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

Jeffrey A. Barney, Jacinta M. Mutambuki, Heather L. Petcovic, Charles Henderson, and Herb Fyniewy

ABSTRACT

Grading practices can send a powerful message to students about what is important. 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: (1) a desire to see students reasoning, (2) reluctance to deduct points from solutions that might be correct, and (3) a tendency to assess correct work more leniently. Increasingly, research has emphasized the importance of cognitive conflict in student learning. This research can serve as a tool to promote cognitive conflict in faculty. This cognitive conflict can be assessed by the use of the construct of ‘burden of proof’.

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 & Wiliam, 1998; Elby, 1998; Henderson et al., 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, 1998; Henderson et al., 2004).
- 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 thought. Henderson et al. (2004) propose that this tension exists because hidden internal values conflict with expressed values.
- Authors developing the construct of ‘burden of proof’ to explain how faculty resolved these conflicts (Henderson et al., 2004, p. 167).

METHODS: Student Solutions

- Ranked student solutions from best to worst and assign each a grade out of 10 points (subjects: chemistry, physics, earth science, and biology).
- Feedback from the instructor to the student, typically in the form of a grade, has a powerful effect on student learning (e.g., Black & Wiliam, 1998; Elby, 1998; Henderson, 1998; Henderson et al., 2004).
- Grading practices can send a powerful message to students about what is important. 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: (1) a desire to see students reasoning, (2) reluctance to deduct points from solutions that might be correct, and (3) a tendency to assess correct work more leniently. Increasingly, research has emphasized the importance of cognitive conflict in student learning. This research can serve as a tool to promote cognitive conflict in faculty. This cognitive conflict can be assessed by the use of the construct of ‘burden of proof’.

RESULTS

- Three values previously identified among physics faculty by Henderson et al. (2004) were present, plus a fourth value regarding the desire to see students’ reasoning.
- Desire to see reasoning was in conflict with expressed values.

CONCLUSIONS AND IMPLICATIONS FOR PRACTICE

- 48% of faculty could be viewed as providing students incentive for showing their work (e.g., graded SSD = SSE).
- 34% of faculty 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 (Campana & Gross, 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.

REFERENCES


ACKNOWLEDGEMENTS

We wish to thank the faculty members who participated in this research project: Dr. Lisa Deleon-Clark & Robert Rathbun contributed to the development of the earth science course and student solutions. Comments and feedback from graduate students Caleb Colletto, Matthew Liddle, and Kyle Rohrmaier have greatly improved the presentation.