Quantitative Literacy (QL) and Numeracy: A Discipline-Based Education Research Perspective from the Geosciences

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Madison’s *Everybody’s Orphan*

“Quantitative Literacy: Everybody’s Orphan” Bernard L. Madison, 2001, *Focus*

Context is key:

Math departments = no context, 
discipline = nothing but context

This article provides an invitation for disciplines to take charge and raise the orphan.

Discipline-Based Education Research (DBER)

DBER is inherently interdisciplinary...Biology, geosciences, and astronomy education research are the most common disciplines. DBER is experts in a particular field figuring out what works best at instructing new experts in that same field. Those methods don’t necessarily work in other fields.

DBER and Geoscience Education Research (GER)


DBER - A Vehicle for QL Instruction

Geology includes quantitative practices (Manduca, et. al., 2008).

The lens of DBER/GER helps us find what works for geologists/geoscientists. We have the benefit of following 20 years of Len Vacher banging on that wall.

Perspectives - How We Got Here - Vic

BA - Geology - U. Florida 1999

Environmental Consulting to 2009

HS Science Teaching to 2014 (incl. Writing content for GA Virtual School)

Graduate School at USF with Len Vacher and Jeff Ryan:

How to put knowledge of geology together with love of educating

Discovery: DBER exists (GER), QL lacking in my prior education experience

MSc 2016, TA for Phy. Geology Lab (1yr), Comp. Geology (3.5 yrs)
Perspectives - How We Got Here - Meghan

2006 - BS in Geology

2009 - MS in Geology (TA’ed all along the way)

2009/2010 - 3-month volunteer at HVO

2010 - Took a break to work at local water management district

2011 - Began Ph.D. program in geology and independently began teaching at local state colleges/science heavy liberal arts college (always wanted to be a teacher)

Now - Ph.D. candidate and continue to teach at local state colleges
Perspectives - Current QL Instruction Thoughts

As HS science teacher, assigned students w/ lower math skill. I regret how little I fought to work it in anyway. QL is for everyone.

Teaching intro lab, >50% of students would skip a question requiring multiplication of two given values with a provided calculator.

Then I found Computational Geology... (see Vacher, 2000, 1998-2005; Fratesi and Vacher, 2005; McGee et. al., 2007; Vacher and Lardner, 2010, 2012; Lehto and Vacher, 2012; Vacher et. al., 2012; Ricchezza and Vacher, 2016, 2017a, 2017b, 2018; Connor and Vacher, 2016; Ricchezza, 2016)

Students take my courses for general ed req. = non-science majors who have avoided math up until this point.

Students cannot get past the idea of earth science/geology having math.

Students end up not even attempting activities involving math or QL, they accept taking a zero (even with one on one intervention).
In CG, students generally come in afraid of math but needing the credit and possibly aware they need the skills.

One key: acknowledging their fear without shame.

Geology has math in it.
Numeracy Breakdown

We did a quick analysis of the last three years of articles and notes from Numeracy. Based on our totally flawless and not-at-all-subjective categorizations:

Social Science/Humanities: 14
Mathematics/Statistics/Math Education: 14
Natural Science/Health Science: 9

How are other STEM-DBER folks (and for that matter, non-STEM) making QL adaptations?
So What, And Who Cares?

QL belongs in-context (thanks Bernie) and GER has quantitative context easily applicable for QL.

Non-geoscience DBER QL practices might apply to geosciences.

STEM (or non-STEM)-DBER-QL Alliance?

Publications in Numeracy trend towards subjects other than natural science and health.

Q and A

The nature of DBER is that what works in the geosciences is domain-specific and may not work in other areas.

What works/worked for you?

Tell us a bit about what area you teach/research in, and how you’ve applied QL/DBER. Was it successful?

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