

Mind the Gap

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“Mind the Gap” is an appropriate metaphor for one of the greatest challenges facing undergraduate mathematics education today. There is a significant gap between students’ experience of mathematics in high school and the expectations they face on entering college, and there are troubling signs that this gap may be widening. There are serious problems in K–12 mathematics education, but college faculty also need to look to their own house and think about the first-year experience of their own students.

In my article “Is the Sky Still Falling?” (2009), I observed that four-year college mathematics enrollments at the level of calculus and above declined from 1985 to 1995 and have since recovered to slightly below the 1990 numbers. Two-year colleges saw calculus enrollments rise in the early ‘90s, then fall to well below the 1990 number, while the number of their students requiring remedial mathematics exactly doubled. In percentages, the picture is dismal. For four-year undergraduate programs, calculus and advanced mathematics enrollments dropped from 10.05% of all students in 1985 to 6.36% in 2005.

This happened while high school students were taking ever more mathematics at ever higher levels. In 1982, only 44.5% of high school graduates had completed mathematics at the level of Algebra II or higher. By 2004, this had risen to 76.7%. In 1982, 10.7% had completed precalculus. By 2004, it was 33.0%, over a million high school graduates arriving in college ready — at least in theory — to begin or continue the study of calculus. Yet over the years 1985–2005, Fall term enrollments in Calculus I dropped from 264,000 to 252,000.

Admittedly, many more students today arrive at college already having earned credit for Calculus I, but they have not produced larger enrollments for Calculus II. Over these same 20 years, Fall term enrollments in Calculus II dropped from 115,000 to 104,000. Across the board, students are arriving in college and failing to take what should be a next course in their mathematical progression.

The college community is not blameless. Too many good students are turned off by their initial college

experience in mathematics. Too often, first-year courses are large and impersonal, instructors — especially adjunct faculty and graduate teaching assistants — are under-prepared, and little thought has gone into implementing appropriate pedagogies. Moreover, a common complaint that I hear from high school teachers is that colleges focus exclusively on what students do *not* know, with the result that many students find themselves assigned to classes they find stultifying.

This last is a tricky issue. The answer cannot be that colleges lower their expectations of what it means to know algebra or calculus. It does mean that colleges need to rethink how to get students from where they are as they enter college to where they need to be. It does mean offering more routes into good mathematics and restructuring existing courses so that they acknowledge and build upon what students do know while remaining mindful of and addressing the gaps in this knowledge. Especially when a student needs to relearn a topic that appears familiar, we must ensure that the course is structured so that it provides fresh challenges that entice students to keep moving forward.

We have learned a lot about teaching undergraduates in the past 20 years. There are proven programs for bridging the gap. The Emerging Scholars Program is one. Stretching Calculus I over two terms with precalculus topics treated on a just-in-time basis is another. But there are no magic bullets. Each college and university must examine what others have done and adapt to its own situation those programs that are most appropriate. 🍷

References:

Bressoud, D.M. 2009. Is the sky still falling? *AMS Notices*. **56**: 20–25. <http://www.ams.org/notices/200901/tx090100020p.pdf>.

For additional data and data sources, see the February, 2009 *Launchings* column at http://www.maa.org/columns/launchings/launchings_02_09.html.

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