Data-Driven Instruction: A Math Curriculum for the 21st Century

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Rationale

Workshops, books, classes, podcasts and videos abound about *how* to teach mathematics. Writers, researchers and teachers have looked at ways to present material interactively, incorporate technology, group students purposefully, assess in new and creative ways, and more. Some are now looking critically at *what kind* of mathematics we are teaching. The content in our secondary math courses has not been substantively updated since the 1950s, when *Sputnik* generated a big push for students to focus on preparation for calculus. The so-called "race to calculus" starts even in the middle grades and affects the pace, topics, and pedagogy of our math classrooms. Yet in the past decade, demand for data and statistical literacy in the workplace has exploded, and our math curriculum does not reflect this new reality. Through interviews with secondary math teachers and a math professor, this research project explores the benefits and drawbacks of shifting the focus of secondary math to statistics and data science instead of calculus.

Literature Review

Existing literature notes many issues with the emphasis on calculus. Bressoud (2016) writes about the growth in emphasis on what he refers to as the race to calculus, noting from 1980 to 2016, the number of students who took AP Calculus increased nine-fold. Of Rutgers University seniors who took calculus, 80% said they did so because it looks good on a college application. And even out of all students who took calculus in high school, Bressoud estimates that less than a fifth would actually go on to Calculus II. The rest retake Calculus I or lower-level math classes. Jeffery and Jimenez (2019) note that there are deep inequalities in math education and that the race to calculus and emphasis on algebra skills disproportionately affects students of color. They advocate for math pathways that would allow students to avoid remedial classes and explore interests in data science. Researcher Jo Boaler, in an interview with Gonser (2021), points out that the math curriculum has not changed to keep pace with technology. High schools still teach techniques for solving problems by hand that could easily be solved with computers; she cites the Algebra 2 example of synthetic division. This content, in turn, turns students off. The huge demand for data science in STEM means that statistics is practical as well. Boaler notes that some big universities are now accepting data science and statistics instead of Algebra 2, and says that this is a move in the right direction. Many of these issues and insights were also raised by the interviewees.

Methodology

To investigate the proposal to shift the focus of secondary math to statistics, six interviews were conducted with secondary math teachers and professors. These included secondary math teachers in Wards 3, 4, 7, and 8 in DCPS and a charter school. The author also interviewed a professor of mathematics at Bard College, an elite predominantly white liberal arts college in upstate New York. Informal conversations with college counselors also informed the findings. Interviewees were chosen to reflect a broad range of student populations and school cultures.

The interview questions were: What can be done at the K-12 level to address the number of students who need remedial math in college? What do you see as the benefits and drawbacks of focusing on calculus? What do you see as the benefits and drawbacks of focusing on statistics and data science? What would the barriers be to implementing a curricular shift toward data science?

Findings

At the high school level, teachers were enthusiastic about statistics and identified several benefits. One benefit was engagement. Statistics is highly contextual, and teachers thought that their students would simply be more interested in the material. The content might be seen as more relevant to their lives and applicable to their future carriers. A second benefit would be accessibility. The focus would be more on concepts than computation, which would allow for more students to be successful. A third benefit identified was numeracy and quantitative reasoning skills. Because the content is less abstract, it could give students more practice thinking proportionally and consolidating their prealgebra skills. Teachers agreed on these benefits despite being at very different schools in terms of demographics, student achievement and school culture.

High school teachers did identify some drawbacks and concerns as well. They noted that calculus prepares students for high level math courses in college, and the precalculus skills would be addressed later. Several teachers thought that secondary math teachers would require substantial training to be ready to teach statistics courses. And the high school teachers noted that unless there were shifts in standardized tests and college counseling and admissions, students who took data science or statistics might be at a disadvantage.

The college professor was less enthusiastic about shifting the focus of secondary math to statistics, and she identified several issues. To her, the most salient issue was K-12 students learning at a facile level. Rather than deep conceptual learning, students were being exposed to many concepts without mastering them completely. Further, she thought that focusing on statistics might hinder students' chances of being successful as college math majors and graduate students. These attitudes might reflect historical privileging of pure mathematics over applied mathematics.

Recommendations

As a result of this investigation, the author suggests the following:

- Educate secondary math teachers and supervisors on the importance and relevance of statistics in the 21st Century workplace
- Pilot Statistics-focused secondary math pathways and assess the impact on standardized test scores and college success
- Support continued conversation through Mathematical Association of America and National Council of Teachers of Mathematics on shifting the focus of secondary math to statistics

Works Cited

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