Q/L and School Math: Fractions & Percentages

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www.StatLit.org/pdf/2007SchieldWingspread6up.pdf

Humanities, QL & Math

QL should apply across the curriculum. QL seems to be least relevant in the humanities.

Humanities focus on context in situations that are generally non-quantitative. Orrill (2007).

QL studies influence of context on numbers.

Influence of context in QL: All statistics are socially constructed. Best (2007).

Goals of School Mathematics

School math goal: Prepare students for college:
* Quantitative majors (STEM and non-STEM)
* non-Quantitative majors (don't require math)

Journalists, religious, social and political leaders are likely to choose non-Quantitative majors.

College students by major:
* Quantitative STEM need most algebra.
* Quantitative non-STEM need some algebra
* Non-quantitative need little - if any - algebra

College Grads and Math

~60% in Quant. majors: need calc or stats
~40% in non-Q majors: math/stats not required

Generally, all college grads need a math course: College algebra may not be OK. Isom (2004)

Math for Liberal Arts, Statistical Literacy and Statistics and QR/QL are more suitable.

Intermediate or college algebra is not required for many of these courses.

Math Needs of Non-Quantitative Majors

Lutsky (2006) reviewed students writing at a liberal-arts college. He found that:
- A third failed to use QL when it was central
- 90% failed to use QL when it was peripheral.

Schield (2006) surveyed college students on statistical literacy. He found that:
- 20% reversed part and whole in a pie chart
- 40% reversed part and whole in a 100% table

Call for Change QL in School Math

1. **Include more ordinary English.**
   Use Percentage and Likely grammar. Read % tables.
2. **Distinguish percentages from fractions**
   Mathematically, percentages are fractions: 20% = 1/5
   Operationally, %-ages are like integers: 5%+1%=6%
3. **Classify fractions in addition by denominators**
   a. Identical (1/9 + 3/9). [Easy, often]
   b. Commensurate unequal (1/9+1/3) [Harder, seldom]
   c. Non-commensurate (1/9 + 1/8). [Hardest, 'never']
   School math focuses on "c".

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Call for Change #2
QL in School Math

4. **Introduce algebra in ways that support QL.**
   a. using rates: death rate is 12 per 1,000 population.
   b. scaling and proportional reasoning (a/b = c/d)
   c. linear models: Y = a + b*X
   d. weighted Ave: Z = <X>*Wt(X) + <Y>*Wt(Y)

A. Use rates, Show relation b/t numer. & denom.
   a. Perfectly linked – normal scaling.
   b. Semi-linked
   c. Independent.
   Doing so focuses on influence of context on #.

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Call for Change #3
QL in School Math

B. Compare rates using different bases
   Accidental death rates
   a. Hawaii > Arkansas -- per mile of road
   b. Hawaii < Arkansas -- per registered vehicle

Note that rates do not have simple cancellation:
   Numerator and denominator are linked in reality

Benefit: Comparing rates shows role of context

Context ties math to non-quantitative majors

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Benefits of Using QL:
Percentages and Rates

Give students positive attitude on value of math

Prepare students for advanced QL topics

- Simpson's paradox. A related factor can reverse the direction of an association.
- Standardization: Take into account the influence of a related factor (context).
- Bayes comparison: P(E|A)/P(E) = P(A|E)/P(A)
- Cases attributable: Deaths due to obesity, second-hand smoke and depression.

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Complex % Bar Graphs