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Effect of High School Math skills on the Types of Professions

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ABSTRACT

In the 21st century, as the importance of STEM professions has increased, the interest to acquire these STEM professions has increased among high school students. For high school students desiring to acquire a STEM profession, this paper attempts to find the relationship between high school math skills and the likelihood of acquiring a STEM profession in the future. Furthermore, this paper attempts to explain the effect that high school math skill has on average wages which are indicated in other related papers. Notably, this paper uses the collected data from renowned a math camp in America about its alumni and their professions. After analyzing 121 alumni data, it was clear that high school students who were skilled at math indeed had a higher chance of acquiring STEM professions such as engineering and computer science. However, STEM jobs related to science did not have high percentages. This indicated that high school math proficiency had a profound effect on the probability of acquiring heavily math integrated professions whereas this was not the case for STEM professions requiring a mix of other STEM knowledges. In addition, the high percentage of computer science and engineering jobs explained how proficient high school math skills led to high average salaries as these are one of the highest paying jobs.

Introduction

As time passes, new technologies are invented, and the importance of STEM education also increases simultaneously. As the importance of STEM education increases, a principal subject in STEM, math, is now becoming one of the most important subjects for students pursuing a STEM career. However, math is not only important for students pursuing a STEM career but also for those seeking a successful life.

According to a research conducted by education experts in Finland, 80% of students who successfully finished advanced mathematics were able to gain admissions to universities. Not only this, but experts in social and behavioral science such as A. Kool say that high school students who completed honor math courses are more likely to get employed since they have a better ability to overcome complex, difficult problems compared to those who did not. Overall, this paper will mainly look at the effects of high school STEM education on future professions.

Literature Review

First, high school math success has a high correlation with success for STEM majors and college overall. According to Kaleva et al. (2019), students who completed advanced math courses in 12th grade have a better chance of gaining college admissions than those who did not. A similar argument for STEM majors is also made in Wang et al. (2013) where it was found that math self-efficacy beliefs, exposure to math and science, math achievement in 12th grade, and math achievement in 10th grade were factors that significantly affected a student's probability of becoming a STEM major. A similar argument can be seen in Quintana et al. (2022), where students who answered yes in a survey that asked them if they are a STEM person were more likely to pursue a STEM major. These two sources suggest that in

addition to strong math skills, math identity in students also affects the likelihood of becoming a STEM major in college. In Brown et al. (2015), the most significant predictor of quantitative pre-engineering GPA turned out to be the adjusted ACT math score, and other significant predictors included Calculus, Algebra II, Trigonometry, and Algebra I grades. Although engineering does not cover all STEM fields, as it constitutes a substantial part of STEM, this information can be used as one of the major correlation factors between high school mathematical achievements and the success in STEM majors at college. This research used the College Freshman Survey on 2,328 students to conduct an analysis for predicting quantitative pre-engineering GPA based on their high school academic performances. This similar pattern of success in college majors is also observed in ACT et al. (2009) which talks about how higher ACT scores had a positive correlation with the probability of earning a degree in the field an individual chose. Based upon all these previous research, one can observe that high school math success seems to have a positive impact on successful college life in general and be extra beneficial for those pursuing a STEM major.

Besides impacting college life, it is also shown that the impact of high school math goes further beyond and impacts future professions. According to Wang et al. (2013), it was shown, based on the research conducted on 1490 students, that 12th graders who had advanced math skills were more likely to acquire STEM professions. Although there were cases where females tended to choose literature related jobs despite being proficient at math, this was due to the general tendency of females to be better at literature than male students meaning they had more job options to choose from. According to Kool et al. (2016), it was also shown that companies hired more students who successfully completed high school honor math courses as they usually demonstrated the ability to overcome more complicated and harder situations compared to students who did not. Also, these students had in general overall higher college GPAs which made them more likely to be employed. This evidence can be seen in James et al. (2013), where it was shown that students who completed a higher level of math course at high school had higher tendencies to get employed and had higher average wages. According to the Bureau of Labor Statistics, one of the sources this research used, those who completed pre-algebra, algebra I, or less earned $12.70 per hour. In contrast, dropouts with geometry or algebra II have a significantly higher median hourly wage of $14.36. Also, the unemployment rate for students who successfully completed high-level math courses in high school was about 8 percent lower than those who did not.

Past research papers such as Kaleva et al. (2019) show the effects of high school math in college admissions in Finland. However, there is no adequate counterpart for the U.S. cases and since the U.S. and Finland have different admission processes, it could be misleading to simply draw conclusions solely based on Finland's results. While there is data from Wang et al. (2013), which directly addresses similar questions we have in this paper, it draws conclusions solely from 12th-grade math achievements. In this paper, we will also look at data from other grades in high school as well. Furthermore, we will use the collected data from renowned math camps in America about their alumni and see what professions and careers they have and evaluate the overall trends seen in the data.

Research Methodology

The data was collected by asking a renowned summer math program the author had attended for the tracked data of past alumni of the camp and what professions they were currently in. To understand the data, quantitative methods were used by looking at the math program's alumni profession data and finding the job categories that appeared frequently. More specifically, a description approach was used in order to analyze the data by using statistical analysis methods to test relationships between the number of the program's alumni and the number of STEM-related jobs. The target population was past alumni of the program which were all adults. The alumni-tracked data was accessed by requesting the head instructor of the program for the data. There was no personal information needed and all names and private information were hidden. What made this data set valuable was the fact that this math program was one of the prominent programs mostly for students who had garnered notable success in high-school math with their exceptional math skills.

Through the findings of this paper, high school students wishing for a STEM career will be able to get a clearer grasp of what level of math will be required for each specific STEM profession. In addition, this paper aims to find a reasonable explanation why advanced high school math skills might lead to higher average wages as stated by other research papers. Overall, the result of this research will help other younger STEM students to make more sound decisions regarding their future STEM professions.

Data

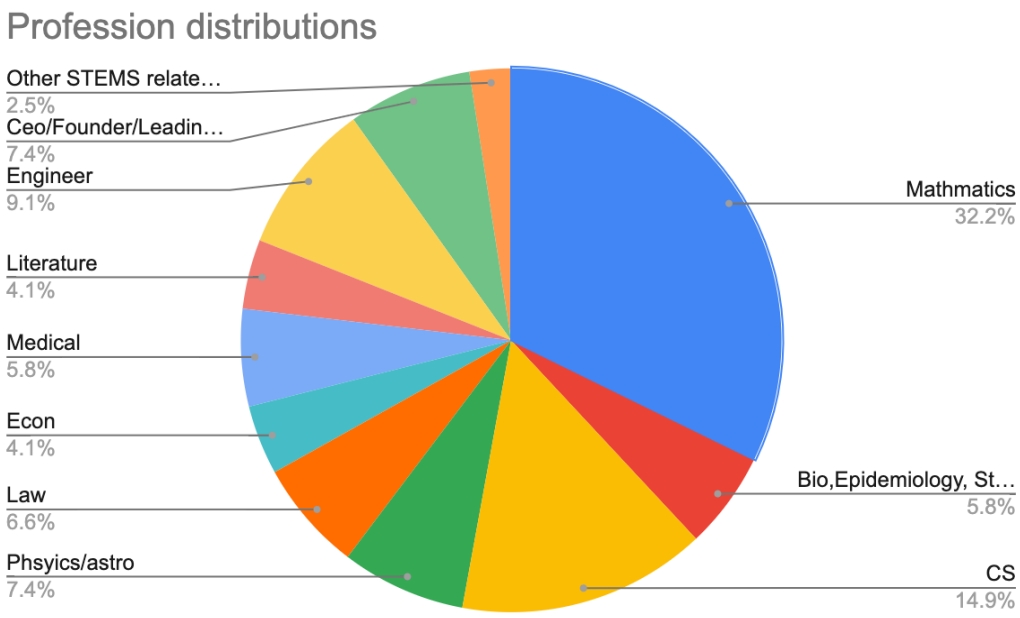

Figure 1. STEM profession distribution.

According to the pie chart, mathematics, computer science and engineering were the top professions these STEM high school students acquired in the future. Other STEM areas such as biology, epidemiology, statistics, physics and medics all had similar distributions of average of 6.2 percent. Meanwhile, non-STEM areas such as law and literature held a small proportion of the professions, with "business" being an exception with 7.4 percent. Note that the category "business" should be taken as a term that can span rather a broad spectrum of companies and entities. For example, STEM areas such as probability and statistics can be highly relevant to their business models for financial sectors. Or the companies themselves could be directly STEM-oriented ones in the domain such as biotechnology.

When observed from the pie chart above, a clear pattern can be observed that the majority of the professions acquired were in the domain of mathematics, computer science, and engineering. This is a clear indication that if an individual is indeed skilled at math, their likelihood of acquiring a STEM related career also increases. All these professions are the ones that heavily rely on theoretical knowledge of mathematics and not much of non-mathematical skills. The data above also shows computer science and engineering were the most heavily picked professions, which is more likely due to the tendency that STEM male students heavily pick computer science or engineering over other non-STEM subjects in which they are usually not sufficiently skilled enough compared to their female peers. A similar pattern was also observed in Wang et. al (2013).

One interesting finding was that science subjects such as physics, astrophysics, biology and epidemiology were not highly picked professions. Even though these subjects are classified as STEM subjects, the small proportion these subjects occupy indicates that these scientific careers tend to more heavily rely also on non-mathematical skills

such as literary and communication skills. The same thing could be applied to economics or business which all occupied a small proportion of the chart.

Conclusion & Analysis

This data also reveals the reason why people who were skilled at math in high school on average had higher median wages than those who were not. Based on the data, one can see engineering and computer science were one of the top-choice professions besides mathematics. As engineers and computer scientists on average have relatively higher salaries compared to other professions in the areas such as journalism and literature, the increased probability of acquiring these two professions leads to higher median wages. However, one vague category among the professions was the "math" category. This category was made up of math professors at colleges or mathematicians working in research facilities or math organizations. As the median wages of these professions differ for each college or research institution, it is hard to determine the effect of high school math skill on wages for these professions. In general, these findings indicated that advanced high school math skills indeed lead to higher chances of acquiring certain STEM jobs such as computer science and engineering. One surprising result was that high school math skills did not have any significant impact on the probability of having certain STEM professions such as science. Overall, this mixed result indicated high school math skills only made noticeable differences at acquiring STEM jobs requiring heavy mathematics and did not have any significant correlations with the probability of having non-math-centered STEM professions.

Implications & Next Steps

This paper clarified the general misconception that advanced math skill is necessary for all STEM jobs. It clearly demonstrated that although advanced math skill has a large effect on the acquisition of math-heavy STEM professions such as engineering and computer science, this was not necessarily the case for non-math professions such as biology, epidemiology, and more. Surprisingly, it also showed how professions related to business were positively correlated with skills in high school math. These findings indicated that, even for students not necessarily pursuing a STEM career, advanced math skills should be highly encouraged as math is used in a more variety of professions than the public generally recognizes. In the future, research with more professions and data from a more variety of organizations will be ideal for better credibility.

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