regardless of their ethnicity.

In terms of high school courses and high school GPA, we found the number of years taking trigonometry and pre-calculus in high school was predictive of the number of STEM courses taken by ELL students in college. Previous research also found math course-taking in high school was a strong predictor for students choosing STEM majors (Engberg & Wolniak, 2013). In this study, we found high school GPA strongly predicted ELL college students' STEM course-taking and STEM GPA. This finding is consistent with previous research that supported GPA was the strongest predictor of choosing STEM majors and STEM retention and success (Kokkelenberg & Sinha, 2010; Rohr, 2012).

Implications

Considering the current state of STEM education, in which a comparatively limited number of students enroll in STEM majors and earn STEM degrees from college, it is critically important to understand how to improve overall enrollment in the STEM disciplines and how to enhance students' STEM achievement and attainment. This study provides several important implications for education policy. First, school counselors could attend to ELL students' course-taking patterns in high school and ensure that ELL students are well represented in advanced level math courses, such as, trigonometry and pre-calculus. Educators should work to remove as many barriers as possible for ELL students to enroll in advanced math courses in high school. School counselors are well-positioned to address the diverse social, emotional and developmental needs of this student population and provide career counseling and guidance (American School Counselor Association, 2012). Second, educators need to address the gender gap in terms of STEM attainment. Support and resources should be provided to female students, especially during college, to make sure that they have an encouraging college environment and experience, which is an important factor for them to stay in STEM disciplines (Espinosa, 2011). Also, when working with ELL students from lower SES families, educators could encourage students by sharing with them the result from this study about lower SES students who were more likely to earn higher STEM GPA in college. Third, ELL students should not be viewed as one group in educational settings because various research, including the present study, has found in-group differences, such as, gender, ethnicity and SES (National Education Association, 2008). Therefore, it is important for educators and policy makers to create and implement tailored programs for different sub-groups within ELL students in order to ensure their unique needs and issues in their personal and academic development are addressed. Fourth, counselor educators in school counseling programs could consider incorporating topics related with ELL students' postsecondary experience into their courses and provide graduate students more opportunities to be exposed to ELL student population to enhance both their knowledge and skills. Lastly, graduate students in school counseling programs are encouraged to learn through readings and experiential activities about ELL students and try to be better prepared to provide support and assistance in

Furthermore, this study used the ELL student population as a whole without testing group differences based on ethnicities. However, based on the results from this study, gender and race/ethnicity are critical factors in ELL students' STEM achievement and attainment in college. It is important for future researchers to conduct group comparison studies based on gender and ethnicities. Also, the present study did not include psychological factors (such as, personality traits, interest, self-efficacy, etc.) and environmental factors (such as, exposure to STEM, school and home environment, etc.). Lastly, the ESL: 2002 data are from more than ten years ago and information included in the data might be dated. Readers need to keep this in mind when interpreting the results. Some examples of research questions that future researchers could focus on include (a) what academic variables in high school are predictive of ELL students' STEM achievement and attainment in college? (b) what college experience variables are predictive of ELL students' STEM achievement and attainment in college? (c) what psychological factors are predictive of ELL students' STEM achievement and attainment in college? (d) what are the differences among ELL subgroups based on gender and ethnicity in terms of STEM achievement and attainment and the predictive factors in high school and college? When future researchers are trying to study these questions, it is recommended to use more updated national data if available.

Table 1.
Descriptive Statistics by Linguistic Background (Unweighted).

	Min	Max	M	SD
SES	-1.97	1.72	-.49	.74
Years of Algebra II	1	4	2.09	.95
Years of Trigonometry	1	4	1.29	.65
Years of Pre-Calculus	1	3	1.31	.68
Years of Calculus	1	4	1.15	.52
High School GPA	0	6	3.61	1.47
STEM GPA	0	4	2.42	.93
Number of STEM Courses	0	72	14.01	12.96
Valid N	183			
	No STEM Credential in College		STEM Credential in College	
STEM Attainment	173 (67.3%)		77 (30%)	
Valid N	251			

Table 2.
Summary of Hierarchical Multiple Regression Analysis for Variables Predicting STEM Course-Taking and STEM Achievement in College among ELLs

	Model 1 (Number of STEM Courses Taken in College as Criterion Variable)						
Predictor Variable	*b*	*SE b*	*β*	*t*	*R*	R^2	ΔR^2
Stage1					.24	.06	.06*
Sex	5.93	1.89	.22	3.14**			
SES	-.44	1.33	-.03	-.33			
Race	-1.44	.86	-.13	-1.67			
Stage2					.54	.29	.23***
Sex	3.99	1.71	.15	2.33*			
SES	-1.00	1.18	-.06	-.85			
Race	-.02	.79	-.00	-.03			
Algebra II	1.38	.93	.10	1.49			
Trigonometry	5.19	1.37	.24	3.79***			
Pre-Calculus	3.18	1.43	.16	2.22*			
Calculus	3.40	1.76	.13	1.94			
HS GPA	1.59	.65	.18	2.43*			
	Model 2 (STEM GPA in College as Criterion Variable)						
Stage1					*.34*	*.11*	*.11****
Sex	.49	.13	.26	3.64***			
SES	-.20	.10	-.17	-2.08*			
Race	-.20	.06	-.25	-3.05**			
Stage2					.51	.26	.14***
Sex	.37	.13	.20	2.86**			
SES	-.20	.09	-.16	-2.16*			
Race	-.14	.06	-.18	-2.31*			
AlgebraII	-.12	.07	-.13	-1.74			
Trigonometry	-.11	.10	-.08	-1.14			
Pre-Calculus	.70	.10	.06	.70			
Calculus	.14	.12	.08	1.11			
HS GPA	.22	.05	.37	4.60***			

Table 3.
Summary of Hierarchical Regression Analysis for Variables Predicting STEM Attainment in College among ELLs

	Step1		Step2	
	B	Odds Ratio	*B*	Odds Ratio
Sex	-1.07**	.34	-1.08**	.34
SES	.08	1.08	-.003	.99
Race[1]	-1.55*	0.21	-.82*	.44
Race(1)	.01	1.01	-.22	3.83
Race(2)	.12	1.12	-.30	.74
Race(3)	1.42**	4.13	1.34*	3.83
AlgebraII			-.02	.98
Trigonometry			.48	1.62
Pre-Calculus			.31	1.34
Calculus			.57	1.77
HS GPA			-.08	.93
Constant			-1.73	.18

[1] Hispanic group was the comparison category; the B coefficient was calculated as the negative sum of the other categories; and the odds ratio was calculated from the B coefficient.

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