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**Introducing MAA Notes #88: *Shifting Contexts, Stable Core:*
*Advancing Quantitative Literacy in Higher Education***

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Introducing MAA Notes #88: *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education*

Abstract

Tunstall, Samuel, Gizem Karaali, and Victor Piercey, eds. 2019. *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education* (Washington, DC: Mathematical Association of America) 258 pp. ISBN 978-1614443247.

This brief essay introduces readers to *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education*, a new edited volume published by the Mathematical Association of America. We begin by describing the story behind the volume, and then outline its four major parts: "A Bird's Eye View," "Curriculum for Quantitative Literacy," "Quantitative Literacy in an Institutional Context," and "Perspectives from the Quantitative Literacy Community." We end with an excerpt from the volume's first chapter, "What Do We Mean by Quantitative Literacy?" by Forest Fisher.

Keywords

Mathematical Association of America, quantitative literacy, numeracy, quantitative reasoning, higher education

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Cover Page Footnote

Samuel Luke Tunstall is Director of the new Quantitative Reasoning and Skills Center at Trinity University in San Antonio, Texas. In addition to serving on the board of the National Numeracy Network, he is also Chair-Elect of the Mathematical Association of America's Special Interest Group in Quantitative Literacy. His research interests include quantitative literacy practices and the assessment of quantitative literacy.

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Victor Piercey received an interdisciplinary B.A. in humanities from Michigan State University in 1997, a Juris Doctor from Columbia Law School in 2000, a M.S. in mathematics from Michigan State University in 2006, and a Ph.D. in mathematics from the University of Arizona in 2012. Since completing his Ph.D, he has been teaching at Ferris State University in Big Rapids, Michigan where he was granted tenure in 2017 and is an associate professor in the mathematics department. His primary work at Ferris has involved the development of a two-semester sequence of general education courses entitled Quantitative Reasoning for Professionals. In 2018, he was appointed Director of General Education.

Backstory

The 1990s and 2000s are marked with scholarship both delineating and advocating for numeracy, quantitative literacy (QL), and quantitative reasoning (QR) in U.S. higher education (e.g., Sons 1994; Steen 1997; Steen et al. 2001; Gilman 2007).¹ Thanks to the dedicated work of numerous individuals and related organizations over the past three decades, such constructs have become firmly entrenched as goals for general education (e.g., Rhodes 2010). In particular, though its status as a focus of K–12 mathematics education is tenuous (Madison 2015), quantitative literacy is now an established goal for much of the undergraduate mathematics curriculum. The Mathematical Association of America (MAA)—the largest organization of mathematicians interested in undergraduate mathematics education in the U.S.—has played a pivotal role in making that possible. And insofar as mathematics departments will continue to serve students through general education courses for the foreseeable future, it remains critical that there be resources for those involved in mathematics teaching and learning to learn about the quantitative literacy movement in higher education. *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education* (Tunstall, Karaali, and Piercey 2019) aims to meet this need.

The volume began rather serendipitously when, in the Spring Semester of 2016, Luke Tunstall—a graduate student at the time at Michigan State University—invited Victor Piercey to campus to sit it on one of its new courses in quantitative literacy (Tunstall et al. 2016), and to share his experiences with folks at MSU involved in teaching and curriculum development. As part of the visit, Luke and Victor chatted about the MAA’s Special Interest Group in Quantitative Literacy (SIGMAA QL) and what some of its current projects were. One of the things that came up in their discussion was the period of time since the last MAA publication concerning quantitative literacy. It had been approximately eight years since Madison and Steen’s (2008) *Calculation vs. Context*—a volume stemming from a conference on quantitative literacy and teacher education. This lacuna was likely related to the fact that *Numeracy* was launched in 2008. In thinking through various ways that quantitative literacy had evolved since the *C v. C* volume (e.g., the expansion of QL programs to more public universities, the consideration of other literacies, etc.), Victor and Luke decided to reach out to the SIGMAA to see if there was interest in generating a new volume for the MAA. Following a warm expression of interest from various folks in the SIGMAA in contributing to the

¹ For those interested in learning more about the history and stories of various organizations and people associated with that scholarship, several pieces in *Numeracy* (e.g., Madison and Steen 2008; Sons 2019; Wallace 2019) provide a fitting start.

volume, Gizem Karaali, then Chair-Elect of the SIGMAA, joined the two to commence work in soliciting and editing papers. And so, the nearly three-year journey began.

A Trip To QLU

The book itself consists of four parts (see Appendix), with each part composed of chapters from folks both veteran and new to the quantitative literacy community. For readers interested in reading the book from front to back, we structured the collection as a trip to “Quantitative Literacy University.” This structure helped weave a consistent narrative across the volume’s four broader themes.

The first part, “A Bird’s Eye View,” is focused around understanding what we mean by quantitative literacy and how QL relates to other disciplines. This panorama is what visitors to QLU might view as they fly over campus, or as they chat with their host during the drive from the airport. With papers concerning theory and a historical overview of quantitative literacy, Part 1 establishes the “stable core” of the volume’s subtitle, while the rest of the book addresses the “shifting contexts.” An intriguing chapter in this Part—one that in some ways unsettles the notion of a “stable core”—is the one from Jeffrey Craig, Rohit Mehta, and James Howard, titled “Quantitative Literacy to New Quantitative Literacies.” Individuals who have read Steen et al.’s (2001) “The Case for Quantitative Literacy,” the opening to *Mathematics and Democracy*, will enjoy seeing how Craig, Mehta, and Howard discuss the impact of technology on the nature of quantitative literacy.

The second part, “Curriculum for Quantitative Literacy,” consists of papers with specific examples of QL in the classroom. This survey might be a visitor’s classroom observations at QLU. In addition to a foundational chapter from Eric Gaze on core principles for any course focused on quantitative reasoning, the part also includes examples of QL embedded in contexts such as finance, in environmental sciences, and in first-year seminars, among others. For those new to teaching coursework centered on quantitative literacy, these chapters provide ideas that can be brought directly into the classroom. The part ends with an engaging paper from Richard Edwards, Vincent Melfi, and Rani Satyam, titled “Yes, But Is It Rigorous? Similarities Between A Quantitative Literacy Course and Transitions to Formal Mathematics,” who make the case that QL involves modes of reasoning not altogether different from those promoted in proof-focused courses.

In the third part, the reader visits with QLU administrators to discuss “Quantitative Literacy in an Institutional Context.” Chapters in this part address institutional commitments to QL as part of systemic change. In particular, this scene includes discussions of challenges to sustaining innovation, the expansion

of access to quantitative literacy for marginalized populations, as well as the landscape of (and theory behind) assessment efforts. These papers illuminate how far the QL community has come over the last three decades while simultaneously highlighting that there is still room to grow, especially in the area of access to QL coursework. Indeed, the chapter from Amy Getz, Connie Richardson, Rebecca Hartzler, and Francesca Leahy of the Charles A. Dana Center at The University of Texas at Austin, titled “Understanding the Problem: The Need to Expand Access to Quantitative Reasoning Courses,” reminds us that work remains to be done if we are to ensure that quantitative literacy and reasoning courses become a normative component of entry-level mathematics programs for all students.

At the end of the visit to QLU, the visitor goes to dinner to chat with some of the faculty at QLU. The conversations in Part 4, “Perspectives from the Quantitative Literacy Community,” are stimulating. For example, in “Classrooms as Laboratories of Democracy: The Role of New Quantitative Literacies for Social Transformation,” Thomas Philip and Laurie Rubel discuss political implications of quantitative literacy, and challenge us to create more opportunities to incorporate quantitative literacy into a broader sense of democratic deliberation. This part, as well as the volume as a whole, concludes with an interview with Len Vacher, a geologist and long-time editor of *Numeracy*, who discusses possibilities of collaboration and cooperation that can go beyond the mathematics department.

Taken as a whole, we hope that the reader who spends time with the volume will walk away with a concrete grasp of both where quantitative literacy is, as well as where it (or they, if one takes on Craig, Mehta, and Howard’s notion of quantitative literacies) may be going in the near future.

Excerpt

Below is an excerpt² from Chapter 1, written by Forest Fisher and titled “What Do We Mean by Quantitative Literacy?” Note that an electronic copy of the book is available to all current members of the MAA through their online Member Library tool. For readers who want a print version or just the eBook, the book website offers more details.³

Introduction

In his introduction to MAA Notes #70, Gillman (2006) describes Quantitative Literacy (QL) as “one of those things about which we say ‘I know it when I see it’” (vii). He then admits that quantitative literacy is quite difficult to describe

² pp. 3–14

³ See <http://maa.org/ebooks/NTE88>.

precisely, and after listing several potential topics that might be covered under this banner (numeracy, some geometric, algebraic, and algorithmic skills, etc.), he finally settles on the definition found in the bylaws of the MAA's SIGMAA on QL (2004): "Quantitative Literacy (QL) can be described as the ability to adequately use elementary mathematical tools to interpret and manipulate quantitative data and ideas that arise in individuals' private, civic, and work lives."

Gillman is not the first person to struggle with the definition of quantitative literacy. Everyone seems to agree that QL is important, but few can agree on what it really means. Indeed, Madison in this volume recalls how many of us "experience difficulty in conveying the meaning of QL/QR to others." In the UK, QL was first referred to as "numeracy" in the 1959 Crowther Report where authors sought to "coin a word to represent the mirror image of literacy." The 1982 Cockcroft Report expanded upon this definition by suggesting that the word numerate should entail two attributes: "The first of these is an 'at-homeness' with numbers and an ability to make use of mathematical skills which enables an individual to cope with the practical mathematical demands on his everyday life. The second is an ability to have some appreciation and understanding of information, which is presented in mathematical terms, for instance in graphs, charts, or tables or by reference to percentage increase or decrease" (11).

Already this description sounds quite different from the "geometric, algebraic, and algorithmic skills" identified by Gillman, but the bigger problem is that this definition is not helpful to instructors who may be entrusted with teaching a QL course. It is not clear what content or approaches an instructor should pursue in the classroom to engender "at-homeness" with numbers. The implicit comparison between quantitative literacy and the traditional notion of written literacy also seems like a stretch; should we use the term literacy whenever we want students to feel at home with a particular set of skills or ideas?

The Association of American Colleges and Universities (AAC&U 2010) offers another equivocal definition. QL is a "'habit of mind,' competency, and comfort in working with numerical data." There are many habits of mind that we might hope to arouse in our students. Should all of them be thought of as a type of literacy? And specifically, what does it mean to be comfortable working with numbers? What content and practices should instructors employ to develop this habit of mind? The AAC&U at least offers some guidance in observing that "individuals with strong QL skills possess the ability to reason and solve problems from a wide array of authentic contexts and everyday life situations. They understand and can create sophisticated arguments supported by quantitative evidence and they can clearly communicate those arguments in a variety of formats (using words, tables, graphs, mathematical equations, etc. as appropriate)."

Much like the AAC&U, Steen (2004) defined QL as a “practical, robust habit of mind anchored in data, nourished by computers, and employed in every aspect of an alert, informed life” (4). Notice that his definition yields a special status to computers, whereas the other definitions do not even mention computers. Even Steen himself admits that “beyond ‘the basics,’ there is little agreement about specific goals appropriate for tomorrow’s world,” and so authors “express contrasting views about the nature and importance of quantitative literacy” (xvi–xvii).

It took mathematicians over 100 years to agree upon a formal definition of the limit, but that consensus created a deluge of new results and understandings (Boyer 2012). Quantitative literacy is at a similar point. “I know it when I see it” will simply no longer cut it. We need to think critically about what we mean by quantitative “literacy.” In particular, can we justify using the word “literacy”? Does QL have more than a superficial resemblance to traditional notions of literacy?

This chapter takes a social linguistics⁴ approach to quantitative literacy. I will look at research on reading-and-writing literacy, and apply it to the study of QL to show that quantitative literacy does in fact resemble reading-and-writing literacy in many ways. I will argue that all forms of literacy involve a representational medium that is shared by different social groups, each with its own unique practices surrounding that medium. As such, literacy is an inherently social phenomenon, and we cannot divorce the study of QL from the social contexts in which it is realized. In the final section, I will propose the following definition:

Quantitative literacy is the facility to participate in the intersecting quantitative practices of many different communities (each with its own patterns of discourse).

For example, many different communities use numerals, algebraic expressions, graphs, charts, and/or computers to represent, interpret, manipulate, and communicate about quantities. However, not all communities are situated in the same way with respect to these practices, so performing a calculation or reading a chart may look very different from one social context to another. I will close the chapter with a discussion about the pedagogical implications of this definition.

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⁴ For a good introduction to social linguistics (also called sociolinguistics), see Gee (2015). Readers may also want to take a look at Craig, Mehta, and Howard in this volume, who also explore quantitative literacy through a social linguistics lens and Karaali, Villafane-Hernandez, and Taylor (2016), who anticipated many of the ideas in this chapter.

References

- Association of American Colleges and Universities. 2010. “Quantitative Literacy VALUE Rubric.” Washington, DC: Association of American Colleges and Universities. <https://www.aacu.org/value/rubrics/quantitative-literacy>
- Boyer, Carl B. 2012. *The History of Calculus and Its Conceptual Development*. New York, NY: Dover Publications.
- Cockcroft, Wilfred H. 1982. *Report of the Committee of Inquiry into the Teaching of Mathematics in Schools*. London: Her Majesty’s Stationery Office.
- Crowther, G Sir. 1959. *The Crowther Report*. Vol. 1. Her Majesty’s Stationery Office.
<http://www.educationengland.org.uk/documents/crowther/crowther1959-1.html>
- Fisher, Forest. 2019. “What Do We Mean by Quantitative Literacy?” In *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education*, MAA Notes #88, edited by Tunstall, Samuel, Gizem Karaali, and Victor Piercey, 3–14. Washington, DC: Mathematical Association of America.
- Gee, James. 2015. *Social Linguistics and Literacies: Ideology in Discourses*. 5th ed. New York, NY: Routledge.
- Gillman, Rick. 2006. “Introduction.” In *Current Practices in Quantitative Literacy*, MAA Notes #70, edited by Rick Gillman, vii–ix. Washington, DC: The Mathematical Association of America.
- Karaali, Gizem, Edwin H. Villafane Hernandez, and Jeremy A. Taylor. 2016. “What’s in a Name? A Critical Review of Definitions of Quantitative Literacy, Numeracy, and Quantitative Reasoning.” *Numeracy* 9(1): Article 2. <https://doi.org/10.5038/1936-4660.9.1.2>
- Madison, Bernard L. 2015. “Quantitative Literacy and the Common Core State Standards in Mathematics.” *Numeracy* 8(1): Article 11. <https://doi.org/10.5038/1936-4660.8.1.11>
- Madison, Bernard L. and Lynn Arthur Steen, eds. 2008. *Calculation vs. Context: Quantitative Literacy and Its Implications for Teacher Education*. Washington, DC: Mathematical Association of America.
- Rhodes, Terrel L., ed. 2010. *Assessing Outcomes and Improving Achievement: Tips and Tools for Using Rubrics*. Washington, DC: Association of American Colleges and Universities.
- “SIGMAA on Quantitative Literacy: Charter (2004)”.
http://sigmaa.maa.org/ql/_charters/2004.php
- Sons, Linda R., ed. 1994. *Quantitative Reasoning for College Students: A Complement to the Standards*. Washington, DC: Mathematical Association of America.

- Sons, Linda R. 2019. "The Sons Report (1989-1994, Mathematical Association of America): The Way It Was." *Numeracy* 12(1): Article 12. <https://doi.org/10.5038/1936-4660.12.1.12>
- Steen, Lynn Arthur. 1997. *Why Numbers Count: Quantitative Literacy for Tomorrow's America*. New York, NY: College Entrance Examination Board.
- Steen, Lynn Arthur, ed. 2001. *Mathematics and Democracy: The Case for Quantitative Literacy*. Princeton, NJ: The National Council on Education and the Disciplines.
- Steen, Lynn Arthur. 2004. "Everything I Needed to Know about Averages, I Learned in College." *Peer Review* 6(4): 4–8.
- Tunstall, Samuel L., Vincent Melfi, Jeffrey C. Craig, Richard Edwards, Andrew Krause, Bronlyn Wassink, and Victor Piercey. 2016. "Quantitative Literacy at Michigan State University, 3: Designing General Education Mathematics Courses." *Numeracy* 9(2): Article 6. <https://doi.org/10.5038/1936-4660.9.2.6>
- Tunstall, Samuel, Gizem Karaali, and Victor Piercey, eds. 2019. *Shifting Contexts, Stable Core: Advancing Quantitative Literacy in Higher Education*. Washington, DC: Mathematical Association of America.
- Wallace, Dorothy. 2019. "Three Formative Questions in the Quantitative Literacy Movement." *Numeracy* 12(1): Article 13. <https://doi.org/10.5038/1936-4660.12.1.13>

Appendix

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Luke Tunstall, Gizem Karaali, and Victor Piercey, Editors.

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