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Ten Years, Twenty Issues, and Two Hundred Papers of *Numeracy*: Toward International Reach and Transdisciplinary Utility

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Abstract

This issue completes the first ten years of *Numeracy*. The purpose of this introductory editorial is to review what has happened to the journal in those ten years. In the twenty issues, *Numeracy*'s output has been 201 papers counting the one or two editorials per issue. More than 50% of the papers are full, peer-reviewed articles, including 13 papers in two theme collections. The others are peer-reviewed notes and perspectives, editor-reviewed book reviews (15% of the total), and a column by contributing co-editor, Dorothy Wallace. The current issue marks an upswing in the number of notes, and our first discussion/reply. The number of papers per year has been increasing (e.g., 66% more in the last three years than in the first three years). The download rate has increased from about 5,000 in the first two years to 5,000 in about 40 days now.

The editorial goes on to document two main outcomes. First, the journal is gaining an international reach: more than half the downloads occur outside the United States now, and the number of contributions from outside the United States has increased from 4 in the first five years to 15 in the second five years. Second, the across-the-curriculum nature of quantitative literacy is coming to the fore. The transdisciplinarity of QL is strikingly evident in this issue, which is discussed in some detail, especially how it conforms to the mission of the Association of American Colleges and Universities.

The editorial ends with some results from a small *ad hoc* study of Google Scholar Citation Profiles. The question was, of the profiles that used "numeracy" or "quantitative literacy" as keywords, what other keywords did those profiles use, and what were the source countries? The results show that (1) QL is very much an American term, (2) there is, metaphorically, a vast and interesting numeracy ecosystem out there for *Numeracy* to engage and serve, and (3) as we become more global, the transdisciplinary relevance of numeracy/QL will emerge even more.

Keywords

numeracy, quantitative literacy, literacy, liberal education, National Numeracy Network, AAC&U essential learning outcomes, Australian Curriculum general capabilities, ETS student learning outcomes, Google Scholar citation profiles

Cover Page Footnote

Len Vacher is a professor of geology at the University of South Florida. The five keywords of his Google Scholar Citation Profile are "quantitative literacy," "numeracy," "geoscience education," "island hydrogeology," and "karst." His awareness of QL began in mid-2001 after 27 years of university teaching. He is a charter member of NNN, served on its first board of directors, after which he transitioned to founding co-editor of this journal. His QL beacons have been Bernie Madison and Dorothy Wallace from the beginning, and, for a few years now, his polestar for liberal education has been Nathan Grawe.

Output

This twentieth issue of *Numeracy* closes our tenth annual volume. With this milestone (and 201 papers counting this editorial), it is appropriate to recall the first editorial (Vacher and Wallace 2008):

> *Numeracy: Advancing Education in Quantitative Literacy* is the electronic journal of the National Numeracy Network (NNN). The mission of the NNN is to promote education that integrates quantitative skills across all disciplines and at all levels….
>
> …. *Numeracy* anticipates a variety of types of papers, a broad range of topics, and a wide audience. The types of papers include research articles, notes and reviews; evidence-based case studies; analyses and primers of methodologies; essays and issue papers; reviews of books and other educational resources; and commentaries/replies. The scope will include all topics relating to quantitative literacy…. The range of disciplines will span all the fields that need to cope with a world awash in numbers….
>
> In keeping with the transdisciplinary nature of QL and the extent and diversity of the stakeholders in QL, it is imperative that *Numeracy* be free of identification with particular disciplines as well as barriers that come with subscription fees [and page charges]. Accordingly, *Numeracy* is … sponsored by the University of South Florida Libraries, which is committed to ensuring that peer-reviewed research is Open Access.

How has that prospectus played out?

Table 1.
Types of Papers by Year and Issue.

	2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		sum
	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2	5.1	5.2	6.1	6.2	7.1	7.2	8.1	8.2	9.1	9.2	10.1	10.2	
Editorial	1	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	1	2	2	1	**24**
Theme Coll												8			5						**13**
Article	4	4	4	3	5	5	4	6	4	5	5	3	3	4	4	9	5	5	4	6	**92**
Note							1				1				1			1		4	**8**
Discussion or Reply																				2	**2**
Perspective	1	1		1	1	2			2				2		1	1			1		**13**
Book Revw	1	1	1	3	1		2	1		1			2	1	1	3	3	3	3	3	**30**
Column		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	**19**
count	**7**	**8**	**7**	**9**	**10**	**9**	**9**	**10**	**8**	**8**	**8**	**13**	**9**	**7**	**14**	**15**	**10**	**12**	**11**	**17**	**201**

Regarding the types of papers, Table 1 shows the run of counts for the various types as they are categorized for the current issue on the journal's homepage[1] and on the content page for each of the earlier issues.[2] For example, some 46% of the papers are articles, and another 15% are book reviews. We have had two theme collections (financial literacy in vol6/iss2 [2013], and assessment

[1] http://scholarcommons.usf.edu/numeracy/
[2] e.g., http://scholarcommons.usf.edu/numeracy/vol1/iss1/ for volume 1, issue 1.

in vol8/iss1 [2015]), and these collections with volunteer editors have contributed another 6.5 percentage points to the proportion of papers that are articles.

Editorials have held steady at one (with an occasional second) per issue, and so has Dorothy Wallace's column, which, with the piece in vol9/iss1 (Wallace 2016) has pivoted from a broad view of quantitative literacy in education to a focus on quantitative literacy for a calculus-level STEM clientele (biology). The editorials and columns are not peer-reviewed, and book reviews are editor-reviewed, now generally by Mike Catalano, our book review editor. Discussion/review exchanges are also editor- rather than peer-reviewed. They are making a long-awaited first appearance in this issue, inspired by the provocative paper by Ander Erickson in vol9/iss2 (Erickson 2016) about rethinking how much QL is needed for a citizen to make good decisions about public issues. *We are hoping to have more discussion/replie*s.

All the other papers are peer-reviewed by three to five (or more) reviewers: articles, theme collections, notes, perspectives (in all, 126 papers, 63% of the total). Notes, as can be seen with the current issue, are becoming more numerous; *that increase is intentional*. These contributions are intended to be of relatively modest scope and, hopefully, with a relatively shorter review/revision schedule for prompter dissemination of new ideas or findings. Perspectives, some of which may have been misclassified before our now-sharper concept of "notes," are meant to be peer-reviewed, scholarship-based, easy-on-the-editors[3] op-ed pieces, *and we would welcome more of them*.

It is also evident from Table 1 that the overall number of papers per year has been increasing. The current issue (vol10/iss2) with 17 papers has the highest per-issue count: 70% above the 20-issue mean (10 papers/issue) and more than twice the number in each of the first three issues. For the first five years, *Numeracy* averaged 17 papers per year; for the last five years, the average has been about a third higher (23.2 papers per year). The highest year is not 2017, though; it is 2015, which illustrates the spike effect of a theme collection; *we would welcome more of them too*. The rank-order of years is shown in Table 2.

Table 2.
Rank Order of Years by Papers Per Year

Year	Papers per Volume
2015	29
2017	28
2016	22
2013	21
2011	19
2010	19
2014	16
2012	16
2009	16
2008	15

Download rates have increased too, of course, as has been noted in several editorials along the way. For example, the editorial in the fifth issue, vol3/iss1 (Vacher 2010), announced our passing the 5000 full-text download mark in late October 2009, some 22 months after the journal's launch. About 14 months later (July 2011), the journal passed 10,000

[3] Meaning well written and cognizant of our Instructions to Authors: http://scholarcommons.usf.edu/numeracy/policies.html.

downloads, and six months after that, it passed 15,000 (Vacher 2011, vol4/iss2). The six-figure (i.e., 100,000) mark was passed in May 2015 (Grawe 2015, vol8/iss2) about four years after the five-figure (10,000) mark. About 10 months later, at the time of the "Grassroots numeracy" editorial (Vacher 2016, vol9/iss2), the download count was about 130,000, and then the count was increasing at the rate of about 36,000 per year, or a little less than 100/day (Fig. 1). Today, about one year later, the number of downloads is increasing at a 12-month average rate of more than 130/day, or about 50,000 per year. Thus, at the 10-year mark, *Numeracy* downloads in a 40-day period generally exceed the number of *Numeracy* downloads that occurred during our first two years.

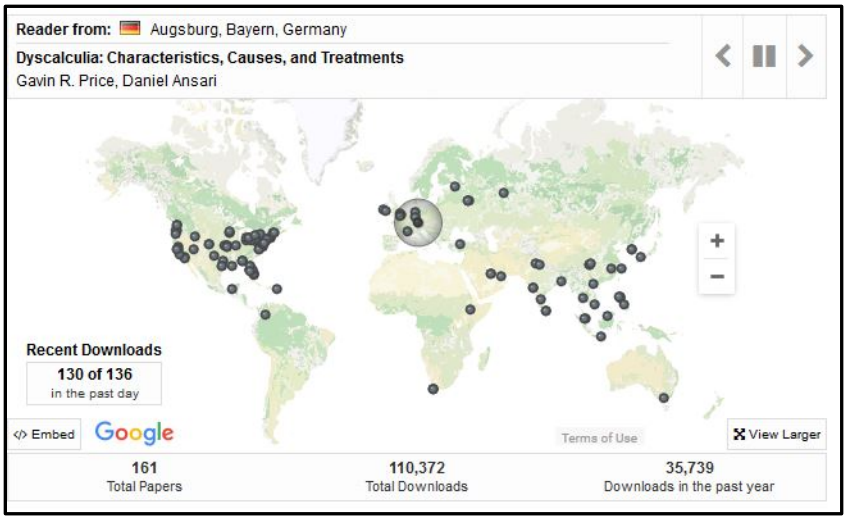

Figure 1. Snip from the map at the bottom of the home page of *Numeracy* at 9:00 am EDT, May 18, 2016, showing location of 130 of the 138 downloads of *Numeracy* papers in the preceding 24 hours.[4] (From Vacher 2016.)

Toward International Reach

Thanks to our publishing platform,[5] the homepage of *Numeracy* includes a world dot map showing the locations of downloads of *Numeracy* papers in the preceding 24 hours. For example, at the time I snipped the map of Figure 1 from my computer screen (about a year ago), it was showing that there had been 136 *Numeracy* downloads in the past day and 35,739 in the past year; at that instant, it was in the process of adding the 130th dot to the map (shown with the surrounding circle). That dot represents the download of the paper by Price and Ansari (2013) at a location in Augsburg, southeastern Germany (Free State of Bavaria, i.e.,

[4] The "Total Downloads" at the bottom of the map are about 24,500 too few. It appears that the count was restarted in mid-2012.
[5] https://www.bepress.com/products/digital-commons/

Freistaat Bayern). The overall map clearly shows the internationality of *Numeracy* – concentrated in the United States and reaching out globally.

The numbers tell the same story. Some were included in the appendix of the "Grassroots numeracy" editorial (Vacher 2016). As described in the text of that editorial,

> … In 2015 and the first quarter of 2016, there were 42,085 downloads from a total of 178 "countries" (including such entities as Bermuda and Puerto Rico that are not included in the 193 member states of the UN). About 50% of the downloads were in the U.S. The top 10 countries by downloads had about 75% of the downloads. The top 34 countries by downloads (down to Saudi Arabia, with 147) had 90% of the downloads. The top 100 countries (down to Tunisia and Kazakhstan, with 15 each) had 99% of the downloads.
>
> All 34 member countries of the Organisation for Economic Co-operation and Development (OECD) downloaded papers…. About 29,000 (69%) of the 42,000 total downloads were in OECD countries. Putting the ca. 21,000 downloads from the U.S. aside (from both numerator and denominator), about 62% of the non-U.S. downloads were from outside the OECD countries (13,106/21,223).

For authors and potential authors, it is worth noting that authors have access to a dashboard whereby they can find the location of downloads of their papers. For example, the global distribution of downloads of "Clinician Numeracy: The Development of an Assessment Measurement for Doctors" (Taylor and Byrne-Davis 2016) is shown in Figure 2. The graduated circles show regional counts on a logarithmic scale (here, one- vs. two-digit counts).[6]

Figure 2. Download map for Taylor and Byrne-Davis (2016), for the period Jan 7, 2016 – June 26, 2017. (279 downloads.)

[6] For a graduated-circles map of *Numeracy* downloads with five different sizes and colors of circles representing five different orders of magnitude of counts, see the "Inception-to-2016 Readership" map on the new NNN website http://thenationalnumeracynetwork.wildapricot.org/Numeracy-Journal

For readers who enjoy quantitative map-literacy problems, it is worth noting that reading binned-data thematic maps such as these readership-distribution presentations makes for some numbing exercises in map and geographic literacy coupled with numeracy. For example, repeatedly drilling down (clicking) on the 13-download circle and its successor(s) at West Africa on the live version of Figure 2 reveals that there were 9 downloads in Nigeria and 4 in Ghana. That's the easy one. More difficult is working out the 56 downloads in northwestern Europe. It turns out that the "56" includes 37 in England, 4 in Northern Ireland and 2 in Ireland (hence, 41 in the UK and 43 in Great Britain), along with 5 in Germany (2 in Heidelberg, 1 in Stuttgart, 1 in Nordrhein-Westfalen, and 1 in Berlin), 1 in France (Strasbourg), 3 in the Netherlands, 3 in northern Italy, and 1 in the Czech Republic; to determine that breakdown, I had to figure out that the "9" in the western Mediterranean represents 2 in Algeria, 4 in Spain, 1 in Portugal, and 2 in Italy (Sardinia); and the "7" in northeastern Europe collects the 3 in the Russia Federation (Moscow), 2 in Poland, 1 in Hungary (Budapest), and 1 in Romania. All told, the 279 downloads were by 41 countries distributed as shown in Table 3 (the constraint for figuring out the 56-9-7). Thus, as is commonly the case now in *Numeracy*'s tenth year, a little more than 50% of the downloads occurred outside the United States. (Actually, the non-U.S. proportion for this paper by Taylor and Byrne-Davis is 52.3% [146/279]. For comparison, the all-*Numeracy* non-U.S. proportion for the five quarters Jan 1 2015 – Mar 31 2016 discussed in "Grassroots numeracy" was 50.5% [21,233/42085], and the all-*Numeracy* non-U.S. proportion for 90 days preceding this editorial [Mar 19 – Jun 17 2017] was 55.1% [6,126/11,108]).

Table 3.

Downloads of Taylor and Byrne-Davis (2016) by Country, Jan 7, 2016 – June 26, 2017.

1-4	United States (133); United Kingdom (41); India (15); Nigeria (9);
5-8	Germany (5), Italy (5), South Africa (5); Canada (5);
9-11	Spain (4), Hong Kong (4); Ghana (4);
12-15	Indonesia (3); Mauritius (3) Netherlands (3), Russian Federation (3);
16-26	Australia (2); Bermuda (2); Chile (2); China (2); Algeria (2); Ireland (2); Japan (2); Pakistan (2); Poland (2); Saudi Arabia (2); Thailand (2)
27-41	Republic of Korea (1); Czech Republic (1); Egypt (1); France (1); Hungary (1); Israel (1); Kenya (1); Ecuador (1); Peru (1); Portugal (1) Romania (1); Syrian Arab Republic (1); Turkey (1); Taiwan (1); Yemen (1).

It would be interesting to see if the foregoing data are evidence of a trend that the proportion of international downloads is increasing, but the data are simply too difficult to work with to do so easily. What seems easier to see is that there is an increase – a welcome increase! – in contributors from outside the United States. For example, counting this issue (vol10/iss2), the sequence of 10 annual counts of papers from outside the United States, starting with volume 1 (2008) is: 0, 0, 0, 1, 3, 5, 2, 1, 4, 3. In other words, the mean for the first five years is 0.8

papers/year, and the mean for the second five years is 3.6 papers/year. The provenance of those 19 papers (in ten years) is: South Africa (4 papers, 3 author-sets), Australia (3 papers, 3 author-sets), England (UK) (4 papers, 2 author sets), Canada (2 papers, 2 author sets), Israel, Scotland (UK), Germany, France, Switzerland, Austria, and so we have had 19 papers from 16 different sets of authors from outside the United States. Admittedly, the 5-count in year-6 (2013) is somewhat anomalous because it includes the financial literacy theme collection where one of the theme-collection editors was aiming specifically for an international sampling; thus four of the eight papers in the theme collection were "Financial Literacy in Country *x*" (Switzerland, France, Australia, Romania). Don't count those four papers, and the run of annual international papers gives a first five-year mean of 0.8 papers/year, and a second five-year mean of 2.2 papers/year. We'll take that as a suggestion that our international sources might be increasing and as an impetus to *encourage our international readers to send us more papers about their studies, findings, and perspectives*.

One of the benefits of increasing the number of contributions from non-U.S. authors, of course, is that we learn from the fresh input. That appears to be especially the case with this issue, where a paper from Australia tells us, in "Numeracy Across the Curriculum …" (Forgasz et al.), of a national program that seems more in line with the thinking of our Association of American Colleges and Universities (AAC&U) (and *Numeracy*!) than is our own. Another lesson learned will be noted in the concluding remark of this editorial.

Outcome: Transdisciplinary Utility

One of the most important developments on the landscape of QL education during *Numeracy*'s first ten years was the publication in 2011 of the AAC&U's Learning Education and America's Promise (LEAP) document.[7] The AAC&U, recall, is a prominent organization of more than 1200 American higher-education institutions with the mission "to make liberal education and inclusive excellence the foundation for institutional purpose and educational practice in higher education."[8] Its definition of liberal education is clear: "a philosophy of education that empowers individuals with broad knowledge and *transferable skills* (emphasis added) and a strong sense of value, ethics, and civic engagement."[9] Also clear, from the LEAP document, is the central role to be played by QL education. Under the heading, *The Essential Learning Outcomes* (emphasis added), the LEAP document states (p.7), "Beginning in school, and continuing at

[7] www.aacu.org/sites/default/files/files/publications/LEAP_Vision_Summary.pdf. *The LEAP Vision for Learning: Outcomes, Practices, Impact, and Employers' Views*.
[8] http://www.aacu.org/about/strategicplan#Priority
[9] http://www.aacu.org/resources/liberal-education

successively higher levels across their college studies, students should prepare for twenty-first century challenges by gaining" the following:

1. Knowledge of Human Cultures and the Physical and Natural World,
2. Intellectual and Practical Skills,
3. Personal and Social Responsibility, and
4. Integrative and applied learning.

Under the Intellectual and Practical Skills Essential Learning Outcome, the document listed six individual intellectual and practical skills:

- Inquiry and analysis
- Critical and creative thinking
- Written and oral communication
- Quantitative literacy ←
- Information literacy
- Teamwork and problem solving

The LEAP document thus frames the four Essential Learning Outcomes as four dimensions of liberal education. The first is to be gained "*through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts*" (emphasis added). The second is to be "practiced extensively, *across the curriculum* (emphasis added), in the context of progressively more challenging problems, projects, and standards for performance." The third is "anchored through active involvement with diverse communities and real-world challenges" (e.g., service learning). The fourth is "demonstrated through the application of knowledge, skills, and responsibilities to new settings and complex problems" (e.g., a capstone experience).

Focusing on the first two Essential Learning Outcomes, it is easy to conceptualize a two-dimensional spreadsheet metaphor in which the first, the knowledge in the disciplines (i.e., sciences and mathematics, social sciences, humanities, histories, languages, and the arts) makes rows and the second, the Intellectual and Practical Skills (e.g., quantitative literacy), make cross-cutting columns (e.g., Vacher 2011). Thus, QL and the other intellectual and practical skills are *transdisciplinary*.

The LEAP document was an important development in multiple ways. The inclusion of QL in the same class as those other obviously essential and transdisciplinary skills was an immense endorsement of QL's unassailable value. That QL is not only an *essential* learning outcome but also a *transdisciplinary* learning outcome effectively refuted the notion that QL is a branch solely within mathematics and solely the responsibility of mathematicians. It, therefore, also

redirected the old problem that QL is everybody's orphan (Madison 2001). No, QL is the responsibility of every educator.

The two-dimensional spreadsheet metaphor that conceptualizes mathematics as a disciplinary-knowledge learning outcome and QL as a transdisciplinary-skill learning outcome tightens the whole fabric by which our students can learn to understand and deal with our quantitative world. Thus, with strong mathematics education *and* strong QL education, students' mathematics knowledge (including skills) can be transported into their other learning areas to the benefit of their understanding of appropriate aspects of those disciplines; also, simply by the practice of applying their mathematics in the context of those other disciplines, the students can strengthen their understanding of mathematics itself. With strong mathematics education and strong QL education, therefore, we have a two-way street: from mathematics to other disciplines, and from other disciplines to mathematics.

The concept that QL is the responsibility of every educator is actualized in Australia. As our new Australian contributors to *Numeracy* tell us in their abstract, "In the Australian Curriculum, there is an expectation that teachers at all grade levels and in all subject areas develop students' numeracy capabilities" (Forgasz et al.). As explained in the text of their paper, the Australian Curriculum includes eight content learning areas (one of which is mathematics) and seven general capabilities (one of which is numeracy). The thinking I characterize as a "two-way street" is illustrated with respect to the numeracy capability in an excerpt that the authors include from the Australian Curriculum website:

> In the Australian Curriculum, students become numerate as they develop the knowledge and skills to use mathematics confidently across other learning areas at school and in their lives more broadly….
>
> When teachers identify numeracy demands across the curriculum, students have opportunities to transfer their mathematical knowledge and skills to contexts outside the mathematics classroom. These opportunities help students recognise the interconnected nature of mathematical knowledge, other learning areas and the wider world, and encourage them to use their mathematical skills broadly.

As evidenced in another paper in this issue (Roohr et al.), there is a parallel in a developing story in the corporate world of assessment. Recall, the AAC&U has six transdisciplinary Intellectual and Practical Skills: (1) inquiry and analysis, (2) critical and creative thinking, (3) written and oral communication, (4) quantitative literacy, (5) information literacy, (6) teamwork and problem solving. The Australian Curriculum has seven transdisciplinary General Capabilities: (1) literacy, (2) numeracy, (3) information and communication technology capability, (4) critical and creative thinking, (5) personal and social capability, (6) ethical understanding, (7) intercultural understanding. Now, the world's largest private

nonprofit educational testing and assessment organization,[10] the ETS (Educational Testing Service),[11] is developing a suite of assessments for five transdisciplinary SLOs (Student Learning Outcomes): (1) critical thinking, (2) quantitative literacy, (3) written communication, (4) civic competency and engagement, (5) intercultural competency and diversity. The set is called the *HEIghten*™ Outcomes Assessment Suite[12] (the capitalized HEI stands for Higher Education Institution). According to our new corporate contributors, the *HEIghten* Outcomes Assessment Suite is "intended to measure general education SLOs for all college students, regardless of college major." In particular, they say, "*HEIghten* Quantitative Literacy is a college-level assessment that evaluates students' abilities to comprehend, detect, and solve mathematics problems in authentic contexts (including personal and everyday life, workplace, and societal contexts) across a variety of mathematical content areas."

Those two papers (Forgasz et al. and Roohr et al.) individually make the point of the across-the-disciplines interest of *Numeracy*. In fact, this entire issue (i.e., vol10/iss2) makes the point collectively, as shown by the thumbnail-sketch "catalog descriptions" of the 17 papers of Table 4. The 17 papers have a total of 31 different authors. Ten authors are from math or math education (8 papers); the others are from a wide variety of fields, including psychology (including psych ed), sociology, education measurement, health and medicine, biostatistics, STEM (physics, environmental science, geology), and humanities. Specific courses include Numeracy for Learners and Teachers, Quantitative Reasoning for Professionals, Research Methods and Introductory Statistical Concepts, Quantitative Reasoning for Teachers, Calculus 1, and Computational Geology. Target audiences for individual courses include general university, business students, education majors, STEM majors, geology majors, biology/pre-med majors, and graduate students in health informatics (med school). As is usually the case, there are multiple papers in assessment, and here too the diversity is broad: for all-university, general education assessment (Roohr et al.); of recently qualified medical doctors (Taylor and Byrne-Davis); of community college students in a major urban setting (Wolfe and Holland). Also, as usual, there is the chewing on questions of the meaning and scope of QL itself (Hammen; Erickson; Grawe; Kelly, and Tunstall and Beymer, not to mention this editorial).

[10] http://www.fundinguniverse.com/company-histories/educational-testing-service-history/
[11] https://www.ets.org/.
[12] https://www.ets.org/heighten

Table 4.
The Intersection of Math, Numeracy, and the Disciplines in the 17 Papers in this Issue of *Numeracy*

Code[13]	Thumbnail sketch, "catalog description" of paper
10.2.1	Editorial, by a geologist, who argues that *Numeracy* is actively tying mathematics and the disciplines together.. ***Vacher.***
10.2.2	Article in which three mathematics education faculty at the largest university in Australia describe a graduate-level course, *Numeracy for Learners and Teachers*, which prepares teachers to teach numeracy in contexts across the curriculum . Explores how both learners and teachers understand numeracy vs. mathematics. ***Forgasz et al.***
10.2.3	Article in which five assessment experts, including one in academia, describe the ETS study that provides evidence of the psychometric quality of pilot forms for the new *HEIghten* quantitative literacy SLO assessment for students in higher education. ***Roohr et al.***
10.2.4	Article in which a mathematician illustrates what QR brings to teaching algebra by describing the theoretical background, content, and preliminary assessment results for materials implemented in *Quantitative Reasoning for Professionals*, a hybrid QR-algebra course for business students. ***Piercey.***
10.2.5	Article in which two medical/health professionals/educators from northern England used their new Medical Interpretation Numeracy Test (MINT, *Numeracy* 9.1.5) to evaluate the Clinician Numeracy of 135 recently qualified doctors in the UK. ***Taylor and Byrne-Davis.***
10.2.6	Article in which a psychologist and a sociologist explored the suitability of the Subjective Numeracy Scale, which was developed originally for health-care use, in a new context: predominantly minority students in their classes (anthropology; sociology; psychology) at an urban (NYC) community college. ***Wolfe and Hoiland.***
10.2.7	Article where two professors, of health care policy and biostatistics, respectively, at two leading NYC medical schools, provide an efficient primer on using visual analogies to teach QL-level medical and health statistics, as drawn from a review of the literature and their teaching experiences. ***Ancker and Begg.***
10.2.8	Note in which a sociology faculty member surveys sociology department chairs to explore how statistics curricula in undergraduate sociology programs are structured, what courses are offered, what pedagogical practices are incorporated, and how successful the surveyed sociologists believe themselves to be in their efforts. ***Deckard.***
10.2.9	Note in which a mathematician provides a detailed description of *Quantitative Reasoning for Teachers*, an online graduate course designed for community college instructors and K-12 teachers for teaching foundational aspects of quantitative reasoning. ***Stump***.
10.2.10	Note in which three STEM professors and a physics undergraduate (the lead author) report on an *ad hoc* study that found that first-year *Calculus I* students, despite coaching, were unable to successfully and correctly incorporate figures (graphs) in their technical writing assignments. Conclusion: explicit instructional time is needed. ***Antonacci et al.***
10.2.11	Note in which a geology doctoral student and senior professor who team teach *Computational Geology* report on their *post hoc* study of attitudes toward math expressed in the weekly written reactions of the students to a chapter-per-week reading of a book by a well-known, prolific popularizer of mathematics. ***Ricchezza and Vacher.***
10.2.12	Discussion in which a mathematician disputes the assertion, made in a previous issue of *Numeracy* (9.2), that QL plays only a surprisingly limited and unessential role in a citizen's ability to make responsible decisions on behalf of the public good. ***Hamman***.
10.2.13	Reply by the original author, also a mathematician. ***Erickson.***
10.2.14	Book review by humor expert and emeritus professor of English on two classics by Lewis Carroll (*Alice and Wonderland*, and *Through the Looking Glass*), and how they can be read now, after reading and analyzing *Innumeracy* and other books of John Allen Paulus, to give insight to continuing discussions of numeracy and QL. ***P. Grawe.***
10.2.15	Book review by a psychology professor of Daniel Kahneman's *Thinking Fast and Slow*, and its insights to the intuitive System 1(fast, and prone to error and laden with heuristics and mental shortcuts) vs. deliberative System 2 (slow, and requiring of effort) – the tensions between them and how they can work together. ***Kelly.***
10.2.16	Book review by a doctoral student in mathematics education and a doctoral student in educational psychology and educational technology of Daniel Kahneman's *Thinking Fast and Slow*. Includes a review of the two systems and discusses how the biases and heuristics of System 1 can be addressed in the QL classroom. ***Tunstall and Beymer.***
10.2.17	Column in which a mathematician tells how she teaches QR in a calculus course populated by both biology majors and math majors. The key is thorough integration of team research projects, many of which lead to further research after the course and in some cases published research papers. ***Wallace***.

[13] The three-part number gives the volume, issue, and article number of the paper, as they appear in the end of the DOI which is activated upon publication. See examples of full DOIs in the references.

Concluding Remark

This decadal review editorial has aimed to document the broad, indeed global, interest in QL and the vibrancy of the community that supports it. After ten years, the journal is being read as much internationally as nationally, and non-mathematicians are contributing as much as mathematicians. Whatever we call it – essential learning outcome (AAC&U), general capability (Australian Curriculum) or student learning outcome (ETS) – QL and numeracy clearly resonate. Although the title of the editorial includes "*Toward* International Reach and Transdisciplinary Utility" (emphasis added), it is also true that we have only begun to scratch the surface of what's out there. That is certainly a conclusion that can be drawn from the results of a little study of Google Scholar Citation Profiles (GSCPs) summarized in Table 5.

Table 5

Keywords Used by Authors in their Google Scholar Citation Profiles

Keywords (mostly grouped)	Number of Scholars in Nm ∪ QL and their Home Countries	Nm	QL	Nm ∩ QL
Mathematics education	GSCPs = 8 → Australia (4), United States, South Africa, United Kingdom, Malaysia	8	–	∅
Assessment	GSCPs = 6 → United States (4), Pakistan, Australia	6	1	1
Assessment (3), evaluation, human performance, Rasch measurement, test development, testing and assessment,				
Education, various	GSCPs = 16 → United States (5), Australia (4), Malaysia (2), Netherlands (2), South Africa, United Kingdom, Singapore	14	3	1
Special education (3), preservice teacher education (2), autism, computational thinking in education, early childhood education, economics of education, international education, intervention, learning problems, learning through play approach, module development, multimedia learning, primary school, professional learning communities, single sex, teacher education literacy, teacher knowledge, teaching, teacher professional learning, technology, zone of proximal development				
Literacy and Language	GSCPs = 5 → Netherlands (2), Australia, United States, Singapore	5	–	–
Literacy (4), language, language and text analysis, language of mathematics, reading, second language				
Mathematics, various	GSCPs = 6 →United States (4), Australia, Malaysia	3	4	1
Mathematics, mathematical thinking, fractions, fractional calculus, humanistic mathematics, quantitative reasoning, quantum algebra, representation theory				
Data, statistics, and statistics ed	GSCPs = 7 → United States (6), Australia	3	5	1
Computational modeling, data science, data visualization, health outcomes, interactive math and data visualization, Monte Carlo simulations, numerical modeling, research methods, statistics education, statistics in health sciences, stochastic processes				
Decision making and risk literacy	GSCPs = 8 → United States (3), Pakistan, United Kingdom, Sweden, Poland, Colombia	8	–	–
Decision making (4), risk literacy (3), decision making under risk and uncertainty, risk, risk perception, risk perception and communication, judgment, judgment and decision making, resilience, climate change adaptation, critical thinking, consumer behavior				
Affect, emotion	GSCPs = 5 → United States (2), United Kingdom,, Sweden, Malaysia	4	1	–
Affect/emotion, emotion, emotions, motivation, mathematical beliefs and attitudes				
Miscell soc and psych	GSCPs = 9 →United States (3), Australia (2), Sweden, Poland, United Kingdom, Netherlands	7	2	–
Aging, faith leadership, family sociology, gender, health outcomes, inclusion, leadership, neuroimaging, psychology, shape perception, social environment, visual object recognition, visuospatial representation				
Economics, business	GSCPs = 5 → United States (3), Germany, Colombia	4	3	2
Economic development, economic growth, human capital, inequality, labor economics, leadership and social justice, marketing, matching theory and social choice				
Miscell geoscience	GSCPs = 3 → United States (3)	2	3	2
Geoscience education (2), geophysics, island hydrogeology karst, planetary geology, volcanology				

Currently there are 11 online GSCPs for authors who list "quantitative literacy" as a keyword[14] ($\mathrm{QL} = 11$). There are 30 authors who list "numeracy" as a keyword ($\mathrm{Nm} = 30$). Five authors list both of them as keywords ($\mathrm{Nm} \cap \mathrm{QL} = 5$). And so there are 36 authors who list "numeracy" or "quantitative literacy" ($\mathrm{Nm} \cup \mathrm{QL} = 36$), six authors who list "quantitative literacy" and not "numeracy" ($\mathrm{QL} \backslash \mathrm{Nm} = 6$), and 25 authors who list "numeracy" and not "quantitative literacy" ($\mathrm{Nm} \backslash \mathrm{QL} = 25$).

Of the 36 authors in $\mathrm{Nm} \cup \mathrm{QL}$ found from the GSCPs, 17 are from the United States. The other 19 are from 11 different countries (Australia, 6; the Netherlands, 2; the United Kingdom, 2; Malaysia, 2; Germany; Pakistan; South Africa; Sweden; Poland; Colombia; Singapore).

Now, get this: those 17 U.S. authors include *all* 11 of the authors who volunteered "quantitative literacy" as a keyword. Therefore, *all* 19 of the authors from outside the United States volunteered "numeracy" and *not* "quantitative literacy." In contrast, the 17 U.S. authors are distributed as follows: six declared "quantitative literacy" and not "numeracy" $[(\mathrm{QL} \backslash \mathrm{Nm})_{\mathrm{US}} = 6]$; six declared "numeracy" and not "quantitative literacy" $[(\mathrm{Nm} \backslash \mathrm{QL})_{\mathrm{US}} = 6]$; and, as noted before, five declared both $[(\mathrm{Nm} \cap \mathrm{QL})_{\mathrm{US}} = 5]$. How's that for indecisiveness? In any event, these data are consistent with the notion that, outside the United States, "numeracy" is the preferred label for the "numeracy" vs. "quantitative literacy" choice. Moreover, it seems, to some extent anyway, the following holds: "numeracy" is to "quantitative literacy" as "biscuit" is to "cookie," and "lorry" is to "truck," and "motorway" is to "highway." As we expand internationally, and that seems to be the trend, we need to keep language (synonymy, polysemy, and word choice in general) in mind.

Table 4 lists the other keywords chosen by these 36 authors of $\mathrm{Nm} \cup \mathrm{QL}$ from GSCPs along with information on how the selections of those keywords vary by country. The additional keywords are collected into eleven groups. To illustrate how the table works, consider the first row. Eight authors who listed "numeracy" **or** "quantitative literacy" as keywords in their GSCP (i.e, GSCPs = 8) also listed "mathematics education" as a keyword. Around the world, these eight "scholars" (as labeled in the header row of the table) are: 4 in Australia and 1 each in the United States, South Africa, the United Kingdom, and Malaysia. All eight of them chose "numeracy" as a keyword, meaning, of course, that none of them, including the one from the U.S., chose "quantitative literacy."

For a slightly more complicated example, consider the second row: the case of keywords that I have lumped together under assessment. Six authors who listed "numeracy" **or** "quantitative literacy" as keywords in their GSCP (GSCPs = 6) also listed at least one from the following: "assessment," "evaluation," "Rasch

[14] Up to five keywords are allowed for a citation profile.

measurement," "test development," "testing and assessment." Three of the six scholars actually chose "assessment." All six chose "numeracy." One of them also chose "QL." Thus the set of "assessment keyword-selectors" consisted of one from the U.S., who selected both "numeracy" and "quantitative literacy" (an author very familiar to *Numeracy* readers, by the way), and three from the U.S., one from Pakistan, and one from Australia, all of whom selected "numeracy" and not "QL."

While the split of the 36 authors in Nm ∪ QL between the United States and "other countries" is nearly even (18 ± 1), co-selection of the keyword "mathematics education" (group 1 in Table 5), and keywords from "education, various" (group 3), "literacy and language" (group 4), "decision making and risk literacy" (group 7), "affect and emotion" (group 8), and "miscellaneous sociology/psychology" (group 9) was consistently more by the authors from "other countries" than by the American authors. For these six groups of keyword choices, the overwhelming "numeracy"-vs.-" quantitative literacy" co-selection was "numeracy." In contrast, authors who co-selected keywords from "mathematics, various" (group 5), "data, statistics, and statistical education" (group 6), and "miscellaneous geoscience," were predominantly from the United States and mostly chose "quantitative literacy." On the other hand, co-selectors of keywords from "assessment" (group 2) and "economics, business" (group 10) were mostly from the United States and mostly selected "numeracy." Although the data from the GSCPs are not numerous, they may be suggesting something of a split between an association of "quantitative literacy" as a label, mathematics, and the United States on one side and an association of "numeracy" as a label, mathematics education, across-the-curriculum, and countries outside the United States on the other.

What about *Numeracy* authors? Of the 36 authors in Nm ∪ QL from GSCPs, 11 have published at least one paper in the first ten volumes of *Numeracy*. Ten of those 11 are from the United States. Thus seven American authors in Nm ∪ QL from the current GSCPs are yet to publish in *Numeracy*. Meanwhile one of the outside-U.S. authors in Nm ∪ QL from the GSCPs has published in *Numeracy* (meaning that 18 haven't yet). Also of interest, nine of the 11 GSCPS that selected QL have published in *Numeracy*, including all five who selected both "quantitative literacy" and "numeracy." Meanwhile four of the six GSCP authors who selected "numeracy" and did not select "quantitative literacy" have not yet published in *Numeracy*.[15]

[15] It is also the case that *several* authors who have published in *Numeracy* and have created Google Scholar Citation Profiles did not select either "numeracy" or "quantitative literacy" as keywords, and *many* authors who have published in *Numeracy* have not created Google Scholar Citation Profiles.

The bottom line is this: while the *Numeracy* data indicate increasing interest, reach, and transdisciplinarity of QL, the GSCPs go further. Not only do the GSCOs affirm the interest, they suggest that as contributions from beyond the United States increase, the evident transdisciplinarity of QL (meaning numeracy) will likely increase as well. Thus, it is likely that, as *Numeracy* continues to provide an outlet for scholarship in quantitative literacy and numeracy, that construct, whatever we call it, will become increasingly recognized as "everybody's responsibility" – an educational value like literacy itself.

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