Faculty Grading of Quantitative Problems: Are Values Consistent with Practice?

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THE PROBLEM

• Grading practices have a tremendous impact on what students do in college courses.
• Research in physics education has documented a tension between what instructors say they value in grading quantitative, free-response student problem solutions, and their actual grading practices (Eby, 1999; Henderson, Yenushalmy, Kuo, Heller, & Heller, 2004).
• Many instructors say they want to see reasoning in a student solution but then grade in a way that either: penalizes students for showing reasoning, or rewards students for omitting clear reasoning.
• Henderson et al. (2004) propose that this tension exists because hidden internal values conflict with expressed values, and develop the construct of “burden of proof” to explain how faculty resolved these conflicts.

THIS STUDY

• Purpose: extend the Henderson et al. (2004) study with faculty in chemistry (n=10) and earth science (n=7), in order to document whether the tension between explicit values and grading practices exists across science faculty more generally.

RESULTS

• Same 3 values are present among earth science and chemistry faculty, plus a 4th value (organized, methodical solution with units).
• Including 30 physics faculty from Henderson et al., 2004:
  • 49% of faculty encouraged students to show their work (e.g., graded SSD > SSE)
  • 34% of faculty penalized students for showing work and rewarded omission of work (e.g., graded SSE > SSD).
  • 52% of faculty placed the burden of proof on the themselves when grading.
• Chemistry faculty were more likely than earth science or physics faculty to grade SSD > SSE; the nature of chemical problem-solving may account for this difference (Cromer & Good, 1989).

IMPLICATIONS FOR PRACTICE

• The construct of “burden of proof” can serve as a tool to promote cognitive conflict in faculty.
• This cognitive conflict can in turn lead to reflection and changes in practice.

REFERENCES


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The research in the faculty study was conducted as a collaborative effort among the authors. Comments and feedback from graduate students Calvin Caballero, Matthew Ludwig, and Kate Rowbotham have greatly improved this presentation.

THE PROBLEM

Values and conflicts identified by Henderson et al., 2004:

- **Value 1**: desire to see student reasoning
  - Solution: Shows reasoning, Correct answer

- **Value 2**: orientation towards grading
  - Burden of Proof on Student
    - Explicit evidence of correct knowledge & procedures needed to earn points
  - Grading Practice
    - Are correct answers and explanations by the student’s reasoning is shown there is more opportunity to deduct points

- **Value 3**: tendency to project correct thinking onto ambiguous solutions

CONFLICT

• **Value 1a**: low grade
  - Solution: Shows reasoning
  - Incorrect reasoning

• **Value 1b**: high grade
  - Solution: Shows reasoning
  - Correct reasoning

• **Value 2b & 3**: high grade
  - SSE does not clearly show reasoning
  - SSE does not clearly show thinking, has correct answer

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