

PKAL 2001 Summer Institute Report

Reflections on Quantitative Literacy

Part 1: What is Quantitative Literacy?

Lynn Arthur Steen, St. Olaf College

After reflecting on the presentations and discussions at this workshop, I began to recognize some key issues that arose over and over again--sometimes explicitly but more often implicitly, occasionally as premises but other times as challenges. They are, in question form:

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What are we talking about?

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Why should we be concerned?

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What can we do about it?

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Who is responsible?

Some may find it funny that a group of academics can spend three days discussing intensely something that they cannot define and which, truth be told, means different things to everyone involved in the discussion. But such is the reality of quantitative literacy (QL), also known as "numeracy" or "quantitative reasoning" (QR). I use these three terms interchangeably for the same concept, something related to but different from mathematics on the one hand and statistics on the other hand. During these sessions we heard also about subtle distinctions between mathematics and mathematical literacy, and between statistics and statistical literacy. This clearly suggests one dimension that is crucial to understanding what we have been talking about. By transforming nouns such as mathematics, statistics, and quantity into adjectives modifying the more universal term "literacy," we signal a desire to shift the educational domain from disciplines to general education, from skills for practitioners and specialists to languages for citizenship. Of course students need both practical skills and functional literacy. But the message of our discussions is that while related, these are not the same--nor can they be taught and learned in the same manner.

The other distinction worth noting is between numeracy (aka QL) and the more traditional disciplines of mathematics and statistics. Mathematics by definition and tradition is abstract and Platonic, dealing with universal truths and relations among ideal objects. Quantitative literacy, in contrast, is concrete and contextual, dealing with contingent inferences drawn from specific facts about real objects or events.

Statistics too deals with real data and real events, but is rooted in the world of uncertainty and chance, of repeated and repeatable events. Quantitative literacy operates with no such boundaries, as often as not being about interpretation of patterns that are entirely specific and predictable.

So we can say of quantitative literacy that it is not a discipline but a language (literacy) crucial to most disciplines. Moreover, while it is related to mathematics and statistics, it is different from each in both substance and application. What we cannot seem to say precisely is what it is.

Why

I heard in the PKAL discussions, as in other venues where educational issues are discussed, two types of answers to the question of why quantitative literacy is so important. One focuses on individual benefit:

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to improve prospects for employment which in this information age increasingly requires quantitative skills;

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to prepare for further education which increasingly relies on numerical data as the warrant for sound argument;

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as a tool for control of daily life, for making choices among options that differ in quantitative detail;

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as a skill for living in a world dominated by computers and data-driven devices;

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as a defense against the world's wiles, to resist political flim-flam and misleading advertising.

The other type of response to the question of importance focuses on benefits to society:

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better trained employees, especially in a technological economy;

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better educated citizens and voters who can think independently about complex issues;

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competent jurors who can thoughtfully address the complex issues of guilt and liability where the evidence is often quantitative and probabilistic.

In my view, the special importance of quantitative literacy (in contrast, for example, to mathematics or statistics as typically taught in school and college) is in the latter goals in each of these two categories.

All subjects--in particular mathematics and statistics--contribute to employment and education. But not all contribute equally to the demands of informed citizenship. For the individual, QL offers a defense against an overload of confusing information and increases the likelihood of wise decisions; for society, QL offers numerically and logically competent citizens who make political judgments at the polls and judicial decisions on juries.

What

Now that we know approximately what QL is and why it is important, what can we do about it? I offer an "RUV" strategy--not quite as powerful as some SUVs, but close.

R

stands for real contexts and real data. As language students need to enter into real conversations with real people, so students of QL need to encounter real situations with real data and real problems. No amount of template word problems from traditional mathematics texts can make up for the unexpected complexities of real problems.

U

stands for ubiquity, for QL in every program, every department, and (nearly) every course. Mathematics departments must do their share, but even with the best of intentions and most thoughtful programs, mathematics is too narrow a field and too sterile an environment in which to educate students about the challenges of problems in other fields. To become QL, students need to get their hands dirty with real data.

V

stands for variety--for different approaches, different contexts, and even different definitions. We have heard in this workshop of the different needs of geologists and sociologists, of engineers and biologists. We have heard about many different approaches and expectations. None of us can say that one or two approaches are "right" and others not. Precisely because quantitative literacy is so context-sensitive, approaches to teaching as well as expectations for students' accomplishment will necessarily vary.

Who

This one is easy: every teacher must be responsible for quantitative literacy. Just as over the last two decades teachers in all disciplines gradually came to understand that they must teach writing as well as their own subject, so now we need to convince teachers in subjects across the curriculum that they all must actively teach QL. Instead of acting surprised or frustrated when students seem not to be able to use mathematical or quantitative tools that instructors know their students once learned in their mathematics courses, teachers need to recognize that re-learning in new contexts is a natural and essential part of the learning process and plan for it as part of their syllabus.

Coda

I conclude by enlisting your help in thinking about what I believe to be the most difficult and intractable issue related to QL: how to enable QL and the traditional algebra-calculus sequence to co-exist in high school without reestablishing the two-track system that has proven to be such a disaster for students from socially and economically deprived backgrounds.