Predicting High School Students' Interest in Majoring in a STEM Field: Insight into High School Students' Postsecondary Plans

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ABSTRACT

This study examined how various individual, family, and school level contextual factors impact the likelihood of planning to major in one of the science, technology, engineering, or mathematics (STEM) fields for high school students. A binary logistic regression model was developed to determine the extent to which each of the covariates helped to predict such academic interest. High school course taking in science and performance on science and math standardized tests were significantly and positively related to an increased interest in STEM. College aspirations were significant, and those with loftier educational goals were generally more likely to plan to major in a STEM field. Other individual-level factors also played a significant role, as male high school students were significantly more likely to have an early interest in STEM relative to their female peers, as were African American high school students compared with White students. Low-income students were significantly more likely to be interested in STEM majors than higher income students, respectively. In terms of school-level context, while teacher academic qualifications had a negative but significant relationship with an early interest in STEM, teacher experience had a small but significant positive relationship.

Introduction

Strengthening the scientific workforce has been and continues to be of importance for every state in America. Preparing an educated workforce to enter Science, Technology, Engineering, and Mathematics (STEM) occupations is important for scientific innovations and technological advancements, as well as economic development and competitiveness. As argued by Carenvale, Smith, and Melton (2011), "without a robust STEM workforce, we [the United States] will become less competitive in a global economy" (p. 6). In addition to expanding the nation's workforce capacity in STEM, broadening participation and success in STEM is also important for women and racial and ethnic minorities, given their historical underrepresentation and the occupational opportunities associated with these fields.

An individual's ability to participate in the STEM workforce, regardless of their background, begins with adequate training and knowledge building garnered from K-12 and postsecondary schooling. The development of skills and knowledge necessary to succeed in math and science in school, in college, and in the workforce is largely a linear process, with little room for diversions or alternative pathways. Students who plan to pursue a STEM major in college often begin preparing in high school by taking certain courses, such as Advanced Placement (AP) courses in math and science, if available. Given the sequencing necessary to culminate in a STEM postsecondary degree or STEM occupation, it is necessary to examine high school students' attitudes, thoughts, and actions towards math and science fields. Included in this line of research is the need to link high school students' planned college majors to various contextual factors. This study investigates high school students' planned major in college, which will give insight into which groups of students are most likely to study and potentially work in the STEM fields.

This study attempts to gain a better understanding of the early determinants of planning to major in a STEM field, which could provide critical information to a number of groups, including high schools and postsecondary institutions which are seeking to increase students' interest in the STEM fields. The research question guiding the study is: *How do individual-level factors, as well as family and school-level contextual factors help determine the extent to which high school students plan to major in a STEM field?* High schools could use this information to provide guidance to students to help foster early awareness of, and interest in, STEM majors and careers. The results could also be useful for colleges and universities in their recruiting efforts, as they not only attempt to increase the overall number of students who are interested in and who major in STEM, but particularly students from traditionally underrepresented backgrounds.

Theoretical Framework

This study was framed borrowing from Perna and Thomas' (2006) conceptual model of student success. The current study used three of the four contextual levels identified by Perna and Thomas (2006): internal/individual, family, and school as they to relate the first key transition point and as an indicator of students' success or college aspirations. Internal context was assessed with individual-level factors falling within one of three categories: 1) demographics; 2) academic qualifications; or 3) motivations. Demographics included both gender and race/ethnicity. Academic qualifications were assessed with high school GPA, standardized test performance, and course-taking patterns. Motivation indicators included highest expected degree and college preference. Family context was assessed with family size, family income, expectation to work during college, and expectation to received financial aid. Finally, high school context was assessed with the following school-level variables: teacher academic capital, teacher experience, attendance and mobility rates, and aggregate performance on standardized tests. For more detail regarding the operational definitions, please see Appendix A.

In terms of theoretical perspective, as suggested by Perna and Thomas (2006), the framework uses multiple perspectives and borrows from classic economic theory (rational-behavior), as well as a more recent sociological one (negative selection). From the rational-behavior perspective (Becker, 1964; Mincer, 1974), decisions to enroll in college and the selection of majors are largely made on the basis of perceived economic returns. In other words, an individual will enroll in college and select a major based on expected future earnings weighed against opportunity costs, relative to both not enrolling and alternative majors in which they could enroll.

The sociological perspective purports that such enrollment decisions and the selection of majors are not only governed by considering economic returns, but also cultural norms and expectations (Coleman, 1988). Brand and Xie (2010) contended that the extent to which rational-choice and sociological perspectives are applied to enrollment decisions depends on one's economic background. In their theory of negative selection, Brand and Xie (2010) argued that students who were among the least likely to enroll in college (economically disadvantaged students) stood to gain the most from matriculating to college and therefore were more apt to weigh the economic benefits of such decisions. On the other hand, economically advantaged students were more apt to make such decisions based on cultural norms and expectations. Assuming intended major is related to one's decision to enroll, majoring in a STEM field for low income students is arguably more intentionally linked to economic justifications than it is for high income students (Beattie, 2002). Brand and Xie (2010) argued that for economically advantaged students, the decision to attend college and arguably major in STEM was better rooted in cultural norms and expectations. Applying the theory to college aspirations is viable based on George-Jackson and Lichtenberger (2012). They found that economically disadvantaged students generally had more confidence in their STEM majors than their high-income counterparts.

Literature Review

A review of factors that impact high school students' interest in STEM fields led to the identification of three main themes: students' interests and motivations, academic qualification, and educational contexts. These three themes largely correspond with two of the factors included in Perna and Thomas' model—namely internal and school-level contexts. While other factors also relate to high school students' interests in and ability to enroll in STEM majors in college, these three themes highlighted here appear to be very influential on students' participation and success in STEM fields as they plan to transition from high school to college.

Students' Interest and Motivations

High school and college present an opportunity for students to explore academic interests and plan their pathway for further education or a specific occupation. Students' own interests and motivations in STEM fields and jobs shape their pursuit of math and science courses, their performance in these courses, and their entry into STEM majors in college. Although White and Asian males are traditionally well-represented in the STEM fields, White students have the lowest levels of interest in science, in comparison to other racial and ethnic groups, while Asian students have the highest levels of interest (Elliott, Strenta, Adair, Matier, & Scott, 1996). Despite Latino and African American students exhibiting similar and sometimes higher levels of interest in STEM fields than White students, fewer enter into and persist in STEM majors in college (Hurtado, Pryor, Tran, Blake, DeAngelo, & Aragon, 2010). By gender, White women have lower rates of interest in science than White men (Seymour & Hewitt, 1997), but with "commitment, as attested by their graduate or professional school goals, will achieve in science and engineering at relatively high rates" (Leslie, McClure & Oaxaca, 1998, p. 268).

Students' interest in STEM majors and careers tend to change over time, particularly in the adolescent years (Frome, Alfeld, Eccles, & Barber, 2006; Sadler, Sonnert, Hazari & Tai, 2011). Students' interests in STEM fields may be shaped, in part, by their orientation to future occupations and potential career earnings. Potential earnings influence Asian women's choice of STEM major more than White women, particularly for Chinese, Filipino, and Southeast Asian women (Song & Glick, 2004). White women historically view familial obligations and occupational pursuits as exclusive endeavors, which results in their favoring jobs that offer more flexibility than those in the STEM sector so that temporary leaves from the workforce will allow them time to raise a family (Hanson, 2004). In addition to social expectations and life factors, women tend to select majors based on different reasons and values as compared to men, with women placing less importance on potential career earnings and more importance on jobs that allow them to nurture others (Turner & Bowen, 1999; Wiswall & Zafar, 2012). Students of color also tend to choose majors that will enable them to give back to others and serve their community rather than choosing majors based on personal financial gain (Bowen, Kurzweil, & Tobin, 2005). Unfortunately, high school students—particularly women and students of color—do not view STEM fields as a means by which to achieve the altruistic goals of serving and caring for others, thereby contributing to their decisions not to choose a college major in STEM (Bonous-Hammarth, 2000).

Academic Qualification and Preparation

Academic qualification and preparation in STEM relates to the math and science courses students take, as well as the grades they receive in those courses. Qualification and preparation can also be measured by students' performance on standardized tests such as state-based proficiency exams, the SAT (formerly known as the Scholastic Assessment Test), and the ACT (American Collegiate Testing). Preparation levels impact not only students' entry into a STEM major, but also their persistence in that major to degree completion (Elliott et al., 1996). Exhibiting a high-level of academic preparation is a common characteristic of students who enter STEM majors in college (Levine & Wycokoff, 1991). White and African American students who took more math and science courses in high school were more likely to enroll in STEM majors in college (Maple & Stage, 1991). In addition, taking more high school science courses increases students' declaration of Engineering and Physical Science majors in college (Ethington, 2001, p. 359). Increasing academic preparation by encouraging students to take "the most academically intensive math courses—trigonometry, pre-calculus, calculus" (Trusty, 2002, p. 471) improves the likelihood of women choosing a STEM major in college. Incorporating major-field program information into the college choice process has a positive impact on declaring a STEM major (Engberg & Wolniak, 2013).

It has been argued that increasing access to high school career and technical education (CTE) courses and programs could ignite interest and understanding of STEM fields by making math and science content more relevant (Association for Career and Technical Education, 2009). Further, the completion of high school career and technical education programs has been established as a factor related to improved performance in math (Stone, Alfeld, & Pearson, 2008), as well as persistence and degree completion in STEM-related postsecondary programs McCharen & High; 2010). Stone, Alfeld, and Pearson (2008) established that through the careful integration of STEM-related content in CTE programs, CTE students improved their math skills without losing the important technical skills. College students who completed select high school CTE programs (pre-engineering) had higher enrollment and persistence rates in STEM-related postsecondary degrees programs (McCharen & High, 2010).

Educational Contexts

High schools shape students' educational opportunities through their course offerings, tracking policies, and—most important for STEM fields—access to science and math courses. The context of the high school and the math/science curriculum offered to students can vary greatly, with schools serving low-socioeconomic families providing fewer STEM educational opportunities to students (Oakes, 1990). In addition, schools that serve a high percentage of racial and ethnic minority students do not offer as many AP courses as other high schools due to disparities in school funding and access to resources, including quality teachers (May & Chubin, 2003). This results in fewer AP math and science courses taken by African Americans, Latinos, and Native Americans, which contributes to the underrepresentation of students of color in the STEM fields in postsecondary education. Although women are underrepresented in certain STEM fields, their rate of completion of AP math and science courses in high school does not vary significantly from those of men (Clewell & Campbell, 2002). Despite their rate of completion in AP math and science courses and despite often earning higher grades in math and science courses than men (Leslie & Oaxaca, 1998), academically qualified women are still less likely to enter into a STEM major or occupation in comparison to men. In other words, "in spite of their strong preparation, girls still end up leaving science" (Blickenstaff, 2005, p. 374).

The context of the university a student attends can impact their future orientation to a STEM career. The impact of institutional settings on STEM entrance or persistence have included such contexts as Ivy League universities (Elliott et al., 1996), liberal arts colleges (Rask, 2010), and community colleges (Jackson & Laanan, 2011; Starobin & Laanan, 2010; Starobin, Laanan & Burger, 2010). For instance, entering a highly selective institution can negatively impact students' aspirations to pursue a STEM career; yet pursuing a degree that leads to a specific career in STEM positively impacts students' interest in STEM (Herrera & Hurtado, 2011). The variety of institutional settings that have been studied in relation to STEM entrance and persistence is indicative of the many possible pathways STEM degrees can be pursued.

In summarizing the literature in the context of the theoretical perspective, the theory of negative selection (Brand & Xie, 2010) helps to explain the relationship between several of the factors identified in the literature and students' interests in majoring in STEM. Affirming the theory, traditionally underserved students with a higher likelihood of being economically disadvantaged, such as Latinos and African Americans, have maintained a relatively high level of interest in STEM, while traditionally served and well-represented students, namely White males, have maintained a relatively low interest in STEM (Elliott et al., 1996). However, interest does not always correspond with STEM participation, as there is evidence that Whites, particularly White males, are well-represented in STEM fields (Elliott et al., 1996) and Latinos and African Americans are underrepresented in STEM fields (Hurtado et al., 2010).

In some instances, the relationship identified in the literature diverges from the theory of negative selection. The divergence could be explained by the theory's original application to a slightly different outcome than the current study (i.e., college enrollment as opposed to interest in STEM), or by Brand and Xie's (2010) strict focus on economic background as opposed to underserved or underrepresented status in STEM. Also disaffirming the theory of negative selection is literature suggesting that psycho-social forces may play more of a role than economics in a traditionally underserved student's decision to major in a STEM field (Bowen et al., 2005; Bonous-Hammarth, 2005). Furthermore, high school context could impact whether one makes the decision to major in STEM, but more in the sense that limited access to STEM-related courses results in fewer students interested in STEM (May & Chubin, 2003; Oakes, 1990) rather than how social and economic forces played a role in students' interests.

Methods

Data Source

In the given state, all high school juniors are required to take the ACT as part of the state's achievement test battery. The resulting dataset was a census of the graduating high school class of 2003. The data were made available to the researchers under shared data agreements with the state's Board of Higher Education and ACT. Because the analysis involved the use of secondary data, an institutional review board exemption was sought and subsequently granted. Obtaining this information for all students in the Class of 2003 increased the generalizability of the findings, and reduced a number of issues related to selection bias that exist in many education studies, particularly studies focusing on students' college choice process. Immediately prior to the ACT test administration, students completed a survey called the ACT Student Interest Inventory. Students are asked to answer a series of questions related to their interest in various activities and subjects, which sheds light on the students' academic interests and plans for college.

The analysis presented focuses on students who maintained a planned college major during high school. Students who indicated that their planned college major was "undeclared" were removed from the dataset prior to analysis. Definitions of the variables used in the study are provided in Appendix A. Specific to the definition of STEM, the following majors are included: Agricultural Sciences, Biological Sciences, Computer and Information Sciences, Engineering, Food Sciences, Health Sciences, Mathematics, Physical Sciences, Psychology, and STEM Teacher Education. STEM fields, as defined by other empirical studies, as well as federal agencies such as the National Science Foundation and the National Institutes of Health, are largely inconsistent and often to do not include the health sciences or STEM teacher education programs, such as math and science education (George-Jackson, 2011). Here, both the health sciences and STEM teacher education are considered to be STEM majors, as both fields require knowledge and mastery of math and science content.

Analytical Methods of Sample

A sample (n=27,935) of the cases with complete information (N=59,618) on all of the variables analyzed in the study was randomly selected. The random sample equated to roughly 47% of the students with complete information, and was selected so that each sub-category included in the analysis had a cell-size of at least 100, in hope that cross tabulations would yield cell sizes of greater than 10, allowing for better reporting. Further, the sample size would assure a sufficient power to determine statistical significance at the $p<0.001$ level. A summary of the profile of the students included in the sample is offered in Appendix B (see Tables 5–7). Regarding students' demographic background, there were slightly more women (53%) than men

(47%) in the sample. The majority of students were white (74%) and from a low or mid-low family income (52%).

Analysis

Descriptive and predictive statistics were calculated on the random sample using SPSS. A two-level hierarchical generalized linear model with students nested within schools was initially tested. However, the null model indicated that there was insufficient variance between schools in the average likelihood of students to have an early STEM interest to justify the use of a nested model (Heck, Thomas, & Tabata, 2012). As a result, a single-level binary logistic regression model was used to predict likelihood of an early interest in a STEM field among a random sample of the Illinois High School Graduating Class of 2003. Binary logistic regression is a variation of generalized linear modeling and is used to predict a discrete outcome using categorical or continuous covariates or predictor variables. It has been described by Agresti (2007) as useful for a wide variety of applications, including social science research. As is the case with the current study, the outcome is generally dichotomous and logistic regression makes no assumption about the distribution of the independent variables. That is, the predictor variables do not have to be normally distributed, linearly related, or of equal variance within each group (Burns & Burns, 2008). There are two main uses of logistic regression. As described in Mertler and Vannatta (2002), the first is the prediction of group membership and the second is to provide knowledge of the relationships and strengths among the variables.

Results

Internal Context

As shown in Table 8, the results of the logistic regression model indicated that demographics played a significant role in determining one's likelihood of having an interest in majoring in STEM prior to high school graduation. In terms of gender, male high school students were significantly more likely to have an early interest in one of the STEM fields as compared to their female counterparts. In terms of race/ethnicity, African American students and Asian students were significantly more likely to maintain an early STEM interest relative to similar White students. However, based on the odds ratios, the difference between Asian and White students was much greater than the difference between African American and White high school students. There was no statistically significant difference between Latinos and White students.

Academic qualifications were examined next. Regarding standardized test scores, higher math and science scores were significantly and positively related to maintaining an early STEM interest, while higher reading and English scores were significantly and negatively related to the outcome. Years of high school science and English were both statistically significant predictors, but the direction of the relationship with the outcome was the opposite. More high school science courses equated to a greater likelihood of an early STEM interest, while more English decreased one's odds. High school students stating a need for help in developing their study skills had significantly lower odds of having an early interest in STEM as compared with similar students without such a need. Further, while the variables related to course taking in mathematics generally lacked statistical significance, stating the need for help in math was significantly and negatively related to having an early interest in STEM.

In reference to students' motivations, generally speaking, those with higher degree aspirations were more much likely to be interested in STEM. The model established that high school students who anticipated earning a graduate degree had significantly higher odds of having an early interest in STEM relative to those planning to earn a bachelor's degree, associate degree, or technical certificate. Preferred college type also played a significant role, as students who planned to matriculate to private colleges were significantly less likely to have a STEM interest relative to those who planned on enrolling at public four-year institutions. High school students planning on enrolling at a community college or another technical institution had significantly higher odds of maintaining a STEM interest than the reference group (public four-year college). Further, high school students who planned to enroll in a nursing school had the greatest odds of planning to major in a STEM field as compared with the reference group. Also, selecting one's college based on a program offered or a particular field of study was related to increased odds of having an early academic interest in STEM, relative to being interested in a given college for other reasons, such as location, tuition, or size.

Family Context

Regarding family context, students from high and mid-high income families had significantly lower odds of having an early interest in STEM relative to their low income counterparts. None of the other variables related to family context indicated statistical significance.

School Context

In terms of school context, college prep students were significantly more likely than CTE students to be interested in majoring in a STEM field; however, there was no difference between students in a general curriculum program and CTE students. Students from high schools with higher aggregate performance on standardized tests were less likely to have an interest in majoring in a STEM field, after controlling for the internal and family contexts. Class size was significantly and negatively related to one's likelihood of planning to major in a STEM field. That is, students from schools with smaller class sizes had higher odds of an early STEM interest as compared with those from schools with larger class sizes. Students from schools with higher attendance rates were significantly more likely to have an early interest in STEM. In terms of school-level measures related to teachers, students from schools where the teachers had higher aggregate academic qualifications were less likely to have an early interest in STEM, while students from schools where the teachers had more experience were slightly more likely to have an early interest in STEM.

Table 8

Likelihood of Maintaining an Early Interest in STEM

Variable	Coefficient	Standard Error	Odds Ratio
Gender: Male	0.264	0.028	1.302***
Race: African American to White	0.121	0.050	1.129*
Race: Latino to White	-0.058	0.049	0.944
Race: Asian to White	0.501	0.059	1.651***
ACT English	-0.034	0.004	0.966***
ACT Math	0.033	0.005	1.033***
ACT Reading	-0.018	0.004	0.982***
ACT Science	0.034	0.005	1.035***
HS GPA (Low to High)	-0.016	0.049	0.984
HS GPA (Mid-low to High)	-0.087	0.046	0.917
HS GPA (Mid-High to High)	-0.068	0.038	0.935
Completed Core Curriculum	-0.024	0.029	0.976
Semesters of English	-0.119	0.014	0.887***
Semesters of Math	0.016	0.012	1.016
Semesters of Science	0.181	0.010	1.198***
Completed AP Science	0.254	0.031	1.289***
Need Study Help	-0.060	0.028	0.942*
Need Math Help	-0.063	0.030	0.939*
Highest Expected Degree (Less than BA to BA+)	-0.452	0.046	0.636***
Highest Expected Degree (BA to BA+)	-0.584	0.030	0.557***
College Pref. (Private 4yr to Public 4yr)	-0.280	0.038	0.755***
College Pref. (CC to Public 4yr)	0.239	0.044	1.269***
College Pref. (Private 2yr to Public 4yr)	0.073	0.144	1.076
College Pref. (Voc./Tech to Public 4yr)	0.376	0.073	1.456***
College Pref. Nursing to Public 4yr)	3.023	0.184	20.554***
College Pref: Field of Study	0.175	0.026	1.192***
Family Income (High to Low)	-0.237	0.044	0.789***
Family Income (Mid-High to Low)	-0.092	0.040	0.912*
Family Income (Mid-Low to Low)	-0.066	0.037	0.936
Expected to Received Aid	-0.018	0.035	0.982
Expected to Work During College	0.039	0.031	1.040
Number of Siblings	-0.019	0.010	0.981
HS Program: CTE to General	-0.076	0.039	0.926
HS Program: College Prep to CTE	0.112	0.032	1.119***
Mean ACT Composite for Class	-0.041	0.011	0.959***
Mean Class Size	-0.012	0.004	0.988**
Attendance Rate	0.025	0.007	1.025***
Mobility Rate	0.004	0.002	1.004
Teacher Academic Capital	-0.112	0.029	0.894***
Average Years of Teaching Experience	0.013	0.006	1.014*
Constant	-2.323	0.597	0.098***

*$p<0.05$; **$p<0.01$; ***$p<.001$

Discussion/Conclusions

The results confirm some of the common perceptions of underrepresented students in STEM fields, while disrupting others. For example, male high school students were much more likely to plan on majoring in a STEM field than their female peers. A similar pattern has been consistently found over time, including a study conducted by Seymour and Hewitt (1997), who found that White women were less likely than White men to be interested in science majors. However, as Creamer (2012) noted, the change of women's long-term interest in pursuing a career in the STEM fields such as engineering can be more positive than the change in men's interest during college. On the other hand, some of the groups that are traditionally underrepresented— African Americans and low-income students— were actually more likely to have an early STEM interest relative to well-represented students. With regards to African American students, this finding is similar to that of Riegel-Crumb and King (2011) who found that male and female African Americans were actually more likely to declare a major in the physical sciences and engineering than White males after differences in pre-college academic preparation was taken into consideration. Early interest in STEM may be key to declaring a STEM major for African American students at the critical transition point between high school and college; however, long-term success is also dependent on the opportunities students have had for adequate academic preparation prior to entering a STEM major.

The finding related to family income and to a lesser extent race/ethnicity provides empirical support for the theory of negative selection (Brand & Xie, 2010), as African American students and students from low-income families were more likely to maintain an early interest in STEM, relative to their White and mid-high and high income counterparts. This suggests that for some students the decision to major in a STEM field may be more associated with economics than social forces. As argued by George-Jackson and Lichtenberger (2012), high school students from low-income families may have a clearer sense of their college major; and conversely, students from higher income brackets may view college as a chance to explore different majors and potential occupations. In other words, high school students from low-income families may be more likely to perceive STEM majors as leading directly to the workforce, potentially reducing the opportunity costs associated with attending college.

In terms of aspirations, those with loftier academic goals were more likely to have an early interest in STEM. Further, college choice was important and somewhat reflective of program offerings at specific types of institutions. Relative to students anticipating matriculating to a public four-year institution, those planning to attend a four-year private school were less likely to have an early STEM interest. However, those planning to enroll at a community college, technical school, or particularly a school of nursing, were significantly more likely to have an early interest in STEM. This suggests that students with an early interest in STEM consider multiple education pathways, and community colleges and technical schools are perceived as a viable option for those with an interest in a STEM-related field.

The motivation for selecting one's college was also vital as those choosing a given college because of a particular program or field of study were more likely to maintain an early STEM interest. This finding reflects that of Herrera and Hurtado (2011) who found that enrolling in a degree program for a specific type of career helps underrepresented students retain interest in pursuing a job in STEM. Of course, as expected, students' interest in STEM careers and intentions to enter such fields often change over time, particularly in the adolescent years (Frome et al., 2006; Sadler, Sonnert, Hazari & Tai, 2011).

High school course taking, particularly in science, was significantly and positively related to an increased likelihood of having an early interest in STEM. Participating in AP science and taking more science courses both significantly increased one's odds of having an early interest in STEM. As Tyson, Lee, Borman, and Hanson (2007) noted, advanced course taken in math and science at the high school level provides a viable avenue to attaining a degree in STEM. Given the findings here, advanced math and science courses taken in high school may lead to a mediating factor of early interest in STEM, which may in turn impact STEM degree completion. This relationship should be explored further in future studies.

Policy Implications

The results of the study can be used to inform programs aimed at improving recruitment into the STEM fields. For instance, programs that offer students and their families information about STEM majors and careers may lead to an early awareness of opportunities in STEM fields. The timing of these interventions is crucial given that many students in their junior year of high school already have a notion of what their college major will be, as well as what job they may have in the future. Recruitment programs that inform students and their parents of the many STEM major options, as well as pathways to STEM-related degrees and occupations, may help strengthen students' selection of STEM majors, as well as their confidence in their choice.

In terms of current policy, these results could be useful as the new STEM learning exchange program is implemented in select states (Branham, 2012) and nationally (Malyn-Smith & Colon-Baco, 2012). Learning exchanges are designed to support the local development of P-20 STEM programs that connect a student's career and educational interests. The STEM programs heavily emphasize educational and school to workforce transitions, as well as facilitate the development of public-private partnerships between schools and a variety of stakeholders. The learning exchanges are designed to coordinate functions across the P-20 STEM talent pipeline and are designed to improve access and success for underrepresented populations in STEM fields, including women, racial/ethnic minorities, low-income, and disabled students (Tyszko, 2011).

This study offers an initial understanding of high school students' initial interest in majoring in STEM and does not necessarily equate or lead to long-term success in these fields. Further, planning to major in a STEM field does not guarantee that a particular student even enrolls in college upon high school graduation. In addition, the congruency between planned major and students' academic qualifications and preparation levels needs to be explored further to provide additional insight into the process by which students enter and persist in STEM majors. In other words, are educational expectations aligned with academic qualifications and at which point in the talent pipeline are underrepresented students with sufficient academic qualifications exiting STEM fields?

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APPENDIX A

Definitions

The following tables provide a description of the dependent and independent variables that were used in this study. Table 1 summarizes how the majors were categorized to create the dependent variable.

Table 1
Categorization of Majors

STEM Majors	Non-STEM Majors
Agricultural Sciences	Architecture
Biological Sciences	Business
Computer and Information Sciences	Community and Personal Services
Engineering	Family and Consumer Sciences
Food Sciences	Liberal Arts
Health Sciences	Non-STEM Teacher Education

Mathematics	Trade and Industrial Relations
Physical Sciences	Visual Arts
Psychology	
STEM Teacher Education	

Tables 2–4, below, summarize the independent variables used in the study.

Table 2

Description of Individual-Level Variables

Variable	Source	Type	Description
Early STEM Interest	ACT	Dichotomous	Coded 1 for those interested STEM major; 0 otherwise (see Table 1).
Gender	ACT	Dichotomous	Includes: a: female; and b) male; reference Male.
Race	ACT	Nominal	Includes: a) African American; b) Latino; c) Asian American; and d) White; reference White
ACT English	ACT	Scale	Scaled indicator of performance on the English component of the ACT
ACT Math	ACT	Scale	Scaled indicator of performance on the Math component of the ACT
ACT Reading	ACT	Scale	Scaled indicator of performance on the Reading component of the ACT
ACT Science	ACT	Scale	Scaled indicator of performance on the Science component of the ACT
High School GPA	ACT	Ordinal	Includes: a) less than or equal to 2.4; b) 2.5-2.9; c) 3.0-3.4; and d) greater than or equal to 3.5; reference less than or equal to 2.4
Completed Core Curriculum	ACT	Dichotomous	Includes: a) did not complete core; and b) completed core curriculum
Semesters of English	ACT	Scale	Scaled indicator of the number of semesters (half years) of high school English
Semesters of Math	ACT	Scale	Scaled indicator of the number of semesters (half years) of high school Math
Semesters of Science	ACT	Scale	Scaled indicator of the number of semesters (half years) of high school Science
Completed AP Science	ACT	Dichotomous	Includes: a) did not participate in AP Science; and b) participated in AP Science
Need Study Help	ACT	Dichotomous	Whether a student state a need for help in developing their study skills
Need Math Help	ACT	Dichotomous	Whether a student stated a need for help with

			mathematics
Highest Expected Degree	ACT	Nominal	Includes: a) less than a bachelor's; b) bachelor's; and c) higher than a bachelor's; reference higher than a bachelor's degree
College Type Preference	ACT	Nominal	Includes: a) private four-year; b) community college; c) private two-year d) vocational/technical school; e) nursing school; f) public four-year; reference public four-year
Field of Study as Main	ACT	Dichotomous	Includes: a) field of study as the main reason for enrollment; b) mentioned some other factor as the major reason for college preference.

Table 3

Description of Family-Level Variables

Variable	Source	Type	Description
Family Income	ACT	Ordinal	Includes: a) High, >$80K; b) Mid-High, $50K to $80K; c) Mid-Low, $30K-$50K; d) Low, <$30K; reference Low
Expected to Received Aid	ACT	Dichotomous	Includes: a) did not expect to receive financial aid; and b) expected to receive financial aid for college
Expected to Work During College	ACT	Dichotomous	Includes: a) did not expect to work while enrolled; and b) expected to work while enrolled
Number of Siblings	ACT	Scale	Scaled indicator of the student's number of siblings

Table 4

Description of School-Level Variables

Variable	Source	Type	Description
High School Program Type	ACT	Nominal	Includes: a) College prep; b) General curriculum; and C) Career and Technical Education (CTE); reference CTE
Mean ACT Composite for Class	IIHSRC*	Scale	High school average ACT composite score.
Mean Class Size	IIHSRC*	Scale	Mean high school class size
Attendance Rate	IIHSRC*	Scale	High school attendance rate
Mobility Rate	IIHSRC*	Scale	High school mobility rate
Teacher Academic Capital	IERC**	Scale	Aggregate measure of teacher academic capital that includes: a) teachers' mean ACT composite scores; b) teachers' mean ACT

			English score; c) percent of teachers failing basic skills test on their first attempt; d) percent of teachers with emergency/provisional certification; and e) teachers' mean undergraduate college competitive ranking.
Average Years of Teaching Experience	IIHSRC*	Scale	Mean years of teaching experience for all teachers in the given high school

*Derived from the Illinois Interactive High School Report Card; **Developed by the Illinois Education Research Council (IERC) using multiple data sources

APPENDIX B

Results Tables

Table 5

Descriptive Statistics: Means and Proportions for Individual-Level Variables

Variable	STEM (n=11,767)	Non-STEM (n=16,168)	Total (n=27,935)
Gender: Male	0.50	0.45	0.47
Race/Ethnicity: African American	0.12	0.10	0.11
Race/Ethnicity: Latino	0.09	0.09	0.09
Race/Ethnicity: Asian American	0.07	0.04	0.05
Race/Ethnicity: White	0.72	0.77	0.75
ACT English	20.47	20.07	20.23
ACT Math	21.52	30.36	20.85
ACT Reading	21.12	20.77	20.92
ACT Science	21.27	20.4	20.77
High School GPA: <2.4	0.25	0.29	0.27
High School GPA: 2.5-3.0	0.17	0.19	0.18
High School GPA: 3.0-3.5	0.26	0.26	0.26
High School GPA: >3.5	0.33	0.25	0.28
Completed Core Curriculum	0.52	0.46	0.49
Semesters of English	7.56	7.56	7.56
Semesters of Math	6.99	6.75	6.85
Semesters of Science	6.55	6.00	6.23
AP Science	0.39	0.28	0.33
Need Study Help	0.44	0.48	0.46
Need Math Help	0.38	0.45	0.42
Highest Expect Degree: Less than BA	0.14	0.17	0.16
Highest Expect Degree: BA	0.27	0.39	0.34
Highest Expect Degree: More than BA	0.59	0.44	0.50
College Preference: Public 4yr	0.67	0.66	0.66
College Preference: Private 4yr	0.14	0.16	0.15

College Preference: Community College	0.12	0.14	0.13
College Preference: Private 2yr	0.01	0.01	0.01
College Preference: Vocational/Technical	0.04	0.04	0.04
College Preference: Nursing	0.03	<.01	0.01
College Choice: Field of Study	0.53	0.47	0.50

Table 6

Descriptive Statistics: Means and Proportions for Family-Level Variables

Variable	STEM (n=11,767)	Non-STEM (n=16,168)	Total (n=27,935)
Family Income: High	0.23	0.24	0.23
Family Income: Mid-High	0.25	0.24	0.25
Family Income: Mid-Low	0.28	0.28	0.28
Family Income: Low	0.25	0.24	0.24
Expected to Receive Aid	0.82	0.81	0.81
Expect to Work during College	0.76	0.75	0.75
Number of Siblings	1.48	1.50	1.49

Table 7

Descriptive Statistics: Means and Proportions for School-Level Variables

Variable	STEM (n=11,767)	Non-STEM (n=16,168)	Total (n=27,935)
HS Program: CTE	0.16	0.20	0.18
HS Program: College Prep	0.56	0.48	0.51
HS Program: General	0.32	0.28	0.31
Mean ACT Composite for Class	20.10	20.27	20.20
Mean Class Size	18.90	19.25	19.11
Attendance Rate	0.93	0.93	0.93
Mobility Rate	0.12	0.11	0.12
Teacher Academic Capital	0.68	0.73	0.71
Average Years of Teaching Experience	14.43	14.37	14.4