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

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ABSTRACT

Grading practices can send a powerful message to students about what is expected. Research in physics education has identified a mismatch between what college instructors value and their actual scoring of quantitative student solutions. This work identified three values that guide grading decisions: (a) a desire to see student reasoning, (b) reluctance to deduct points from solutions that are correct, and (c) a tendency to assume correct reasoning when ambiguities are present. When values are in conflict, the conflict is resolved by placing the burden of proof on either the instructor or the student. In this qualitative interview study, we verified that this mismatch exists and that the same three values are present among earth science (n=7) and chemistry (n=10) instructors. Furthermore, we identified a fourth value regarding the desire to see the correct use of units. Overall, we found that 42% of earth science and 69% of chemistry faculty placed the burden of proof on the student when grading subjective problems (SSD > SSE), and 34% placed it on the instructor (SSE > SSD). Students (n=26) exposed to ambiguous solutions provided either explicit evidence of correct reasoning or the correct answer. The difference in values is significant. Although all of the faculty in this study and the physics study stated that they valued seeing student reasoning, only 49% overall graded in such a way that would actually encourage the instructors to provide them. 34% of instructors could be viewed as penalizing students for showing their work. This research may contribute toward better alignment between values and practice in faculty development.

BACKGROUND

- Feedback from the instructor to the student, typically in the form of a grade, has a powerful effect on student learning (e.g., Black & William, 1998, 1999; Self, 1998).
- Grading practices, therefore, can have a tremendous impact on what students do in a college course.
- 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 (Elby, 1998; Henderson, 1999; Kuo, 1997).
- Many instructors say they want to see reasoning in a student solution to make sure that the student really understands, but then grade in a way that penalizes students for showing their reasoning, or rewards omitting clear reasoning.
- Henderson et al. (2004) propose that this tension exists because hidden internal values conflict with expressed values.

In this study we develop the construct of ‘burden of proof’ to explain how faculty resolve these conflicts (Henderson et al., 2004, p. 167).

METHODS: Student Solutions

- Same three values previously identified among physics faculty by Henderson et al. (2004) were present, plus a fourth value.
- All values suggest that grading can be neglected. The stone was swung around and let the string at a fixed position. Assume that by the time that you quarter turn before release? Assume that the air parcel is not saturated because there is work shown... [nulling was wrong.]
- Value 1: shows correct thinking, has explicit errors, needs to earn points (E1) shows student thinking, has explicit errors, has correct answer (SSD)
- Value 2: shows correct thinking, has explicit errors, needs to earn points (E2)
- Value 3: shows correct thinking, has explicit errors, can be neglected (E3)
- Value 4: shows correct thinking, has explicit errors, cannot be neglected (E4)

METHODS: Interviews and Practices

- RESULTS

VALUES

- Values and Conflicts Identified by Henderson et al., 2004

- CONCLUSIONS AND IMPLICATIONS FOR PRACTICE

- Including 30 surveys and 6 interviews physics from Henderson et al. (2004):
- 49% of faculty could be viewed as providing students incentive for showing their work (e.g., graded SSE > SSD).
- 34% of could be viewed as penalizing students for showing work, and rewarding omission of work (e.g., graded SSD > SSE).
- 48% of faculty placed the burden of proof on the student, requiring students to prove knowledge in order to earn points.
- Chemistry were more likely than earth science or physics faculty to grade SSD > SSE. The nature of chemical problem-solving may account for this difference (Camacho & Good, 1999).
- This research can serve as a tool to promote cognitive conflict in faculty. This cognitive conflict can in turn lead to reflection on and changes in practice.

PURPOSE AND RESEARCH QUESTIONS

- Our goal is to extend the Henderson et al. (2004) study with faculty in chemistry (n=10) and earth science (n=7), in order to document whether the mismatch between explicit values and grading practices exists across science faculty more generally.
- 1. Which, if any, of the previously identified values are expressed by chemistry and earth science faculty as they grade quantitative problems?
- 2. How do faculty from chemistry and earth science weigh expressed and implicit grading values in the grading process?
- 3. Are chemistry and earth science faculty more likely to place the burden of proof on themselves, or on the student when grading student work?

REFERENCES

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