Numeracy
Advancing Education in Quantitative Literacy

Volume 11
Issue 1 *Winter 2018*

Article 1

2018

Quantitative Reasoning: A Guided Pathway from Two- to Four-Year Colleges

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Abstract
In this editorial, I place the Quantitative Reasoning (QR) movement within the national context of math pathways and the broader Guided Pathways initiative. Community colleges in particular are experiencing a radical re-envisioning of their math requirements. Thoughtful reflection on the communication and computation needs of their students for the 21st century has led to state-wide adoption of QR curricula as an alternative pathway to the traditional College Algebra route. These Guided Pathways have shown great promise in boosting graduation rates and addressing equity and the achievement gap for our most vulnerable, first-generation, low-income students.

Keywords
Quantitative Reasoning, QR, Community Colleges, pathways, mathway, guided pathways

Cover Page Footnote
Eric Gaze directs the Quantitative Reasoning (QR) program at Bowdoin College, is Chair of the Center for Learning and Teaching, and is a Senior Lecturer in the Mathematics Department. He is the current President of the National Numeracy Network (NNN 2013 – 2017). He has a QR textbook published with Pearson, *Thinking Quantitatively: Communicating with Numbers*, with blog thinkingquantitatively.wordpress.com. Eric has given talks and led faculty workshops on the topics of QR Across the Curriculum and QR Assessment, and he has served on review teams of QR programs. Eric was the Principal Investigator for a NSF TUES Type I grant (2012-14), Quantitative Literacy and Reasoning Assessment (QLRA) DUE 1140562, and has published articles on teaching and learning related to citizen literacy. Prior to coming to Bowdoin, Eric led the development of a Masters in Numeracy program for K-12 teachers at Alfred University as an Associate Professor of Mathematics and Education.

Before reading further, carefully consider these two questions: How many undergraduates are there currently in the U.S.? Of these, what percentage go to community colleges? It is important you try to answer these questions before reading, or else what follows may seem like just another collection of statistics being used (skillfully I hope!) to make my point. You need to care about the answers to these additional questions to fully appreciate the magnitude of the impact the quantitative reasoning (QR) movement has in the lives of real college students struggling to get ahead.

- How many community college students have been homeless at some point?
- What percentage of all undergraduates are over 25 years old?
- What percentage of all undergraduates work over 30 hours a week?

Gail Mellow, President of LaGuardia Community College (City University of New York), provides answers to these questions in a recent *New York Times* editorial, "The Biggest Misconception About Today's College Students" (Mellow 2017). Because some of us teach in very different contexts, the answers may be surprising. For example, I know the answer to the last two questions for the students who attend my institution, an elite Liberal Arts College nestled in the snowy confines of scenic northern New England. Zero. In fact, only 16% of all 18 million undergraduates attend *any* private, non-profit college or university, and a paltry 0.4% attend the Ivies. By contrast, community colleges account for almost half of all undergraduates and educate the vast majority of our most vulnerable, first-generation, low-income students. At President Mellow's LaGuardia Community College, 57.5% of students living with their parents have a family income below $25,000, and for those students living away from their parents the percentage rises to 77%.

These facts are relevant for *Numeracy*'s audience because QR curricula are increasingly providing an alternative *pathway* to the traditional, algebra-based mathematics found in the developmental math courses at two-year colleges. If you are not familiar with "dev ed," it refers to remedial coursework that students are placed into which does not carry any college credit. For students working their way through college, often caring for children and barely making ends meet, the prospect of two or three developmental math courses that do nothing but ostensibly prepare them to take College Algebra is daunting if not impossible. Putting aside the financial consideration of the cost of these extra math requirements, the decontextualized procedural approach of these courses does nothing to address why students failed to master this material in the first place. It simply condenses high school algebra into a shorter time frame. Not surprisingly, failure rates have been consistently high, meaning students must retake the courses, leading to a vicious cycle that often ends in dropping out (Hacker 2012).

Uri Treisman, from the Dana Center at UT-Austin, has been a leading figure in championing the need for alternative *pathways* for students. You can listen to his podcast[1] to learn more about his work on the "joyful conspiracy" and the Dana Center Mathways Project.[2] The mismatch between College Algebra's original purpose as preparation for Calculus and the mathematical needs of students is finally being addressed as educators recognize that most students do not need an algebra-intensive curriculum or Calculus to excel in their degree programs (Burdman 2015).

The idea that College Algebra is not an appropriate default gateway course, first articulated by the Mathematical Association of America, Committee on the Undergraduate Program in Mathematics (2004), has since gained traction, culminating in a recommendation in 2015 from the MAA for implementation of multiple mathematics pathways aligned to fields of study, some of which should include early exposure to statistics, modeling, and computation (Saxe and Braddy 2015). Quantitative reasoning offerings have exploded across the country largely as a response to this call.

State-level efforts in Arkansas, California, Georgia, Indiana, Michigan, North Carolina, Ohio, Tennessee, Texas, Virginia, and Washington are replicating and customizing national models and providing frameworks and support for colleges to explore, strategize, and move toward implementation of QR (Gaze 2014). While these initiatives are exciting for those of us who advocate for change, they represent a significant work load for the institutions charged with the work. In addition to developing new QR curricula and training faculty in new pedagogical methods, two-year schools must negotiate transfer articulation agreements with four-year schools. (These agreements are critically important because 46 percent of all students who completed a degree at a four-year institution in 2013–2014 had been enrolled at a two-year institution at some point in the previous 10 years [National Student Clearinghouse Research Center 2015].)

The National Center for Inquiry and Improvement offers assistance through its Guided Pathways program to community colleges that more broadly encompass the QR movement within the math pathways movement.[3] Guided pathways require colleges to help students clarify their end goals and provide pathways to achieving these goals that include high school bridge programs and curricula tied specifically to programs of study. The principles of guided pathways inherently require more than one curricular option. As Tristan Denley, Chief Academic Officer for the University System of Georgia puts it, "It's vital to know what pathway a student is on and ensure the math and English courses they

[1] http://tccta.libsyn.com/interviews-with-educators-uri-treisman-0
[2] http://www.utdanacenter.org/wp-content/uploads/Launch-Years-Brief-Number-1_FINAL.FINAL_.pdf
[3] http://www.ncii-improve.com

DOI: https://doi.org/10.5038/1936-4660.11.1.1

take connect to their program of study and their career goals" (quoted in Johnstone and Karandjeff 2017, 14).

The emergence of a guided pathways approach prompts reflection on what it means to be liberally educated in the 21st century and what "communication and computation" skills are needed for a meaningful career and life of informed citizenship. These student end goals must inform our curriculum development and assessment to help students stay on their chosen path and to ensure that student learning is taking place through the most effective instructional practices. For example, a student who places into developmental math and who is pursuing an allied health pathway might not need to endure multiple algebra courses leading to calculus. Rather, she may take a more fitting sequence that allows mastery of the statistics and quantitative reasoning required when working in a health care setting. The results of reforms at Georgia State University suggest that such an approach not only boosts graduation rates; it simultaneously closes achievement gaps across racial/ethnic subgroups (Fig. 1).[4] The data speak for themselves!

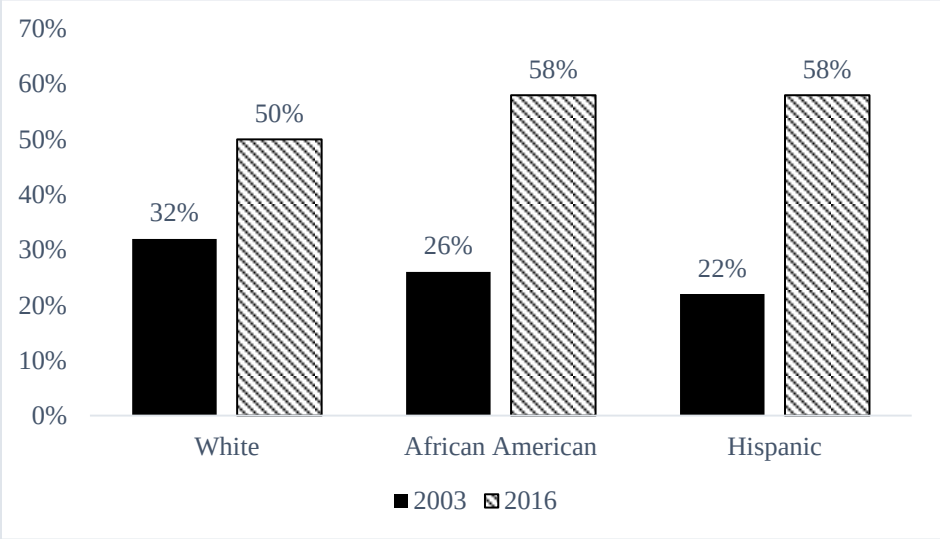

Figure 1: Georgia State University Graduation Rates 2003 vs. 2016

The rapid pace of recent reforms in two-year curricula is exciting for those of us in the QR movement—both because it proves that large-scale change is possible and because results like those from Georgia State demonstrate that the results can meaningfully transform students' lives. Still, the bulk of the work remains to be done. Those tasked with completing the job will need a community

[4] To hear more about Georgia State University's approach from Vice Provost Tim Renick, see http://success.gsu.edu/approach/

of scholars sharing evidence-backed ideas so that every state-wide system and institution can learn from others' experiences. In recent issues, *Numeracy* has served as a locus for that discussion (Secolsky et al. 2016; Wolfe and Hoiland 2017). In coming years I hope to see much more of the same as we address this critical educational issue.

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