Pedagogical Challenges of QL

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Challenges

- QL is a habit of mind rather than a content-rich academic discipline.
- Students believe that QL is mathematics and behave as they do in traditional mathematics courses.
  - They expect template problems and homework exercises that match the template, and template problems are antithetical to QL.
  - They believe QL is mathematics and therefore deem it not relevant to their lives and set apart from other areas of study.
- Abstracting generalities from contextual examples is difficult pedagogy.
- Multiple contexts challenge QL faculty and student understanding and knowledge.

Challenges - continued

- Course material must be fresh and engaging.
- Excursions into political and social issues are sometimes delicate and mysterious.
- Mathematical and statistical concepts occur repeatedly and unpredictably.
- Use of technology is essential but often foreign to students.
- Mathematics and statistics encountered is usually elementary.
- QL requires practice beyond school.

Assessment Challenges

- Assessment of QL requires authentic tasks.
  - Complex realistic, meaningful, and creative performances (Wiggins)
  - Authentic tasks require construction of knowledge, disciplined inquiry, & value beyond school (Wiggins).
- What are the learning goals for QL?
- What are the developmental steps in QL?
- What can current standardized tests tell us about students' quantitative literacy?
- What should we value, i.e. what should we score?
- What are the standards for proficiency?
- Can we assess whether or not students are inclined to practice?
- How are mathematical and numeracy skills related?

Issues with traditional courses

- Emphases on components not processes
- Lack of mental constructs in lower level courses
- Lack of venues for continued practice beyond the course
- Not organized like the real world
- Tend to degenerate to methods and procedures
- Develop template problem expectations
- Not enough ambiguity
- Not enough interpretation and reflection

QL-Friendly Course
Mathematical Reasoning in a Quantitative World

- using numbers
- percent and percent change
- linear and exponential growth
- indices and condensed measures
- graphical interpretation and production
- counting
- probability, odds & risk
- weights and geometrics measurement
- weather maps, measurement and indices

Canonical QL Situation

1. Encountering a challenging contextual circumstance, e.g. reading a newspaper article that contains the use of quantitative information or arguments. (Productive disposition and conceptual understanding)
2. Interpreting the circumstance, making estimates as necessary to decide what investigation or study is merited. (Adaptive reasoning)
3. Gleaning out critical information and supplying reasonable data for data not given. (Productive disposition and conceptual understanding)
4. Modeling the information in some way and performing mathematical or statistical analyses and operations. (Strategic competence and procedural fluency)
5. Reflecting the results back into the original circumstance. (Adaptive reasoning)

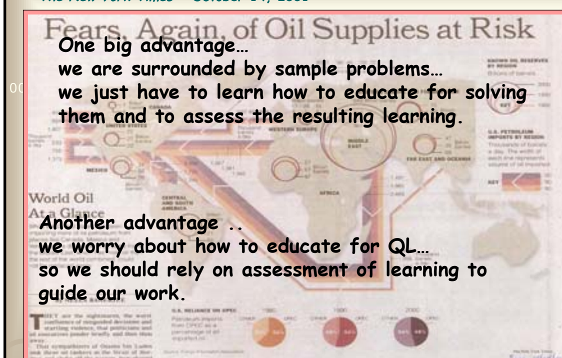
Characteristics of QL-friendly Course

- Mathematics is encountered in many contexts such as political, economic, entertainment, health, historical, and scientific. Teachers will require broader knowledge of many of the contextual areas.
- Pedagogy is changed from presenting abstract (finished) mathematics and then applying the mathematics to developing or calling up the mathematics after looking at contextual problems first.
- Material is encountered as it is in the real world, unpredictably. Unless students have practice at dealing with quantitative material in this way they are unlikely to develop habits that allow them to understand and use the material. Productive disposition as described by Kilpatrick, Swafford and Findell (2001) is critical for the students.
- Much of the material should be fresh -- recent and relevant.

Characteristics of QL-friendly Course - Continued

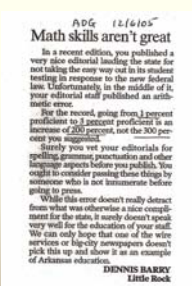
- Considerably less mathematics content is covered thoroughly.
- The mathematics used and learned is often elementary but the contexts and reasoning are sophisticated.
- Technology – at least graphing calculators – is used to explore, compute, and visualize.
- QL topics must be encountered across the curriculum in a coordinated fashion requiring those encountered in a QL-friendly course to make cross curricular connections.
- An interactive classroom is important. Students must engage the material and practice retrieval in multiple contexts.

The New York Times - October 14, 2001



One big advantage…
we are surrounded by sample problems…
we just have to learn how to educate for solving them and to assess the resulting learning.

Another advantage ..
we worry about how to educate for QL…
so we should rely on assessment of learning to guide our work.



ADG 12/6/05

Math skills aren't great

In a recent edition, you published a very nice editorial lauding the state for not taking the easy way out in its student testing in response to the new federal law. Unfortunately, in the middle of it, your editorial staff published an arithmetic error.

For the record, going from 1 percent proficient to 3 percent proficient is an increase of 200 percent, not the 300 percent you suggested.

Surely you vet your editorials for spelling, grammar, punctuation and other language aspects before you publish. You ought to consider passing these things by someone who is not innumerate before going to press.

While this error doesn't really detract from what was otherwise a nice compliment for the state, it surely doesn't speak very well for the education of your staff. We can only hope that one of the wire services or big-city newspapers doesn't pick this up and show it as an example of Arkansas education.

DENNIS BARRY
Little Rock

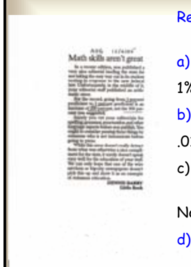
Refer to the December 6 letter to the editor, *Math skills aren't great.*

a) Find the increase in percent proficient.

b) Find the percent increase in the percent proficient.

c) Is the letter writer correct that the original article was wrong? Why

d) Is the letter writer correct or incorrect when he states, "going from 1 percent proficient to 3 percent proficient is an increase of 200 percent?" Why?



Refer to the December 6 letter to the editor, *Math skills aren't great.*

a) Find the increase in percent proficient.

1% X=3% x=300%

b) Find the percent increase in the percent proficient.

.01 x 3.00 or .01 x 300% = .03

c) Is the letter writer correct that the original article was wrong? Why?

No, he did not correctly calculate the percent change.

d) Is the letter writer correct or incorrect when he states, "going from 1 percent proficient to 3 percent proficient is an increase of 200 percent?" Why?

No, it is an increase of 300%, not 200%

a) Find the increase in percent proficient.

1% → 3%

The percent proficient increased by two percentage points.

b) Find the percent increase in the percent proficient.

$$\frac{3\% - 1\%}{1\%} \quad \frac{2}{1} = 2 \quad 2 \times 100 = 200 \quad \text{a 200\% increase}$$

c) Is the letter writer correct that the original article was wrong? Why?

The letter writer was correct, but he needs to calm down a bit. It was a small, common mistake, but a mistake nonetheless.

d) Is the letter writer correct or incorrect when he states, "going from 1 percent proficient to 3 percent proficient is an increase of 200 percent?" Why?

He is correct. The editorial assumed that if the # tripled, it would mean it increased by 300%. What the editorial forgot to do was add on to the original # to the problem.

1% ↗ 2%
X2 +1% 3% It is the same reason why a number that doubles increases only 100%

a) Find the increase in percent proficient.

Increase in percent: 3% - 1% = 2% increase

b) Find the percent increase in the percent proficient.

Percent increase: $\left(\frac{3-1}{1}\right) \times 100 = 200\%$

c) Is the letter writer correct that the original article was wrong? Why?

Yes, because if the percent increase was to be 300% like the original article stated, the ending proficiency would need to be 4% instead of 3%.

Ex: $\left(\frac{4-1}{1}\right) \times 100 = 300\%$

d) Is the letter writer correct or incorrect when he states, "going from 1 percent proficient to 3 percent proficient is an increase of 200 percent?" Why?

The letter writer is incorrect in making that statement due to a misuse of wording. The letter writer made an error in saying "increase of 200%," when he should have said "it's a percent increase of 200%."