"Planting the Seeds of STEM: Identifying Factors to Lead Students to Studying in Science, Technology, Engineering, and Mathematics (STEM) "

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Abstract

Using the High School Longitudinal Study of 2009 (HSLS:09) dataset to analyze a nationally representative sample of 23,503 students across the United States. We looked to identify factors that influence students pursuing STEM degrees and occupations, and which influence students pursuing further education beyond high school.

Parental education and occupation, locale, and household income were identified as critical factors. This confirms that students are positively influenced into fields of STEM by their parents STEM fields, and educational attainment. This emphasizes targeted and personalized support, especially for specific students or areas with resource-limited backgrounds to implement and improve academic and career counseling, mentor programs, and outreach programs by recruiters to foster a more inclusive and diverse field of work and study.

What is STEM?

- Biological / Natural Science
- Biomedical Sciences
- Computer Science
- Engineering
- Health Professions
- Mathematics
- Statistics
- Physical Sciences

Demographic Findings

Urban areas
- Multitude of opportunities for STEM and educational opportunities, such as museums, presenters, or conventions

Rural areas
- Often have resource constraints in their school districts.
- Fewer STEM role models and opportunities.

Parent Education & Pursuit of Higher Education
- HS diploma → 23% of students
- Bachelors → 54% pursuing STEM
- Graduate degree → 72% of students

Household Dynamics:
- Large household sizes → higher aspiration for further education.
- All incomes preferred public colleges or universities
- Income < $15,000 → 92% preferring to attend public institutions
- Income > $175,000 → one in three prefer private institutions

Model 1- Predicting STEM Degree of College Students

97 factors analyzed, 34 statistically significant factors (p < 0.05)
Reference factor: Parent in a non-STEM field

Key Significant Factors
- Student enjoys STEM
- Expected career at 30 (STEM vs. Non-STEM)
- Parent's STEM occupation
- Parent's highest major in STEM
- Race (Native Hawaiian/Pacific Islander) → Highest positive coefficient (+0.85048)
- Parents encouraging military career → Largest negative coefficient (-1.06346)

Course Selection & STEM Pathway
- Advanced courses, such as AP/IB Calculus or Science positively contribute to log-odds of entrance into STEM degree programs

Income & STEM Pursuit
- Lower- and Middle-class households contributed to positive log-odds for STEM degrees, while upper class households strayed from STEM degrees

Model 3: Predicting STEM Occupation at Age 30

80 factors analyzed, 36 statistically significant (p < 0.05)
Reference factor: Parent's occupation = Non-STEM

Key Significant Factors (p ≈ 0)
- Duration of STEM course enrollment
- STEM identity

Higher odds of STEM Occupation
- STEM coursework → Significantly increases odds of STEM occupation
  - Students may report fewer years than state/school requirements
    - Example: Ohio requires 7 STEM units (4 math, 3 science)
- Public high school students

Lower odds of STEM occupation:
- Parent expects child to enter military or workforce
- Living in a suburb or Northeast region of the US

Model 2: Predicting College Enrollment

84 factors analyzed, 44 statistically significant (p < 0.05)
Reference factor: Parent's highest education = High school diploma

Key Significant Factors
- Any high school completion status
- Career influence from family/friends
- Parents with Master's degree
- Living in the Western U.S. → Smallest positive coefficient (0.18089)

Course Selection & STEM Pathway
- Advanced courses, such as AP/IB Calculus or Science positively contribute to log-odds of entrance into colleges and universities

Household Income & College Enrollment
- Incomes < $75K → Negative log-odds for attending college
- Parents with associate, bachelor's, or master's degrees → Positive log-odds

Other Key Patterns
- Students in rural areas & public high schools → Lower odds

Model 4: Predicting a Senior's Plan After Graduation

Model Type: Multinomial Logistic Regression
Reference Category: Pursuing Higher Education

Key Findings
- Pursuing STEM degree
  - ≈ 46% **less likely** to enter workforce after HS than continue education
- Public School Students
  - ≈ 21% **more likely** to serve in military than pursue higher education
  - ≈ 89% **less likely** to need more HS than pursue higher education
- Household with 8+ members
  - ≈41% **more likely** to enter workforce than pursue higher education
- Income Level: $135,000 - $155,000$
  - 2 times **more likely** to start a family than pursue higher education

Conclusion and Future Work

When considering all demographic factors, there exists no significant difference between factors impacting STEM Education or Occupation amongst Black and White individuals, as well as no significant difference amongst Males and Females. Socioeconomic factors, as well as the type of occupation the parents are the largest factors of influence to a student's path for their field of work or study in STEM or Non-STEM fields. It was found that students who attended private high schools appeared to be more likely to pursue STEM fields, as well as individuals in the middle and lower class.

Future Work: In future work, the variable interactions, such as a low-income student in the rural south, should be measured to see if certain individuals are significantly advantaged or disadvantaged. Additionally looking into retention into programs of study and occupation can allow for further investigation to identify if other external factors impact their pursuit of STEM.