

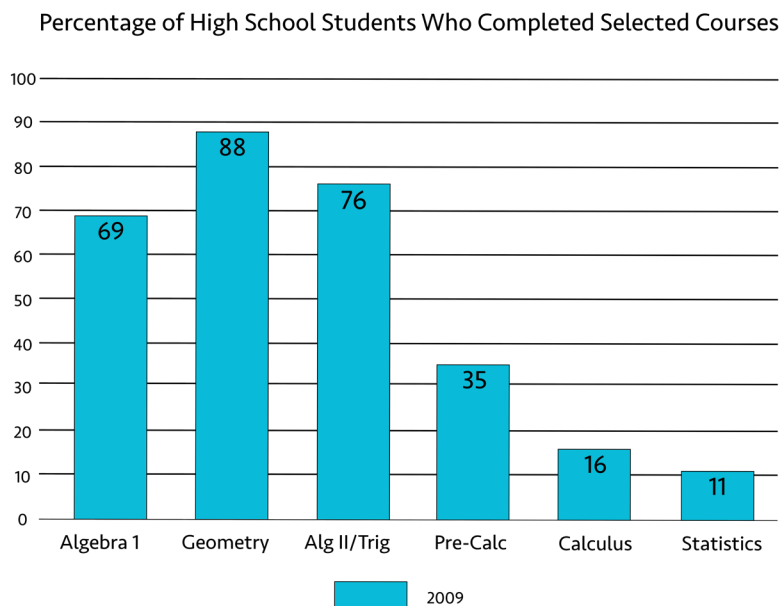


Are We Teaching the Wrong Mathematics to High School Students?

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It was the 1800's when governments decided that US high school students should be taught algebra and geometry in high school, with calculus being positioned as the ultimate goal. The mathematical needs of work and life have changed immeasurably since that time, especially with the arrival of computers, yet these courses have stayed in place as the mathematical preparation of our high school students. Perhaps we could justify the thousands of hours students spend working through antiquated methods they will never use in their lives, if they enjoyed the experience, but national data gives a different perspective as most students drop math courses after they take them. The following graph shows us the percentage of students completing courses across the US in 2009:

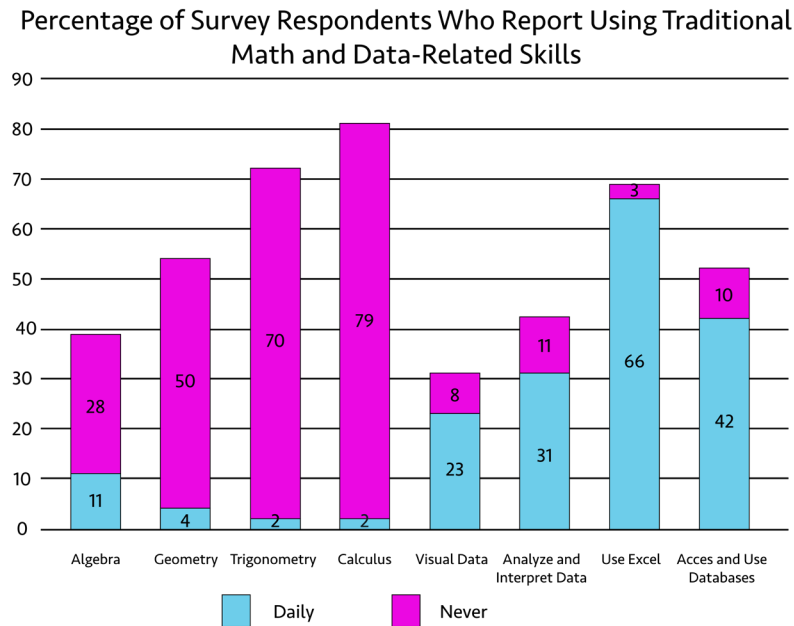


<https://nces.ed.gov/fastfacts/display.asp?id=97>

This data raises an important question. Can we justify teaching algebra and geometry to students, on the basis that it is the foundation for calculus, if only 16% of students take calculus? It would perhaps be justifiable if the students used their algebra and geometry knowledge in college, but most students take algebra 2 in high school and then turn away from mathematics for good. This is a problem for the mathematical and scientific future of our nation.

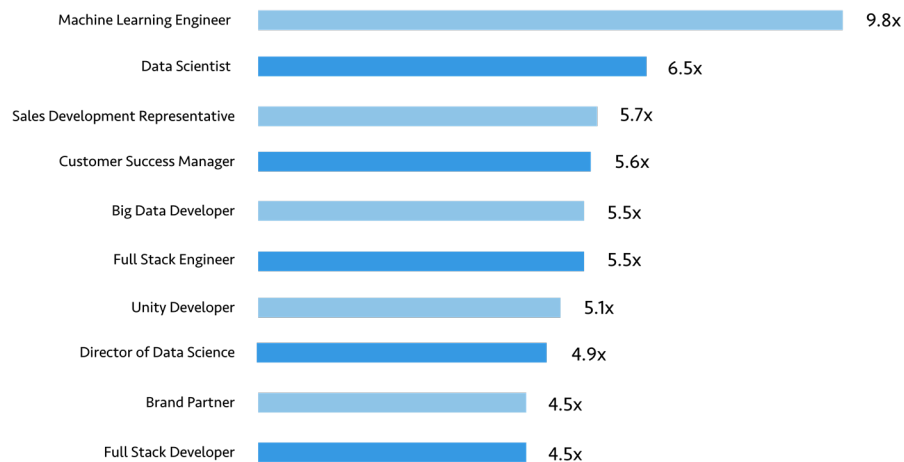


It could perhaps be justifiable to give students this mathematical preparation if students used algebra and geometry in their lives, but a survey of those who listen to the Freakonomics podcast – a group skewed towards higher income professionals – showed something interesting:



This data shows not only that workers are not using algebra, geometry, trigonometry or calculus but that there is another area of mathematics that is much more critical to their lives – data science. Seven of the ten fastest growing job categories in the United States are data centered, and an incredible 90% of the data ever created by humanity has emerged in the last two years. When our young people enter the workforce they will need to be confident and skilled at working with big data sets but we are woefully under preparing our students for this important mathematical work.

Top 10 Emerging Jobs





There is something else important about a future that includes mathematics courses based in data science – students enjoy them. Instead of working on abstract methods that mean nothing to students, they are given complex real problems to grapple with – problems about the environment, about space travel, about health and nutrition, and they learn important mathematical approaches that help illuminate and explain the data inside these problems.

For some readers the idea that students may no longer learn synthetic or polynomial division is heresy, perhaps because the topics have been taught since the 1800's. This may also be the reason that secondary mathematics teaching is so difficult to change. We are used to it, most people hate it, but still they want their children to go through it. It is time to question this thinking, especially given the extent of mathematical trauma and mathematical aversion that sweeps the nation.

Less than 10% of students take courses in statistics in high school and in younger grades the data science in the common core and other curriculum standards is often left out by publishers and teachers. Our proposal is not to throw algebra and geometry out of the window. Introductory algebra and spatial problem solving are both important. Our proposal is to give students and teachers a choice in their third year of high school mathematics, between algebra 2 and a 21st century course in data science. Los Angeles Unified is currently leading the way in this endeavor, having secured permission from the California Board of Education to recognize data science as equivalent to algebra 2 and be accepted as an A-G requirement, but few schools know that this is a possibility and continue to ignore the data science parts of the mathematics curriculum. As they do so, scores of students leave schools and colleges with a mathematical hole in their preparation, missing the inspiration they could have experienced from learning mathematical approaches that illuminate complex data sets. Data science and statistics is important for jobs and for college courses – statistics is required in many more college majors than calculus.

You may be wondering how our nation's mathematics teachers can teach a course that they have not experienced or learned themselves but we are very hopeful in this regard. Teachers are some of the most voracious life-long learners in our society and the methods and techniques of data science are mathematical at their core. We see teachers, K-12, as excited to take on a challenge that will allow K-8 students to become excited about data science and become data literate, and will help move high school mathematics out of the nineteenth century and into the present day. One of the rewards we will reap from this change will be classrooms filled with engaged and excited students – learning mathematics and enjoying it. The other will be mathematically powerful citizens equipped with data analytic knowledge they can use to solve some of society's most pressing problems.