Challenges in Designing and Implementing a College Competency Requirement in Quantitative Reasoning

Tibor Marcinek and Ana Dias
Central Michigan University
Context for the course development: National Trends

What quantitative literacy requirements should be established for all students who receive a bachelor’s degree?

● 1989: MAA’s Subcommittee on QL Requirement
● 2004: Special interest group for Quantitative Literacy (SIGMAA QL).
Context for the course development:
Activities at CMU

- Spring 2005: QL Committee at CMU Mathematics Department

  ✓ wanted to learn more about the national trends with respect to quantitative literacy
  ✓ was composed of diverse faculty with main research focus in Mathematics, Statistics and Mathematics Education.
CMU Competency Requirement – criteria for QL course:

- Have a sufficiently low student-to-instructor ratio...
- Require students to work on projects ...
- Provide opportunities, via group work ...
- Provide realistic problems that reflect ...
- Have at least one weekly assignment ...
- Have at least two examinations ...
Challenges of Course Design

- Interpretation of *Numeracy/QL*
  “the ability to adequately use elementary mathematical tools to interpret and manipulate quantitative data and ideas that arise in an individual’s private, civic, and work life.”

- Meaning of a “real-life problem”

- Selecting course text and pedagogy
Textbooks for Quantitative Literacy

- Proposed by big names in QL
- Promising: primarily meant for QL courses
- Based on case studies and media articles.
“The Course Philosophy”

“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...”

- 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.
- 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.
Introduction to Percent and Percent Change

Percent

“Percent” means “per 100” so 32% means “32 per 100” or “32 out of 100” or \( \frac{32}{100} \).

32% of 545 is 174.4 means \( \frac{32}{100} \times 545 = 174.4 \) and \( P \% \) of \( N \) is \( A \) means \( \frac{P}{100} \times N = A \).

Example 1. Know \( P \) and \( N \), find \( A \). Find 0.5% of 270.
\[
\frac{0.5}{100} \times 270 = 1.35
\]

Example 2. Know \( P \) and \( A \), find \( N \). 48 is 225% of what?
\[
\frac{225}{100} \times N = 48, \text{ so } N = \frac{48}{2.25} = 21.3, \text{ or } N = \frac{4800}{225} = 21.3
\]

Example 3. Know \( N \) and \( A \), find \( P \). What percent of 25 is 75?
\[
\frac{P}{100} \times 25 = 75, \text{ so } \frac{P}{100} = \frac{75}{25} = 3, \text{ so } P = 300\%.
\]
“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.”

1. Give the following tax rates in percent.
   a) $12.00 per $10000
   b) 23 mills
   c) $3.75 per $225
   d) $7350 tax on an income of $47000
"Material is encountered as it is in the real world, unpredictably..."
Interpretation(s) of QL/numeracy

“the ability to adequately use elementary mathematical tools to interpret and manipulate quantitative data and ideas that arise in an individual’s private, civic, and work life”
“Real-life” problems

- Is the problem relevant?
- Is the problem authentic?
Authenticity vs. Relevance

- Statisticians: Is hand size a good predictor of person’s height?
  - what is hand size?
  - statistical indicators, variance
  - measurement error
Challenges of Course Design

Challenges of Implementation
THANK YOU