“Investigation of student understanding of the concept of velocity in one dimension”

David E. Trowbridge, Lillian C. McDermott


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History of Physics Education Research (PER)

American Association of Teachers Formed

1930

1950

PER Focus on K-12 curriculum reform

1970

Birth of Modern PER!

1980

PER continues to expand

2019
Motivation of Study

- Students are not “blank slates” when they walk through the door to the lecture hall
- Students typically come in with ideas already established by their previous instruction and their everyday experience (for better or worse)
- How do we systematically address these issues?
Testing Students’ Understanding of Velocity

- What is “understanding”?
  - The ability to interpret the simple motions of real objects
- Predominantly based on student interviews
- Two simple scenarios, designed to target common misconceptions about the relationship between velocity and position
- Grading criteria:
  - 2 - fully correct
  - 1 - mostly correct
  - 0 - not correct
First Stage Experiment

Q: A model train with uniform speed went 45 cm in 1.5 s, how far would it travel in 2.5 s?

Jean Piaget (1896 – 1980)
https://en.wikipedia.org/wiki/Jean_Piaget

Child’s Conception of Movement and Speed

Jean Piaget
Translated by G.E.T. Holloway and M.J. MacKenzie
Difference between Velocity and Position

Task 1: passing twice

Task 2: no passing

Do these two balls ever have the same speed?

Response: twice!

Response: never!
### Table II. Results of pre-course interviews. Percentages and numbers (n) of students in each group who received scores of 0, 1, or 2.

<table>
<thead>
<tr>
<th></th>
<th>Speed Comparison Task 1</th>
<th>Speed Comparison Task 2</th>
<th>Total</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
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<tr>
<td>In-service teachers</td>
<td>(IT)</td>
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<td>18</td>
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<tr>
<td>General physics</td>
<td>(GPS)</td>
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<td>27</td>
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<tr>
<td>Calculus physics</td>
<td>(CP)</td>
<td>15</td>
<td>17</td>
</tr>
</tbody>
</table>

### Table III. Results of post-course interviews. Percentages and numbers (n) of students in each group who received scores of 0, 1, or 2.

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Experimental Results Analysis

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“The ability to solve conventional problems on examinations or to pass the usual types of “mastery” tests does not always indicate conceptual understanding.”
Critical Analysis

Potential Weaknesses
● Nonuniformity of testing among students
● Relatively small sample of students from one university
● Difficulty of visually analyzing velocity, even for those who understand it

Strengths
● The first study of its kind
● A jumping off point for continuing to address issues in physics instruction
Citation Analysis

- Cited 210 times since publication in 1980
- Most citations (14) in 2012 and 2013 and 6 citations in 2019
  - Still relevant to modern PER
Summary

- The pioneering PER study
- Sought to understand and address the common misconceptions of students entering introductory physics classes
- Argued it is necessary for instructors to actively intervene to prevent confusion on similar but related concepts
- Still influences PER 40 years after its publication