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The Second Decade of *Numeracy*: Entering the *Seas of Literacy*

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The Second Decade of *Numeracy*: Entering the *Seas of Literacy*

Abstract

This multipurpose editorial explores and tries to count the many types of literacy that are referred to by name in Wikipedia and *Numeracy*. Wikipedia's Category:Literacy page identifies 44 kinds of literacy that are the subject of articles, ranging from numeracy and graphicacy to braille literacy and diaspora literacy. In addition, searching Google finds more than 30 adjective-literacy or noun-literacy collocations, including quantitative literacy, adult literacy, and document literacy, that do not have Wikipedia pages of their own but are mentioned on other Wikipedia pages. The sum puts this modest literacy count in line with the more than 70 bodies of water called "seas" according to the International Hydrographic Organization and thus suggests *Seventy Seas* of Literacy as apt for a metaphoric *Literacy World Ocean*. As for *Numeracy*, full-text searching using the bepress search tools provided on the journal's landing page identifies at least 15 types of literacies, ten of which were used as keywords. The search also finds six different adjective- or noun-*numeracy* collocations in *Numeracy*, including adult numeracy, health numeracy, and situated numeracy, disproportionately used by international authors. The facility of making numeracy collocations prompts the notion of a metaphoric *Sea of Numeracy* as a candidate to be one of *Seven Seas* of Literacy. Extending the metaphor, the numeracy collocations would be fertile, life-sustaining estuaries along the coast of the numeracy sea, where seawater from numeracy mixes with freshwater inflow from the disciplinary or cultural contexts identified by the modifier in the collocation.

In addition to submitting this metaphoric view of literacies and numeracies, this editorial aims to familiarize *Numeracy* readers with our search tools and to make a case for consideration and care in regard to keywords. Also, we call attention to some changes in the makeup of the managing editors, the rollout of some new types of papers ("From Book Authors" and "Roots and Seeds"), and a new theme collection on social justice.

Keywords

literacy, metaphor, Literacy World Ocean, new literacies, transliteracy, numeracies, keywords, Wikipedia, bepress search tools, collocations

Cover Page Footnote

Len Vacher is a professor of geology at the University of South Florida. He is a Fellow of the Geological Society of America and the 2004 recipient of the National Association of Geoscience Teachers' Neil Miner Award. He served on the charter board of the NNN, was a founding co-editor this journal, and currently is one of its Senior Editors. He received the Bernie Madison Award at the NNN's 2017 annual meeting in New York.

The last issue of 2017 marked the closing of *Numeracy*'s first decade. The editorial in that issue (Vacher 2017) made two points: (1) collectively, the papers demonstrate the transdisciplinary scope of our field, and (2) *Numeracy* has begun to get a steady stream of papers from authors outside the United States.

Now, with this issue, we have entered our twelfth year. Both observations of a year and a half ago still apply.

Additionally, it is becoming clear that the transdisciplinary nature of numeracy means that our papers are intersecting other literacies.

Also, with the continued growth of the journal, we have expanded the number and distribution of managing editors and added some new features (see Table 1).

Table 1.
Changes to Numeracy

Managing editors
Nathan Grawe took the reins as Executive Editor with issue 11(1). At the same time, founding Co-Editors Len Vacher and Dorothy Wallace became Senior Editor and Contributing Editor, respectively. With this issue, 12(1), Bernie Madison, first president of the National Numeracy Network and co-author of the first article in our inaugural issue (Madison and Steen 2008), joins in as Senior Editor. Meanwhile, Mike Catalano, who started as Book Review Editor with issue 7(1), continues with that portfolio.
"From Book Authors"
Our new feature of reflections by authors on their new books was kicked off in issue 11(1) by John Allen Paulos (2018; *A Numerate Life*) and Jason Makansi (2018a; *Painting by Numbers*). That was followed in 11(2) by Tim Dixon (a18, *Curbing Catastrophe*) and Nathan Grawe (2018, *Demographic Change and the Demand for Higher Education*).
"Roots and Seeds"
Our new feature of recollections of and reflections on the history of our field as an educational entity is inaugurated in this issue by Linda Sons (2019) and Dorothy Wallace (2019a).
Theme Collection: Social Justice
Our third theme collection, Social Justice, edited by Kira Hamman, Luke Tunstall, and Victor Piercey, appears in this issue, 12(1). The first two theme collections were Financial Literacy, edited by Annamarie Lusardi, Audrey Brown, and Dorothy Wallace, in issue 6(2), and Assessment, edited by Donna Sundre, in issue 8(1).

Keywords

An untold number of ideas have been lost because they were obscured by an article with a general title and no key words. (Merriam 2012, 6)

For a glimpse at the expansive scope of *Numeracy* now, one can browse the keywords authors have chosen for their papers thus far in our second decade.

Last year in issue 11(1), and selecting only one keyword per paper, we have *pathways* (Gaze 2018), *discourse analysis* (Oughton 2018), *lexical ambiguity* (Kaplan and Rogness 2018), *reference and thematic maps* (Xie et al. 2018), *economics* (Grawe and O'Connell 2018), *liberal arts majors*[1] (Perez et al. 2018), *statistics education* (Hassad 2018), *science education* (Makansi 2018a), *social justice* (Tunstall 2018a), *biography* (Hamman 2018a), and *laboratory exercise* (Wallace 2018a).

From issue 11(2), there are: *community colleges* (Mellow 2018), *social practice* (Craig and Guzmán 2018), *assessment* (Frith and Prince 2018), *language arts* (Agnello 2018), *India* (Jayaraman et al. 2018), *household income* (Best 2018a), *citizenship* (Briggs 2018), *climate change* (Dixon 2018), *Higher Education Demand Index* (Grawe 2018), *global warming* (Hamman 2018b),

[1] From the title of the paper.

relative risk (Makansi 2018b), *modeling* (Catalano 2018), *metrics* (Best 2018b), *popular science* (Tunstall 2018b), and *service learning* (Wallace 2018b).

Now the present issue, 12(1): it starts with a theme collection whose title is itself a keyword in the context of quantitative numeracy – *social justice*. It follows then with a typically diverse set of 11 papers, and the following selection of one-per-paper keywords: *information literacy* (Erickson 2019), *graphical comprehension* (Bolch and Jacobee 2019), *learning outcomes* (Mayfield and Stewart 2019), *task design*[2] (Glassmeyer 2019), *financial education* (Willows 2019), *MAA-CUPM* (Sons 2019), *National Numeracy Network* (Wallace 2019a), *interview* (Tunstall et al. 2019), *faculty development* (Lardner 2019), *news items* (Madison 2019), *learning theory* (Wallace 2019b).

Wikipedia and the *Seas of Literacy*

A quick Google search for "literacy" immediately finds the *Wikipedia* page titled "Literacy." The piece opens with the traditional definition, "the ability to read and write," citing Merriam-Webster.com. Then it immediately goes on to tell us that it is more complicated than that. Thus:

> The concept of literacy has evolved in meaning. The modern term's meaning has been expanded to include the ability to use language, numbers, images, computers, and other basic means to understand, communicate, gain useful knowledge, solve mathematical problems and use the dominant symbol systems of a culture.

That last sentence is footnoted with a reference to a UNESCO report (UNESCO 2006). The report itself starts with "Defining and conceptualizing literacy" (as a 1st-order heading), calling out "four discrete understandings of literacy" –

- Literacy as an autonomous set of skills
- Literacy as applied, practiced and situated
- Literacy as a learning process
- Literacy as text.

Then under "Literacy as skills" (the first 2nd-order heading), the report elaborates under three 3rd-order headings:

- Reading, writing and oral skills
- *Numeracy skills* (emphasis added here, of course)
- Skills enabling access to knowledge and information.

Already, one can anticipate myriad kinds of literacies: e.g., traditional literacy, numeracy, information literacy, computer literacy, technological literacy,

[2] From the title of the paper.

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web literacy, visual literacy, applied literacy, situated literacy, functional literacy, and perhaps even transliteracy for the ability to move across literacies.

Back on the first paragraph of the *Wikipedia* article, "Literacy," there is a small thematic map of the world showing the illiteracy rate by country in 2015, according to the 2015 *CIA World Factbook* (which has its own *Wikipedia* page). Visually, that map – showing, as any global map would, a world ocean consisting of connected seas – together with the thought of myriad new literacies, which must be connected in various ways, triggers, at least for an earth scientist, the metaphors of the World Ocean and the Seven Seas.[3]

The Seven Seas metaphor prompts the question (Fig. 1): "Well, just how large is this Literacy World Ocean?"

Figure 1. The water hemisphere (Citynoise, 24 Aug., 2015, Creative Commons, Attribution Share-Alike 4.0 International license). Azimuthal equal-area projection. (Downloaded 12/17/2018).
Geo-literacy and *map literacy* questions: How many of these land bodies can you identify? Which way is North?

Back, then, to Google with the search term "kinds of literacy" – one of the first on the generated list was "The Top 10 Literacies in Education Today" by Pietilla (n.d.). She lists: (1) *digital literacy*, (2) *media literacy*, (3) *visual literacy*, (4) *data literacy*, (5) *game literacy*, (6) *health & financial literacy*, (7) *civic and ethical literacy*, (8) *news literacy*, (9) *coding and computational literacy*, (10) *foundational literacy* (13 in all?).

Going on to the second page from the Google search – there was Mulcahy (2012), "20 Types of Illiteracy" (which, by the way, doesn't seem fair: how can there be 20 illiteracies and only 10 literacies?). Mulcahy lists: (20) *agricultural illiteracy*, (19) *computer illiteracy*, (18) *critical illiteracy*, (17) *cultural illiteracy*, (16) *ecological illiteracy*, (15) *emotional illiteracy*, (14) *financial illiteracy*, (13) *functional illiteracy*, (12) *health illiteracy*, (11) *information illiteracy*, (10) *media illiteracy*, (9) *mental health illiteracy*, (8) *numerical illiteracy*, (7) *racial illiteracy*, (6) *reading and writing illiteracy*, (5) *scientific illiteracy*, (4) *statistical illiteracy*, (3) *technological illiteracy*, (2) *trans-illiteracy*, (1) *visual illiteracy*.

[3] Since the 19th Century, the Seven Seas are the Arctic Ocean, the North Atlantic Ocean, the South Atlantic Ocean, the Southern Ocean, the Indian Ocean, the South Pacific Ocean, and the North Pacific Ocean, according to *Wikipedia* on its "Seven Seas" article. According to the same *Wikipedia* page, there are more than 70 bodies of water called "seas" according to the International Hydrographic Organization (which has its own *Wikipedia* page).

These easily accessible lists by Pietilla (n.d.) and Mulcahy (2012) are a good start. They provide a total of about 20 kinds of literacy (allowing for likely double counting and synonymies). More kinds of literacy can easily be found on *Wikipedia* because "Literacy" is a *Wikipedia* category.[4] The Category:Literacy page[5] lists the names of 75 *Wikipedia* articles.[6] Of these, 44 of the titles identify kinds of literacy (Table 2); the 31 others include such titles as "International Literacy Day," "Book desert," and "*Maestra* (film)." Additionally, the Category:Literacy page lists eight subcategories, including "Literacy advocates" (30 pages), "Organizations advocating literacy" (42 pages), and "Reading and literacy television series" (36 pages). And thus we see the Literacy World Ocean is wide and deep.

Table 2.
Literacies with their own Web Pages on *Wikipedia

literacy	multiliteracy	critical literacy	cultural literacy	family literacy	religious literacy
oracy	media literacy	computer literacy	social literacy	early literacy	diaspora literacy
numeracy	statistical literacy	digital literacy	political literacy	emergent literacy	power literacy
graphicacy	financial literacy	web literacy	racial literacy	adolescent literacy	object literacy
Electracy	physical literacy	net literacy	scientific literacy	braille literacy	
visual literacy	transliteracy	data literacy	ecological literacy	emotional literacy	
graph literacy	balanced literacy	post literacy	carbon literacy	health literacy	
information literacy	information and media literacy	technological literacy	agricultural literacy	mental health literacy	

*Selected from the 75 pages listed at https://en.wikipedia.org/wiki/Category:Literacy (12/15/18)

Even so, the list in Table 2 is hardly complete. For example, there are some notable, obvious absences: e.g., quantitative literacy(!), adult literacy, new literacies, game literacy, ethical literacy, news literacy, civic literacy, foundational literacy. Absence from the list of articles, however, does not mean that all those (and other absent) literacies do not exist on *Wikipedia*.

Table A1 in Appendix A lists well more than 30 literacy collocations that are not themselves *Wikipedia* articles but are present in the Wikipedia universe. An example is *quantitative literacy*, the first data row of the table. As shown in the table, a Google search using [Wikipedia, "quantitative literacy"] identifies three *Wikipedia* articles: "Literacy," "Functional illiteracy," and "Literacy in the United States." The usage of the "quantitative literacy" collocation in the "Functional illiteracy" article is in a paragraph about the findings of a National Center of

[4] See https://en.wikipedia.org/wiki/Help:Category#Finding_articles_for_a_category (accessed 12/17/2018) for explanation of *Wikipedia* categories and category pages.
[5] https://en.wikipedia.org/wiki/Category:Literacy (accessed 12/17/2018)
[6] https://en.wikipedia.org/wiki/Wikipedia:What_is_an_article%3F (accessed 12/17/2018)

Education Statistics' National Assessment of Adult Literacy (NAAL)[7] – "Literacy is broken down into three parameters: prose, document, and quantitative literacy." None of those three literacies have their own page in *Wikipedia* (Table 2), and none of their mentions in the "Functional illiteracy" article link out to other articles. As shown in the Table A1, *document literacy*, like *quantitative literacy*, is used in the "Literacy," "Literacy in the United States," and "Functional illiteracy" articles, and *prose literacy* is used in the "Literacy" and "Functional illiteracy" articles. As another (and related) example, *Adult literacy* is not an article, but it is used in seven articles: the three that *quantitative literacy* is used in, plus "Adult Literacy Index," "Adult education," "List of countries by literacy rate," and "Journal of Adolescent and Adult Literacy."

> As an aside, it cannot escape notice that not only is the collocation "quantitative literacy" not an article on *Wikipedia*, it seems to be little used in that open-content encyclopedia, and it does not even appear in the "Numeracy" article. Evidence continues to accumulate that the widespread use of "quantitative literacy" in the United States is not representative of its use internationally (see Vacher 2017).

Back to the point and the metaphor: The 40-plus literacies of Table 2 plus the 30-plus literacies in Table A1, easily put the total number of literacies in line with the "more than 70 bodies of water called 'seas' according to the International Hydrographic Organization" noted in footnote 3. Also, it can be noted, that numerous other literacies that we know "are out there" were not found on *Wikipedia* (e.g., the eleven at the bottom of Table A1).

Numeracy, Keywords and Literacies

Numeracy's publishing platform[8] provides a useful search tool that some of our authors and readers may not fully appreciate. The search tool's search box can be found on the journal's home page[9] – in the left-side blue column below the black box with the link to submit an article and the blue box to select an issue. In the search box, you can enter a search term, say "numeracy," which will identify and provide the links to 200[10] papers in *Numeracy* (Table 3).

It should be noted that the search is a *full-text search* (FTS in Table 3), which means that 200 papers used the word "numeracy" *somewhere in the paper*. In comparison, the collocation "quantitative literacy" was used by "only" 193[11]

[7] https://nces.ed.gov/naal/kf_demographics.asp
[8] https://www.bepress.com/ (accessed 12/19/2018)
[9] https://scholarcommons.usf.edu/numeracy/ (accessed 12/19/2018)
[10] All counts in this section and Table 3 pertain to the period ending with the launch of this issue. Other periods can be set through the Advanced Search link below the search box.
[11] Note, if you don't use quotation marks around "quantitative literacy," the search box returns a count of 202, (i.e, the number returned for papers using "quantitative" and "literacy," in either

Numeracy papers; thus for "numeracy vs. quantitative literacy mentions," "numeracy" beat "quantitative literacy." Given that there were a total of 230 *Numeracy* papers at the time of this exercise, and assuming that each of those papers used one or both of those terms, then by inclusion/exclusion,[12] 163 used both, 37 used only "numeracy," and 30 used only "quantitative literacy."

Table 3.
Literacies Found From Full Text and Keyword Searches of *Numeracy* Papers, 2008-2018 (*N*=230)

	FTS	Key words														
		1	2	3	4	5	6[a]	7	8[b]	9	10	11	12	13	14	15
1 Numeracy	**200**	53	88	13	6	3	2	1	3	1		1				
2 Quantitative literacy	**193**	45	95	8	5	3	2	1	2	1		1				
3 financial literacy	**37**	9	22	15	2	1		1								
4 statistical literacy	**37**	11	19		6	1		1		1		1				
5 mathematical literacy	**27**	7	18	1	1	3	1	1	1							
6 adult literacy	**21**	10	12		1	2	1	1								
7 information literacy	**12**	2	10		1	1		1				1				
8 scientific literacy	**11**	5	8		1	1		1								
9 new literacies	**9**	5	7			1				1						
10 data literacy	**3**	1	1							1		1				
11 map literacy	**2**	1	2									1				
12 critical literacy	**1**	1	1													
13 media literacy	**1**		1					1								
14 functional literacy	**1**	0	1													
15 situated literacy	**1**	1	1													

Notes: (a) "Adult numeracy" as the key word, rather than "Adult literacy"
(b) "Science literacy" as the keyword, rather than "Scientific literacy."

In addition to the column with the results of the full text search, Table 3 includes a 15×15 matrix showing usage of 15 various "literacies" as keyword tags in those 230 *Numeracy* articles. For example, of the 200 papers that used "numeracy" in the paper, 53 are tagged with "Numeracy" as a keyword, and 88 are tagged with "Quantitative literacy."[13] Continuing across that row, those 200 papers collectively identified five other literacies as keywords: "Financial literacy" (in 13 papers), "Statistical literacy" (6), "Mathematical literacy" (3), "Adult literacy"[14] (2), and "Scientific literacy"[15] (3). Reading down a column of the table, "Information literacy" was a keyword tag in one of the 37 papers that used "financial literacy" in the text, one of the 37 papers that used "statistical

order and collocated or not. Possibly more enlightening: "map literacy" (with quotes) returns 2, whereas both "math literacy" and "literacy math" (without quotes) return 42; "map" returns 47; and "literacy" returns 207.

[12] The classes as containers metaphor (see Lakoff and Nunez 2000, Chap 6)

[13] In this section, the search term is capitalized when speaking of its occurrence as a keyword, to conform with the practice of the search tool's list of linked keywords. The search term is not capitalized when speaking of its occurrence in the text.

[14] Actually, it was "adult numeracy," and not "adult literacy" as the keyword.

[15] Actually the term was "science literacy" when used as a keyword.

literacy," one of the 27 papers that used "mathematical literacy," one of the 21 papers that used "adult literacy," one of the 12 papers that used "information literacy," one of the 11 papers that used "scientific literacy," and the one paper that used "media literacy."[16]

Table 3 illustrates an especially useful keyword feature that is part of *Numeracy*'s search tool. How it works can be explained by exploring the occurrence of "information literacy" in the 230 papers. As shown by the "information literacy" row in the table, the search for that term reveals that 12 papers used the collocation in the text, and then by clicking on the "keywords" link that appears with the completed search, you find that eight of the papers are tagged with "Quantitative literacy" as a keyword, four with "Quantitative reasoning," three with "Faculty development," two with "Educational resource," two with "Numeracy," two with "QL/QR centers," and two with "Quantitative Literacy."[17] It also shows that those 12 papers are tagged with a total of 40 other keywords exactly once. Among those keywords tags are "Information literacy," "Map literacy," "Mathematical literacy," "Quantitative Map Literacy," and "Statistical literacy."

Each of the keywords in the generated list is itself a link connecting to the papers that list that keyword. Thus, the two papers that use "information literacy" in the text and are tagged by "Numeracy" as a keyword are easily found to be Karaali et al. (2016) and Vacher (2017). Clicking on the listed paper connects with the landing page of the paper,[18] and that page lists all the keywords supplied for the paper. From that list, you see that keywords for Karaali et al. (2016) include "Numeracy," "Quantitative literacy," Statistical literacy," and "Mathematical literacy," and keywords for Vacher (2017) include "Numeracy," and "Quantitative literacy." The paper in that row that is tagged by "Information literacy" as a keyword is easily found (by clicking on that keyword in the list) to be Erickson (2016), which also listed "Quantitative literacy" as a keyword tag. Similarly, the paper that used "information literacy" in the text and was tagged with "Map literacy" is easily found to be Xie et al. (2018), which also used "Quantitative Map Literacy" as a keyword.

As just described, the table was developed with a column-wise approach: first developing the rows of mentions of the literacy from the full-text searches, and then filling in the columns, left-to-right, row by row, from the list of linked key word tags. Thus, as said, it was determined that the "1" in the "information

[16] Anticipating a coming point, these are all the same paper.

[17] Note the capitalization of the non-lead word. Table 3 combines the results for "quantitative literacy" and "Quantitative Literacy," and the search tool does not distinguish between "quantitative literacy" and "Quantitative literacy."

[18] The landing page of a paper is the page that includes the title, authors, abstract, download link, and suggested reference style including DOI.

literacy" row and "Information literacy" column is due to the Erickson (2016) paper.

Noting that the counts in the "Information literacy" column (number 7) sum to seven, it would be a big mistake to conclude from Table 3 that "Information literacy" was a keyword tag for seven papers In fact, there was a total of one paper using "Information literacy" as a keyword; Erickson's paper used "numeracy," "quantitative literacy," "financial literacy," "statistical literacy," "mathematical literacy," "adult literacy," "scientific literacy" and "media literacy, as well as "information literacy," in the text. In the same way, the counts in the "new literacies" and "map literacy" columns were produced by one paper each, Agnello (2018) and Xie et al. (2018), respectively.

It is worth noting that the papers using "Informational literacy," "New literacies," and "Map literacy" as keyword tags are recent (2016, and 2018)

Numeracy, Keywords and Numeracies

In the same way that *literacy* has grown to be more than foundational reading and writing, *numeracy* is no longer limited to foundational, school-drilled "rithmetic" (e.g., see Cockcroft 1982; Sons 1994, 2019; Steen 2001). They both are now widely regarded as sense-making abilities and propensities. Thus, by their very nature, they critically intersect with other disciplines and a variety of different cultures and sociological contexts, as shown for "literacy" by the collocations of Tables 2, 3, and A1. Such intersections occur for "numeracy" too, as shown by numeracy collocations in *Numeracy*. For example, the following showed up as keywords in the search exercise that produced Table 3:

- Adult numeracy (Smit and Mji 2012, Oughton 2018)
- Clinician numeracy (Taylor and Byrne-Davis 2016, 2017)
- Functional numeracy (Oughton 2018)
- Health numeracy (Ancker and Begg 2017, Taylor and Byrne-Davis 2017)
- Physician numeracy (Taylor and Byrne-Davis 2016, 2017)
- Situated numeracy (Craig and Guzmán 2018, Oughton 2018).

It is worth noting that nine of these ten papers were published in the past three years.

Also of note: three of the six sets of authors using numeracy collocation keywords are from outside the United States. By comparison, the proportion of author-sets for all articles, perspectives and notes in volume 11 (2018) that are from author sets from outside the US is two of 12.

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Concluding Thoughts

Metaphors are well-known vehicles of thinking and talking (Lakoff and Johnson 1980) – for both literacy (Barton 1994, Chap. 2) and mathematics (Lakoff and Nunez 2000). Full disclosure, I am a fan of metaphors and the role they play at the intersection of cognitive science and linguistics (Vacher et al.2006). Using the language of domains interaction theory (see Vacher et al. 2006, abstract[19]), in this concluding section, some elements of the hydrosphere (italicized) are manipulated in the source domain to talk about various literacies and numeracies that are in the target domain.

Do we have a case for a *Sea of Numeracy* to be one of the *Seven Seas* in the *Literacy World Ocean*?

Can we say that the *Sea of Numeracy* is known by different names by different cultures (including disciplines) *along the shoreline* (e.g., the *Quantitative Literacy Sea* and the *Quantitative Reasoning Sea*), in addition to the *Sea of Numeracy*?

Or is it that the three constructs (numeracy, QL, QR) are different enough to be metaphorized (modeled) as *regional parts of the same larger ocean*, and that that *interregional ocean* would be the sea that qualifies to be one of the *Seven Seas*. An example could be the *Philippine Sea*, *South China Sea*, and *East China Sea* as parts of the *North Pacific Ocean* (one of the *Seven Seas*). Alternatively, would it be possible to think of one of the three constructs (e.g., numeracy via the *Sea of Numeracy*) as one of the *Seven Seas*, and the others as parts of it, like the *Philippine Sea* (*Quantitative Literacy Sea*) and *South China Sea* (*Quantitative Reasoning Sea*) are *marginal seas* of the *North Pacific Ocean*?

No matter how we think of the troublesome threesome (numeracy, quantitative literacy, quantitative reasoning) – whether as synonyms or with nuanced differences (e.g., Vacher 2014, Karaali et al. 2016) forming a triad – how are we to think of the *Statistical Literacy Sea* and the *Mathematical Literacy Sea*? Are they each an independent member of the *Seven Seas*, thus perhaps combining with the numeracy-QL-QR triad to make for three of the *Seven Seas*? Or, are they all folded into a single one of the *Seven Seas*? In which case, what do we call that big, inclusive sea? How about that for the *Sea of Numeracy*? Perhaps my bias shows.

One of the benefits of *an ocean* being called the *Sea of Numeracy*, by the way, is that it makes for nice names when "numeracy" is combined with an adjective or noun to form a numeracy collocation. From the keyword tags in *Numeracy* so far, the *Sea of Health Numeracy* seems a good bet; it would even

[19] The abstract is open access.

have marginal seas, namely the *Clinician Numeracy Sea* and the *Physician Numeracy Sea*.

Such a specifically disciplinary sea also conjures up the image of mixing, because of the need for literacy of the discipline or in the culture as well as numeracy. Mixing in connection with *seawater*, of course, brings to mind an *estuary* metaphor, conceptually mapping from the source element where seawater mixes with freshwater river inflow in an embayment formed by flooding of the lower reaches of the river valleys with the ending of the last Ice Age (climate warming and sea-level rise). So rather than *seawater* (numeracy) we would have *brackish water* (numeracy in the context of the discipline or culture). Familiar geographic elements of the source domain could easily be the *Chesapeake Bay* (with *river input* from, e.g., the *Susquehanna*, *Potomac*, *Patuxent*, *James*, and *Rappahannock Rivers*); *Delaware Bay* (*river input* from the *Delaware River*); *Apalachicola Bay* (*river input* from the *Apalachicola*, *Chattahoochee*, *Flint River* system); even *Tampa Bay* (*river input* from the *Hillsborough River*). Given the *estuary* metaphor, there could be a hierarchy reflecting, for example successive specificity of the disciplinary context – i.e., the *Sea of Numeracy*, with a marginal sea, the *Sea of Health Numeracy*, with its *Physician Numeracy Bay* and *Clinician Numeracy Bay* (not to mention, in time, the *Nutrition Numeracy Bay* and *Pharmaceutical Numeracy Bay*). Possibilities abound.

Meta-editorially: This editorial should make it clear how enriched the journal is by the inflow of papers from new colleagues beyond our borders, and from the exciting new generation of authors who are in or have recently completed doctoral studies. Among the latter are eight from this and the preceding issue: Charlotte Bolch, Luke Tunstall, Oyemolade Osibodu, Dr. Jeffrey Craig, Dr. Lynette Guzmán, and Ellen Agnello.

Secondly, it should be evident that keywords play a huge role in library research and scholarship. Authors and editors should take note: keywords deserve thought and care. Quoting Dan Merriam[20] (2012, 6) again, "Most research rests on a foundation of previous knowledge and research…. (D)evelopment of a list of key words should be done carefully in order to provide future researchers with the greatest opportunity for locating your work."

Acknowledgment

This editorial is a direct outgrowth of my interview with Gizem Karaali for the forthcoming *MAA Notes* volume about quantitative literacy in higher education.

[20] https://en.wikipedia.org/wiki/Daniel_Francis_Merriam (accessed 31 Dec 2018). Daniel F. Merriam (1927-2017) was one of the pioneers who brought statistics and computer modeling to geology (beginning in the 1960s) and one of the founders of the International Association for Mathematical Geology. His "key words piece" was written as editor of the journal for the geology honorary society, at age 85.

The interview was in March 2017, and the volume is expected soon. In the midst of the interview (Karaali, in press), I demonstrated that I didn't know anything about other forms of literacy, and, to myself, I resolved to do something about that. This little exploration of the Literacy World Ocean is a start.

The *Notes* volume itself will be must reading for the *Numeracy* community. We will no doubt have a "From the Authors" piece and at least one book review about the new volume in the Summer issue. You will recognize the three editors: Luke Tunstall, Gizem Karaali, and Victor Piercey. The book will be available for purchase at the MAA Books website.[21]

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[21] https://www.maa.org/press/books

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Appendix A. Other Literacies

According to the *Wikipedia* article on the subject,[22] collocation is a term from corpus linguistics for a sequence of words or terms that co-occur more often than would be expected by chance. For our purposes a collocation is a permutation of a small number of words that works together to form a semantic unit. *Quantitative literacy*, *World Ocean*, and *social justice* are examples. Table 2 in the text includes about 40 literacy collocations that are articles on *Wikipedia*. Here we list many more that are not themselves articles but are used in articles on *Wikipedia*.

Table A1
Literacy Collocations that Appear in Wikipedia Articles But Are Not Articles Themselves

	Searching: Wikipedia "[----] literacy"	**Finds these *Wikipedia* articles**
1	"quantitative literacy"	Literacy Functional illiteracy Literacy in the United States
2	"mathematical literacy"	Critical mathematics pedagogy Mathletics (educational software)
3	"computational literacy"	Andrea diSessa
4	"risk literacy"	Gerd Gigerenzer Risk Numeracy
5	"basic literacy"	Literacy Adult education Literacy in American Lives ProLiteracy Literacy in India Education in the United States Yes, I CAN
6	"prose literacy"	Literacy Functional illiteracy
7	"document literacy"	Literacy Literacy in the United States Functional illiteracy
8	"education literacy"	Literacy Education in the Age of Enlightenment Media literacy Likbez Prison education Journal of Adolescent & Adult literacy Reading Recovery Education in Mali Paulo Freire
9	"adult literacy"	Adult Literacy Index Literacy Adult education Literacy in the United States List of countries by literacy rate Functional illiteracy Journal of Adolescent and Adult Literacy
10	"new literacy"	Multiliteracy Brian Street Reading path James Paul Gee

[22] https://en.wikipedia.org/wiki/Collocation (accessed 12/31/2018)

https://scholarcommons.usf.edu/numeracy/vol12/iss1/art1
DOI: https://doi.org/10.5038/1936-4660.12.1.1

11	“traditional literacy”	Literacy Information literacy Health literacy 21st century skills Bibliotherapy
12	“linguistic literacy”	Visual literacy English-language learner
13	“language literacy”	Literacy English as a second or foreign language Language acquisition Language ideology Word recognition Multilingualism Pashayi languages
14	“economic literacy”	Test of Economic Literacy Economics education Test of Understanding in College Economics Council for Economic Education Test of Economic Knowledge National Center for Research in Economic Education Basic Economic Test Economic ideology
15	“communication literacy”	Multimodality
16	“functional literacy”	Functional illiteracy Literacy
17	“game literacy”	Whole language Inanimate Alice
18	“New Literacies”	Multiliteracy
19	“civic literacy”	Civic engagement 21st century skills Digital citizen
20	“language arts literacy”	PAARC New Jersey Core Curriculum Content Standards
21	“nutrition literacy”	Nutrition (includes a numbered section, “Nutrition literacy”) Health literacy Food desert
22	“climate literacy”	Scientific literacy Climate change education (CCE)
23	“environmental literacy”	Environmental Literacy Plan Environmental education
24	“legal literacy”	Literacy Legal awareness
25	“moral literacy”	Colin McGinn Barbara Herman The Book of Virtues” A Treasure of Great Moral Stories Sue Knight
26	“ocean literacy”	Scientific literacy
27	“physics literacy”	Scientific literacy
28	“chemistry literacy”	Scientific literacy
29	“academic literacy”	Academic writing
30	“historical literacy”	Historical thinking
31	“geographical literacy”	Royal Canadian Geographical Society
32	“medical literacy”	Neil B. Shulman
33	“faith literacy”	Faith literate
34	“politics literacy”	CPCS
35	“business literacy”	Financial intelligence (business)
36	“internet literacy”	Net literacy
37	“foundational literacy”	Marilyn Jager Adams

38	"situated literacy"	none found
39	"practiced literacy"	none found
40	"applied literacy"	none found
41	"disciplinary literacy"	none found
42	"news literacy"	none found
43	"spatial literacy"	none found
44	"geospatial literacy"	none found
45	"earth science literacy"	none found
46	"map literacy"	none found
47	"biology literacy"	none found
48	"ethical literacy"	none found

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