Examining Conceptual Understanding of Pre-Service Elementary Teachers

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Course for Elementary Teachers

- **P.E.T. - Physics for Elementary Teachers**
- **Inquiry-Based Curriculum**
- **Forces, motion, energy and other concepts**
- **3-4 sections of 32 students at SELU**
- **Required for all elementary ed. majors**
Focus of Conceptual Understanding

- **focus**: objects moving at a constant speed
- Two main student ideas
  - **Newtonian**: no net force is needed to move at constant speed
  - **Force=Motion**: a net force is needed in the direction of motion
Methods

- Compare force and motion responses to test items
- P.E.T. students
- Traditional Algebra-Based physics students
Force and Motion questions

- 5 Items exploring student ideas of force and motion.
- Multiple-choice with written explanations
- Given to both P.E.T. classes and to the algebra-based physics classes
Item 1

- The following is the graph for an object with only one force acting on it. For each segment, is there a force acting on the object? In which direction?
Analysis

- **Section A - Constant Speed:**

  - PET: \( n = 22 \)
  - Physics: \( n = 56 \)

  Significantly different responses (physics was more likely to answer Newtonian)
Sample explanations

- **Newtonian**: “There is no force. No force is needed for constant motion”

- **Force = Motion**: “Yes, there is a force in the direction of motion. If there were no force, it would stop.

- **Other** (speeding up segment - C): the force moves in the opposite direction because of gravity
An elevator moves upwards at a constant speed. Which describes the forces acting on it:

- cable is stronger than gravity
- cable is equal to gravity
- cable is weaker than gravity
Responses

Forces equal  cable greater  Newtonian  Force=Motion

PET - n=61  Physics n=53
Responses

- **Force=Motion**: “the cable is stronger because if it were equal, the elevator would not move. If it were weaker, the elevator would be going down.”

- **Newtonian**: “There are equal. Balanced forces are the same as no force. No force is needed for constant motion.”

- **Other**: “The cable must be stronger, otherwise the elevator would never move.”
Summary

- Force and constant speed - this is a difficult idea
- P.E.T. students sometimes perform better than physics students, but sometimes worse
- Possible question interpretation problems