

Confidence-to-Certainty Metacognitive Shifts for Students in Undergraduate Linear Algebra

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Assessing students' metacognition can help educators better understand student learning. In the present study, the authors evaluated students' pre-assessment confidence, response correctness, and post-response certainty during routine examinations in an undergraduate linear algebra course to investigate the magnitude and direction of students' metacognitive shifts (Δ meta) from mean confidence to mean certainty as compared to response correctness. Results of this study provide insights to student perceptions of their knowledge during examination performances in linear algebra and can inform efforts to improve mathematics teaching and learning.

Keywords: confidence, certainty, correctness, metacognition, metacognitive shift, correlation

Motivation and Study Objectives

Scholars have studied the alignment of confidence and certainty to response correctness (Gardner-Medwin & Curtin, 2007; Hunt, 2003; Preheim, Dorfmeister, & Snow, 2022), but Δ meta has not been empirically compared to overall correctness or performances on different types of questions (e.g., multiple choice vs. process-based questions). The objective of this study is to investigate this gap in knowledge within an undergraduate linear algebra student population.

Methods and Preliminary Results

Students' Δ meta was ordered and evaluated for correlation with performance. Interestingly, five students demonstrated no overall Δ meta (boxed), and one student stood out on either end of the ordered Δ meta (Fig. 1A). Preliminary analyses show a correlation ($r = 0.43$, $p < 0.001$) of Δ meta to overall score (Fig. 1B). Confidence and certainty were separately examined with respect to ordered Δ meta (Fig. 1C). Only certainty showed positive correlation to Δ meta ($r = 0.57$, $p < 0.001$). The presentation will further describe these correlations, the five students who demonstrated no Δ meta, and the comparison of Δ meta between question types.

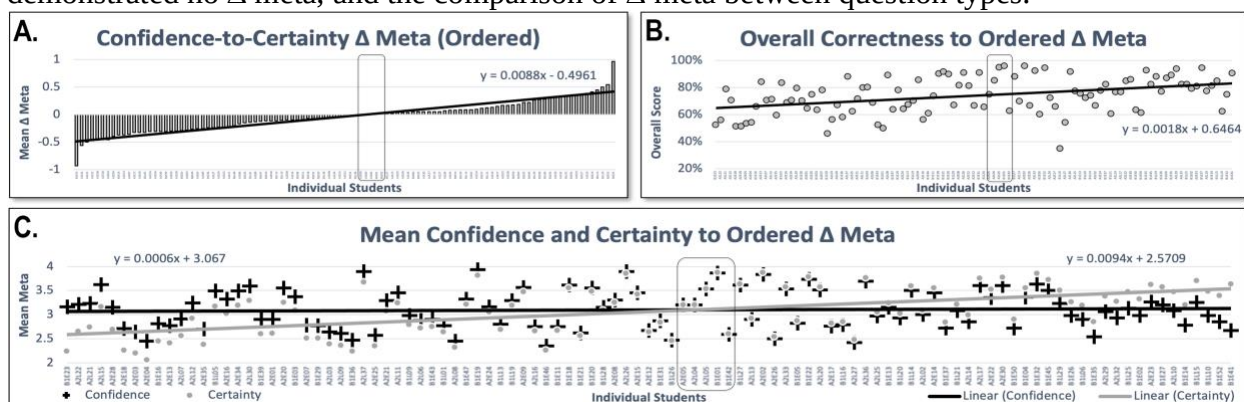


Figure 1. Correctness (B), confidence (C), and certainty (C) correlations to Δ meta (A).

Discussion and Conclusions

This study demonstrates how examining Δ meta can provide mathematics educators with a deeper understanding of student metacognition, learning, and performance, especially regarding undergraduate linear algebra and multiple choice vs. process-based examination questions.

References

- Gardner-Medwin, A., & Curtin, N. (2007). Certainty-Based Marking (CBM) for reflective learning and proper knowledge assessment. *Re-Engineering Assessment Practices (REAP) Int. Online Conference on Assessment Design for Learner Responsibility, Proceedings for Raising Students' Meta-Cognition (Self-Assessment) Abilities*. Retrieved from <http://discovery.ucl.ac.uk/178612/>
- Hunt, D. P. (2003). The concept of knowledge and how to measure it. *Journal of Intellectual Capital*, 4(1), 100–113. <https://doi.org/10.1108/14691930310455414>
- Preheim, M., Dorfmeister, J., & Snow, E. (2023). Assessing Confidence and Certainty of Students in an Undergraduate Linear Algebra Course. *Journal for STEM Education Research*. <https://doi.org/10.1007/s41979-022-00082-6>