Theoretical Framework

Through this research, we hope to identify aspects of student math and physics framing. A resources framework models knowledge as existing in pieces and these pieces are compiled in real-time to form an explanation. The notion of framing describes the idea that these resources are context dependent and a person will bring to bear those resources that they think are useful for answering the question.

Research Questions

How do students and faculty:  
• use math language when solving math and physics problems?  
• reason while solving math and physics problems?  
• frame math and physics problems and can we identify them?

Framework

Math Resources Physics Resources

Toy model of student conceptual resources that are not connected and either of which might be called on when starting a problem.

Math Resources Physics Resources

Experts are more often considered to have more connections between math and physics resources and can move between frames more readily.

Interview Protocol

This is a three part protocol written in a non-trivial, progressive order. Each part of the protocol consists of prompts with follow-up questions.

Part I: Math Problem written by a Mathematician:

Q: “How do you think about what the equals sign means when you see it written in the context of this equation?”

Part II: Math Problem written by a Physicist:

Q: “Given the following 2x2 matrix, is it possible to determine the eigenvalue(s) for this matrix?”

Part III: Physics Problem written by a Physicist:

Q: “If we wanted to determine the probability that the particle was either spin up or spin down in the z-direction, can you describe how we would go about doing that?”

Common Question (CQ)

Each part of the protocol has a common question intended to identify features that influence students and faculty framing.

“After doing this problem, do you feel you’re doing more math or doing more physics? Why?”

Responses to the Common Question

Below is the analysis of the math and physics language used throughout the interview. The frequency of the math and physics language is compared to the responses to the common question to gain further insight into how they frame the problem.

Nontraditional PER Interview Method

Our data were collected through video recorded interviews. These interviews lasted an average of 60 minutes where the interviewee wrote their responses to the questions in the protocol on a provided whiteboard.

The interviewees consisted of:

- Two Physics Professors
- Two Physics Graduate Students
- Three Physics Undergraduate Students

Unlike most Physics Education Research (PER), we are interviewing physics professors along with the students (graduates and undergraduates). This method, however, is more prevalent in Research in Undergraduate Mathematics Education (RUME).

References


This material is based upon work supported by the National Science Foundation under NSF DUE-1156974. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

Acknowledgements

Illustrations provided by: Matt A. Losman

Conclusion

From the perspective of framing, we observe a disconnect between what our interview subjects report “doing” and the language and reasoning they use within the interview settings. Both experts and novices struggle to identify the types of thinking in which they are engaging.