Student preferences for grade weighting in introductory physics

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BACKGROUND

Research into alternative grading practices in STEM education lags behind the popularity of such alternatives, especially in physics (Hackerson et al, 2024). A primary theme in alternative grading practices is the delineation between the **effort** that a student puts into a course and their demonstration of **mastery** over course content. Some grading strategies (e.g., standards-based) are designed under the presumption that mastery is of primary importance. Other alternative grading strategies (e.g., contract-based) foreground learning practices under the assumption that learning happens when students spend time on appropriately designed learning activities. Thinking of grading along these poles can help instructors and researchers parse **student perspectives of grading** in terms of effort and mastery, as we explore here.

CONTEXT AND METHOD

We administered a survey about grading to N = 88 students from algebra- and calculus-based introductory physics. The survey included a set of free-response questions about their experiences with grading. We carried out content analysis on the students' responses and identified four themes relevant to our analysis here:

1. **Stress-Expressing**: "Stress is a negative outcome of grades." 53% of students expressed this theme.
2. **Effort-Affirming**: "Grades represent the effort a student puts in, and this is a good thing." 47% of students expressed this theme.
3. **Mastery-Affirming**: "Grades represent a student's mastery of the subject matter, and this is a good thing." 30% of students expressed this theme.
4. **Mastery-Agnostic**: "Grades represent a student's mastery of the subject matter, and this is a mix of good and bad." 29% of students expressed this theme.

We also asked students the following numerical question about their **weighting preferences**:

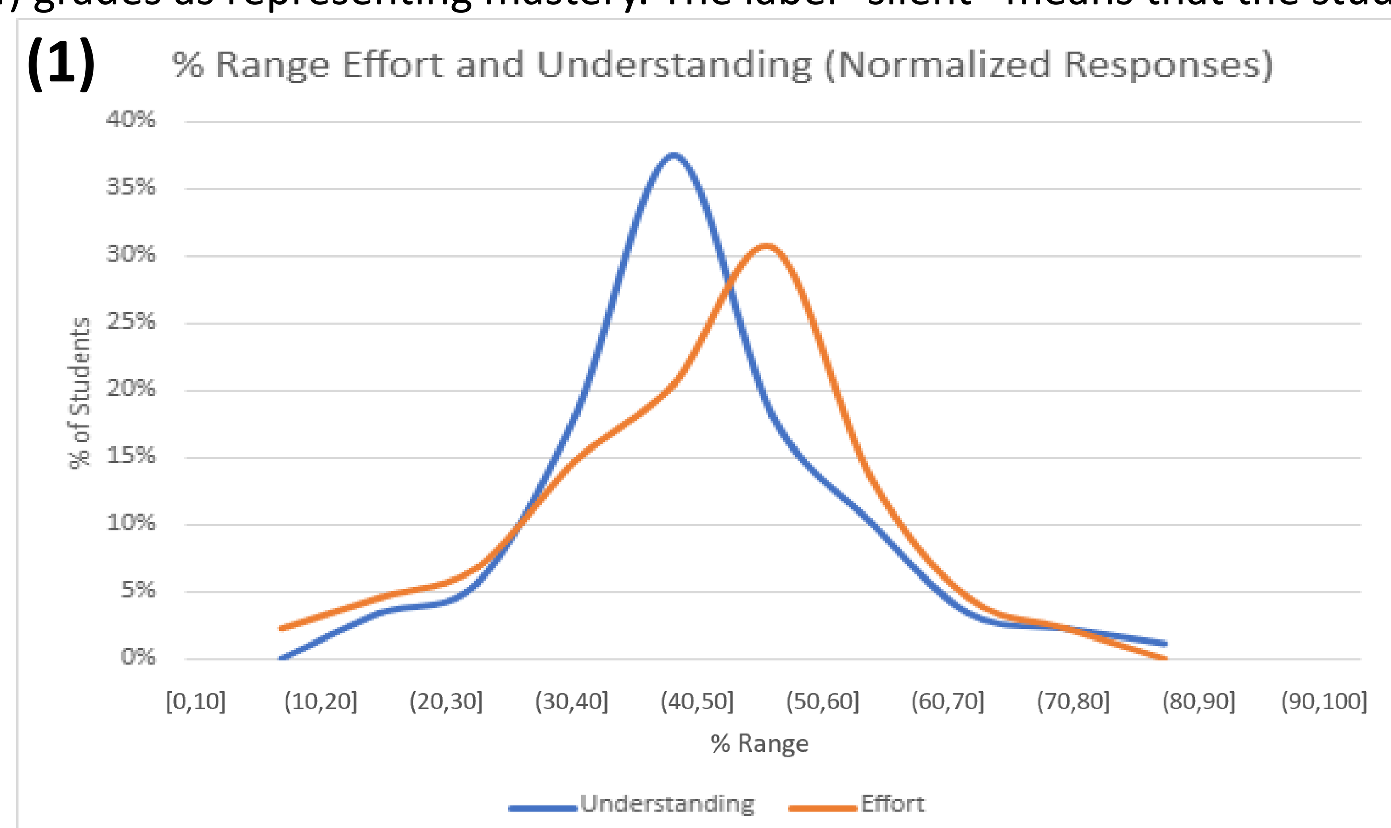
Weighting Preference Question

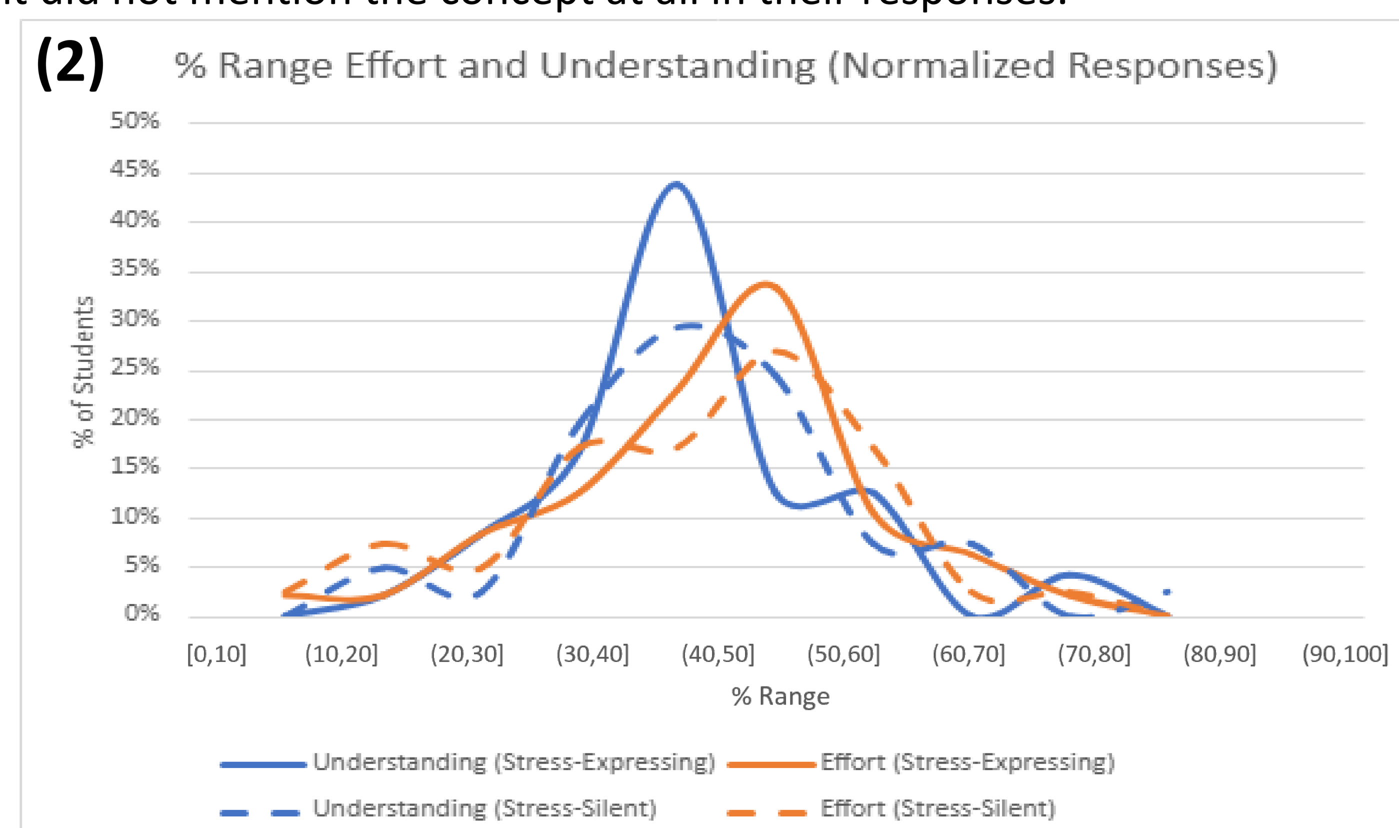
Suppose you had a choice in how physics instructors weighted students' understanding of the material (for example, the degree to which you "got the right answer") and their effort in the course (for example, the degree to which you "did all the work") in calculating the final letter grades. How would you prefer the instructor to weight understanding and effort?

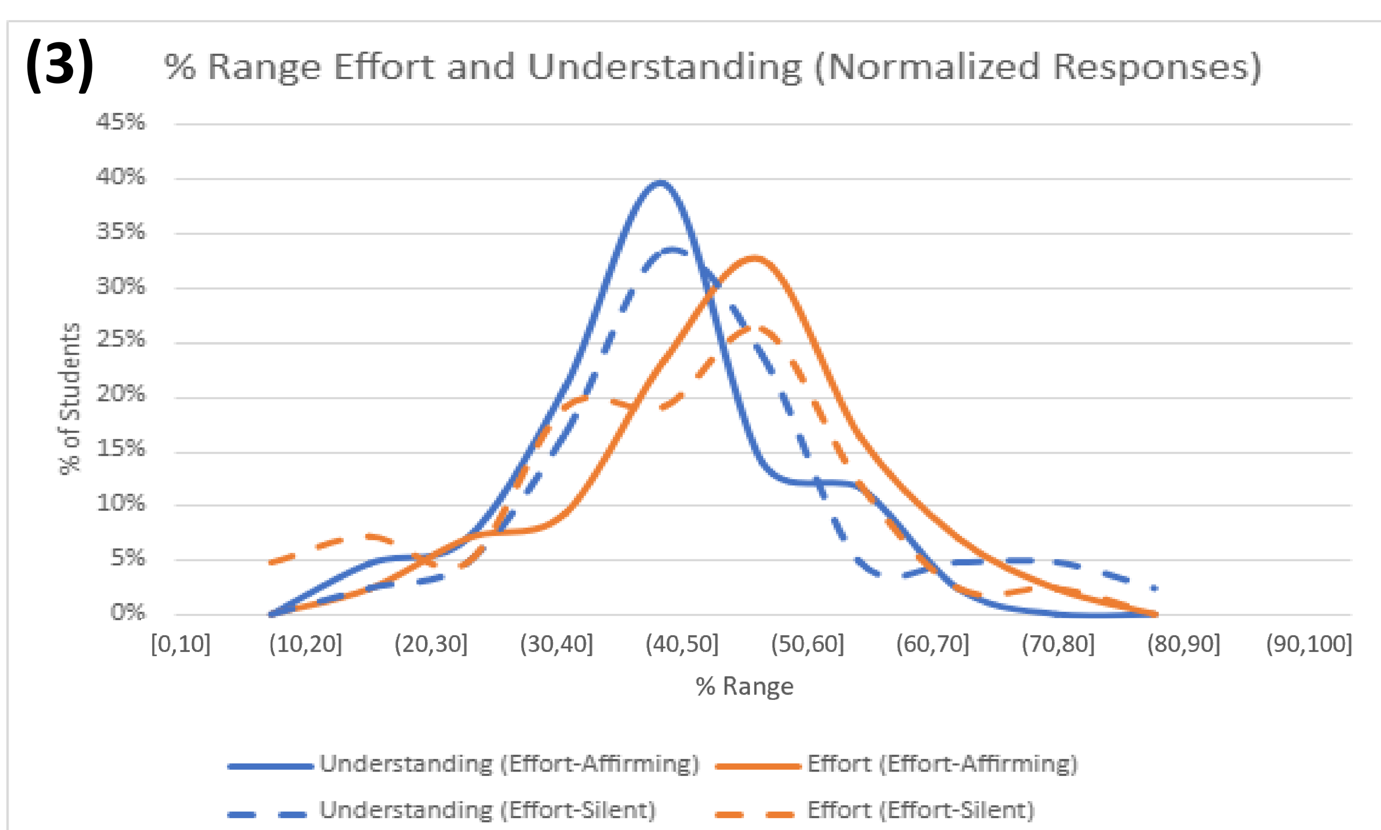
We describe students' preferences for how effort and understanding are weighted in introductory physics grades.

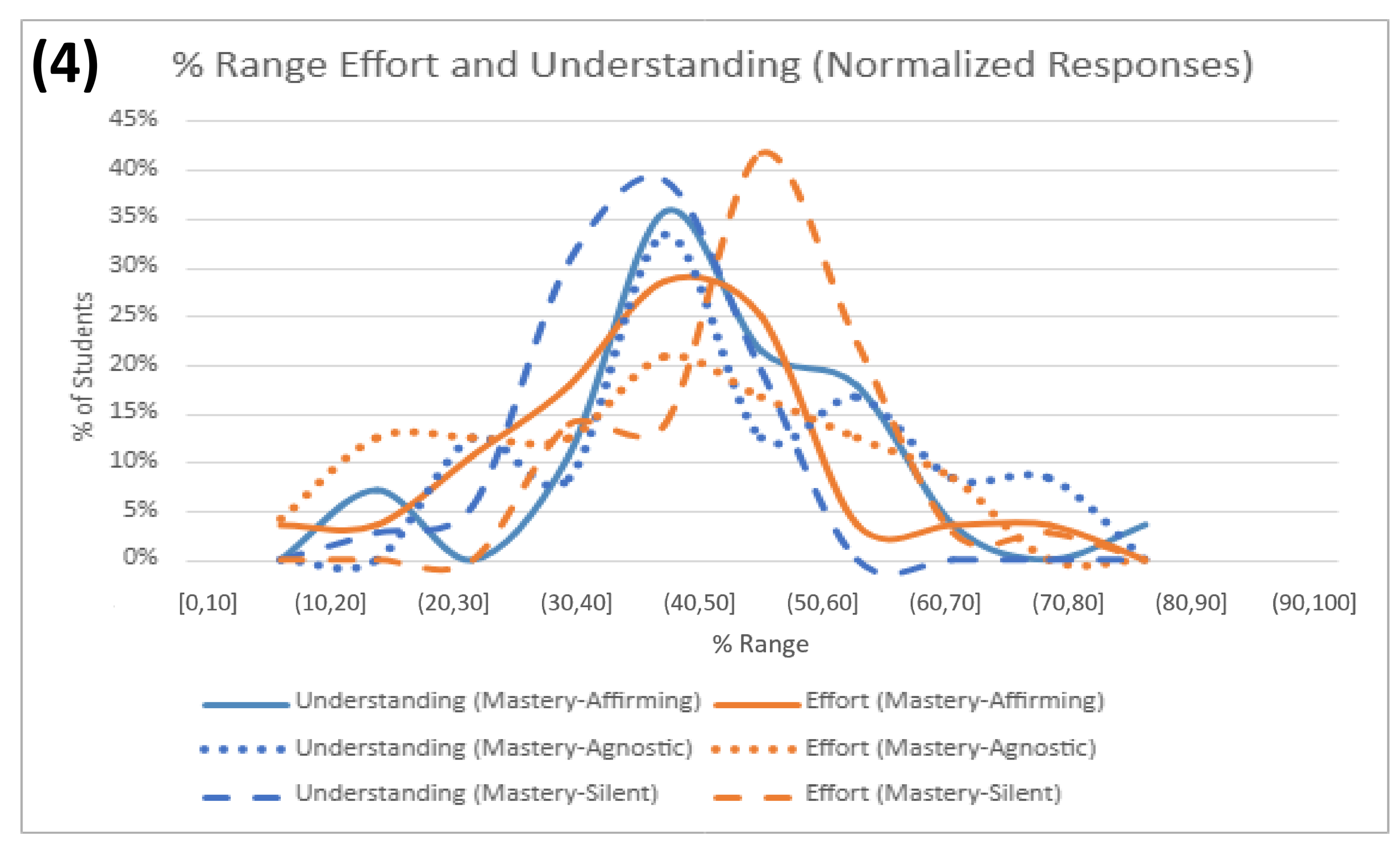
RESULTS

Figures 1-4 show distributions of students' weighting preferences for **understanding** and **effort** when determining a physics grade. Responses are reported for (1) all N = 88 students and disaggregated by whether students mentioned (2) grade-related stress, (3) grades as representing effort, and (4) grades as representing mastery. The label "silent" means that the student did not mention the concept at all in their responses.









DISCUSSION

We reviewed the weighting distributions for all students and disaggregated by the four themes. We used Kruskal-Wallis H-tests to evaluate significant differences between groups.

Figure 1 (All Students): Most students (51%) weighted effort more heavily than understanding. 14% weighted effort and understanding equally, and 35% weighted understanding more heavily than effort.

Figure 2 (Stress): The stress-based distributions are indistinguishable, with no significant differences ($p > .05$, $d = 0.04$). Therefore, it does not seem that a perception of grade-related stress explains how students prefer their grade to be weighted between effort and understanding.

Figure 3 (Effort): The effort-based distributions are indistinguishable, with no significant differences ($p > .05$, $d = 0.29$). Therefore, it does not seem that a positive perception of grades representing effort explains how students prefer their grade to be weighted between effort and understanding.

Figure 4 (Mastery): The mastery-based distributions show **significant differences ($p < .01$, $d = 0.75$), with Mastery-Silent students weighting effort significantly heavier** (dashed orange curve) than Mastery-Affirming and Mastery-Agnostic students. It therefore seems that there is some association between a preference for weighting effort higher in a physics grade and whether a student perceives mastery as an important factor in grading.

IMPLICATIONS

These findings offer important insight for instruction:

1. Students want grades to reflect **both** their effort spent on course tasks and their understanding of course material.
2. Stress does **not** seem to impact students' weighting preferences. A well-designed grading strategy might reduce stress, but we are unlikely to eliminate stress from a reformed design alone. When communicating our grading strategies to students, we should emphasize the promotion their mental well-being.
3. Students' weighting **preferences might change** if we expand their considerations of how grades represent content mastery. Instructors should discuss their ideas of what mastery means.

REFERENCES

E. L. Hackerson, T. Slominski, N. Johnson, J. B. Buncher, S. Ismael, L. Singelmann, A. Leontyev, A. G. Knopps, A. McDarby, J. J. Nguyen, et al., *Disciplinary and Interdisciplinary Science Education Research* **6**, 15 (2024)

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