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

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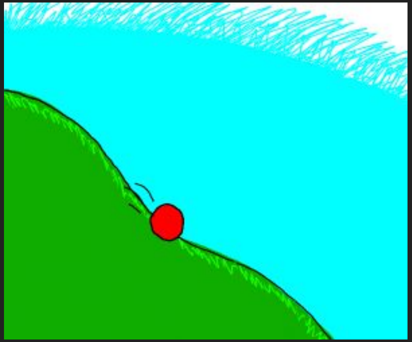
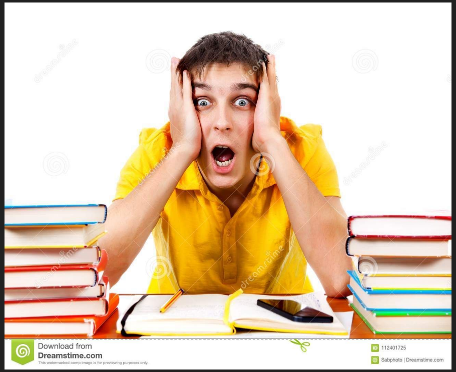
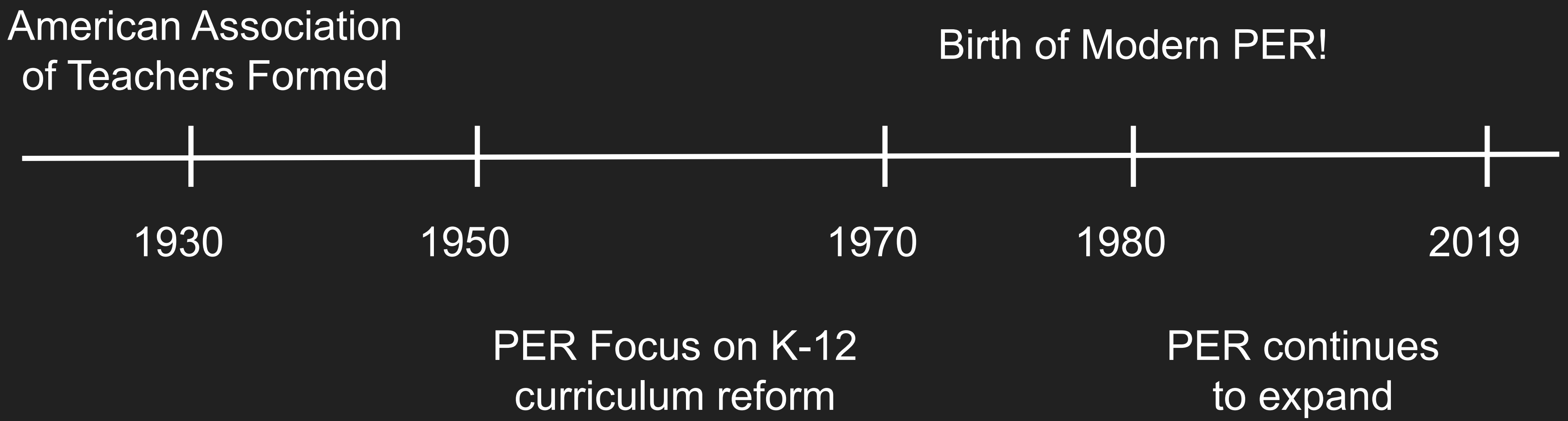
*American Journal of Physics* 48, 1020 (1980)

doi: 10.1119/1.12298



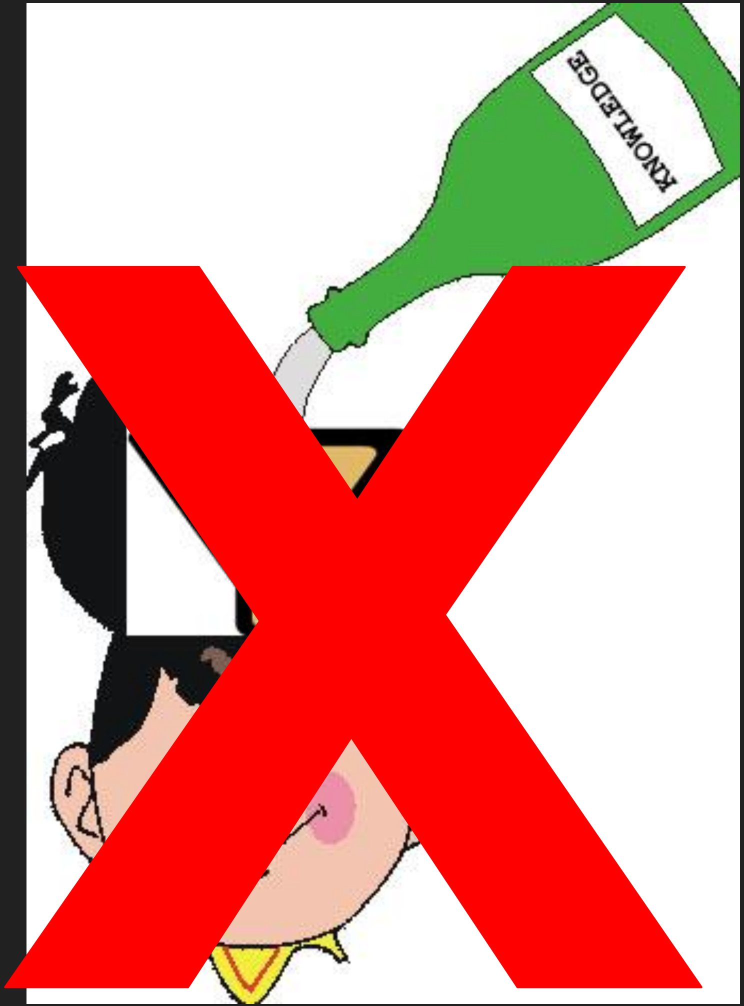


# History of Physics Education Research (PER)



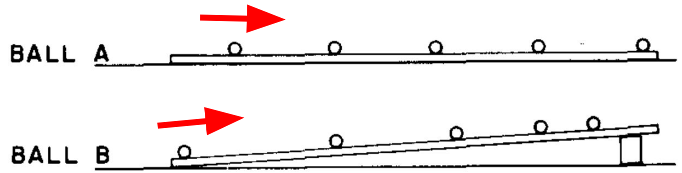
# Motivation of Study

- 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?

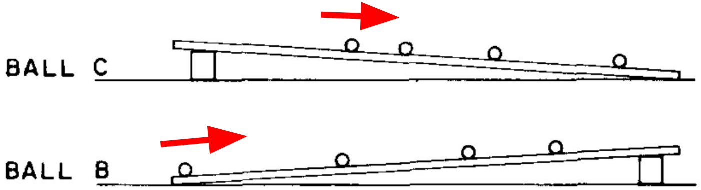


# Testing Students' Understanding of Velocity

- 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

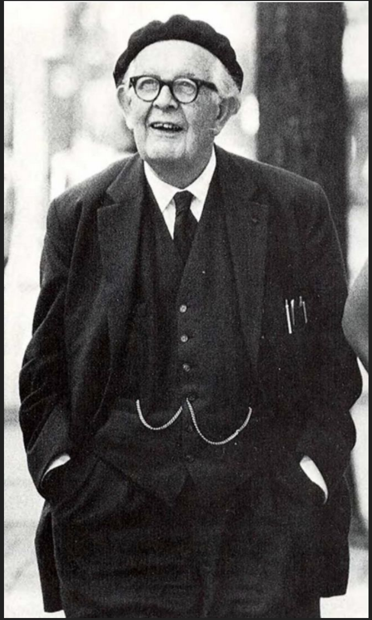



Speed Comparison Task 1




Speed Comparison Task 2

# First Stage Experiment



Jean Piaget (1896 – 1980)

https://en.wikipedia.org/wiki/Jean_Piaget

**Child's Conception of Movement and Speed**

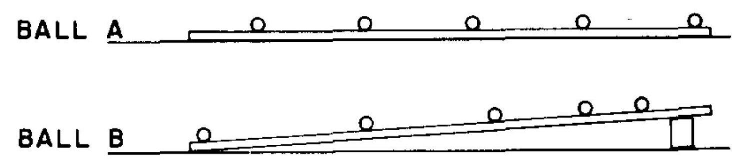
**Jean Piaget**

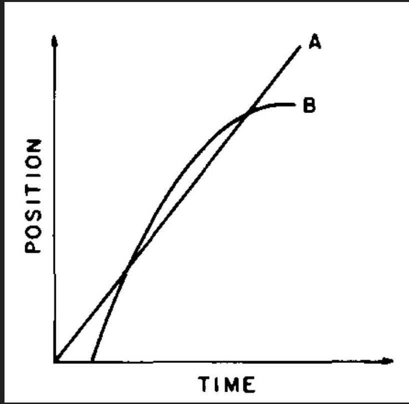
***Translated by G.E.T. Holloway and M.J. MacKenzie***

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

# Difference between Velocity and Position

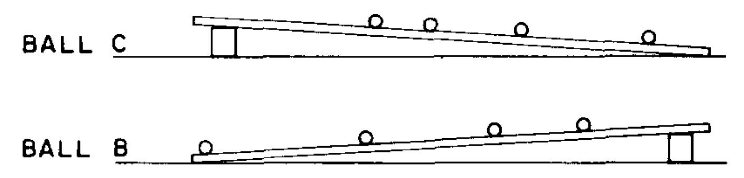
Task 1: passing twice

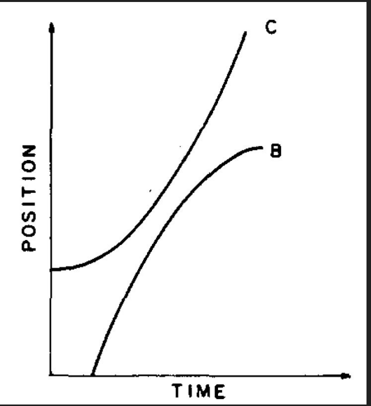



Response: twice!

Task 2: no passing




Response: never!

?

Do these two balls ever have the same speed?

Pre-course interview

Table II. Results of precourse interviews. Percentages and Numbers ($n$) of students in each group who received scores of 0, 1, or 2.

| | | Speed Comparison Task 1 | | | | Speed Comparison Task 2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | total | 0 | 1 | 2 | total |
| In-service teachers | (IT) | 41 (9) | 18 (4) | 41 (9) | 100 (22) | | | | |
| Academically disadvantaged | (AD) | 30 (11) | 17 (6) | 53 (19) | 100 (36) | 37 (13) | 0 (0) | 63 (22) | 100 (35) |
| General physics | (GPS) | 14 (3) | 27 (6) | 59 (13) | 100 (22) | | | | |
| Calculus physics | (CP) | 15 (7) | 17 (8) | 68 (31) | 100 (46) | | | | |

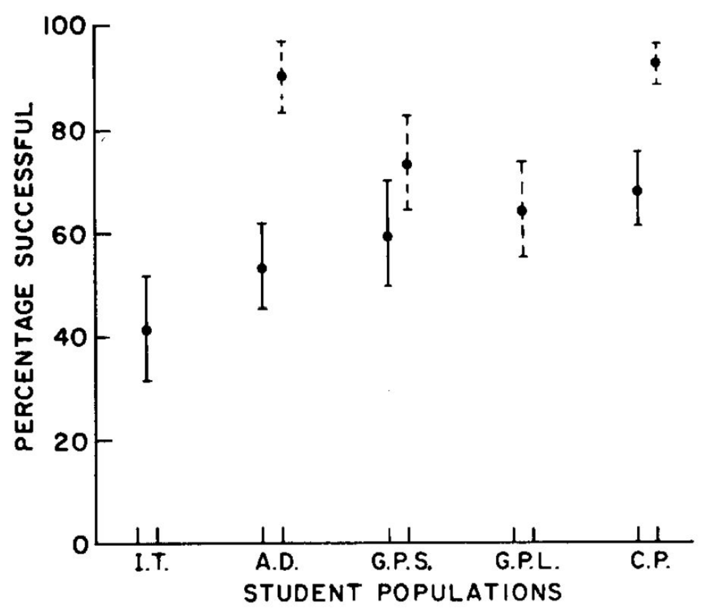
Post-course interview

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

| | | Speed Comparison 1 | | | | Speed Comparison 2 | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 0 | 1 | 2 | total | 0 | 1 | 2 | total |
| Academically disadvantaged | (AD) | | | | | 10 (2) | 0 (0) | 90 (18) | 100 (20) |
| General physics (self-paced) | (GPS) | 23 (5) | 4 (1) | 73 (16) | 100 (22) | | | | |
| General physics (lecture) | (GPL) | 25 (7) | 11 (3) | 64 (18) | 100 (28) | | | | |
| Calculus physics | (CP) | | | | | 5 (2) | 3 (1) | 92 (36) | 100 (39) |

# Experimental Results Analysis

| | |
|---|---|
| In-service teachers | (IT) |
| Academically disadvantaged | (AD) |
| General physics (self-paced) | (GPS) |
| General physics (lecture) | (GPL) |
| Calculus physics | (CP) |




"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**

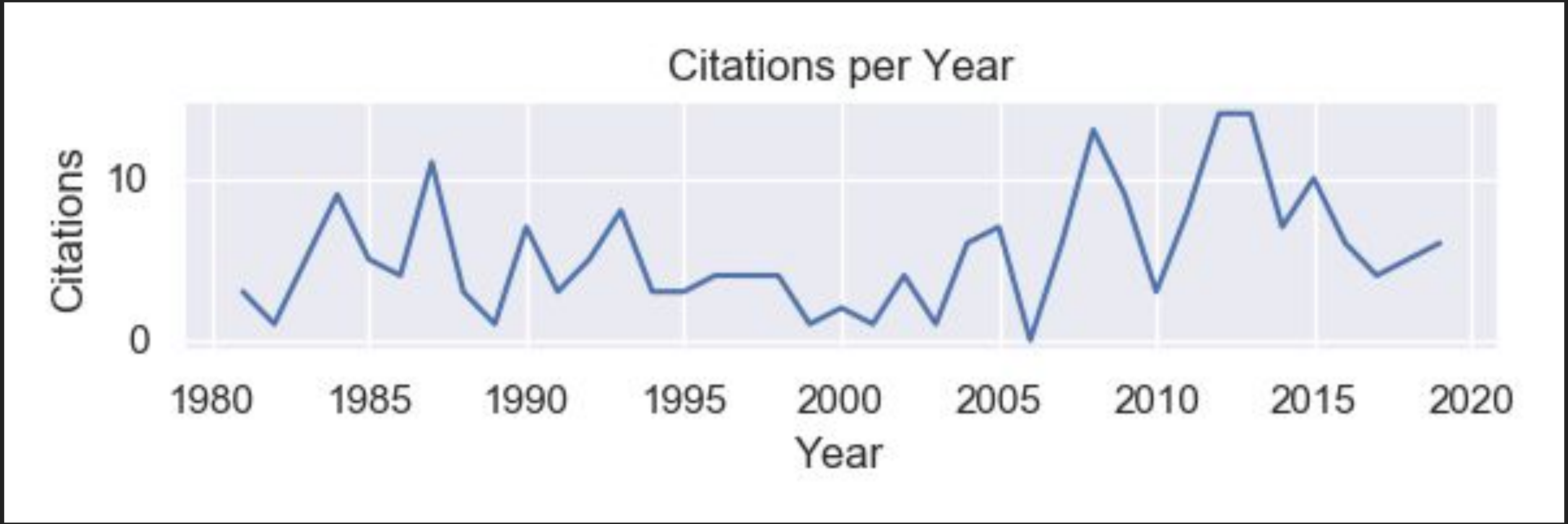
- Nonuniformity of testing among students
- Relatively small sample of students from one university
- Difficulty of visually analyzing velocity, even for those who understand it

**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