Research Designs to Test and Refine the Pathway Active Learning Environment

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Project Overview

Pathway Active Learning Environment

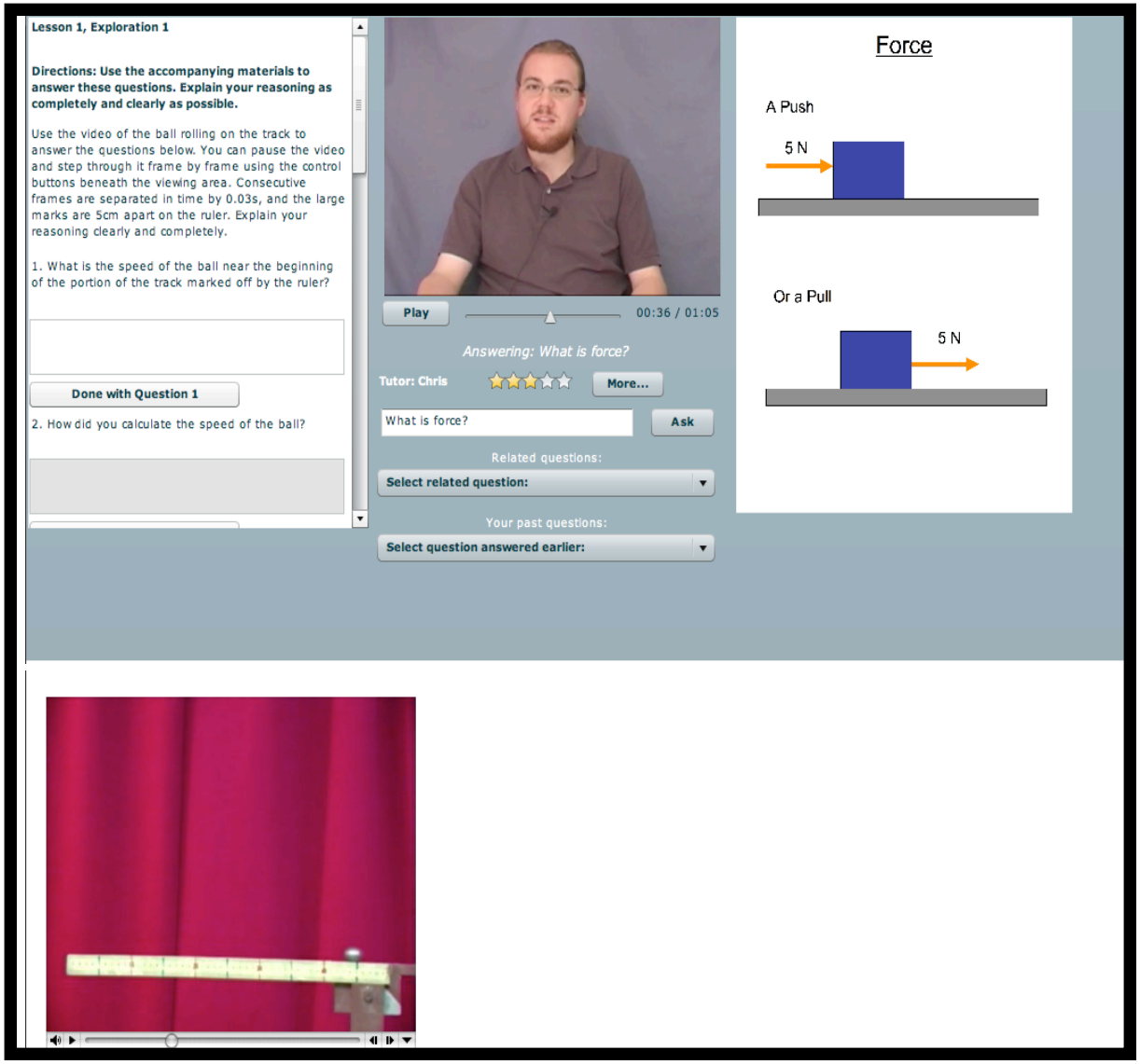
- Develop an interactive online synthetic tutor
  - Targeted at high school & intro college physics students
  - For supplemental instruction at home
  - To study student learning processes
- Seek to exploit benefits of human tutoring[1]
  - Interaction is mostly student-centered[2]
  - Students must self-explain[2]
  - Students must challenge their constructed explanations[2]

[1] Bloom (1984) [2] Chi et. al (2004)

Active Learning Environment

Two Components

- Guiding Lessons
- Synthetic Tutor (SI)



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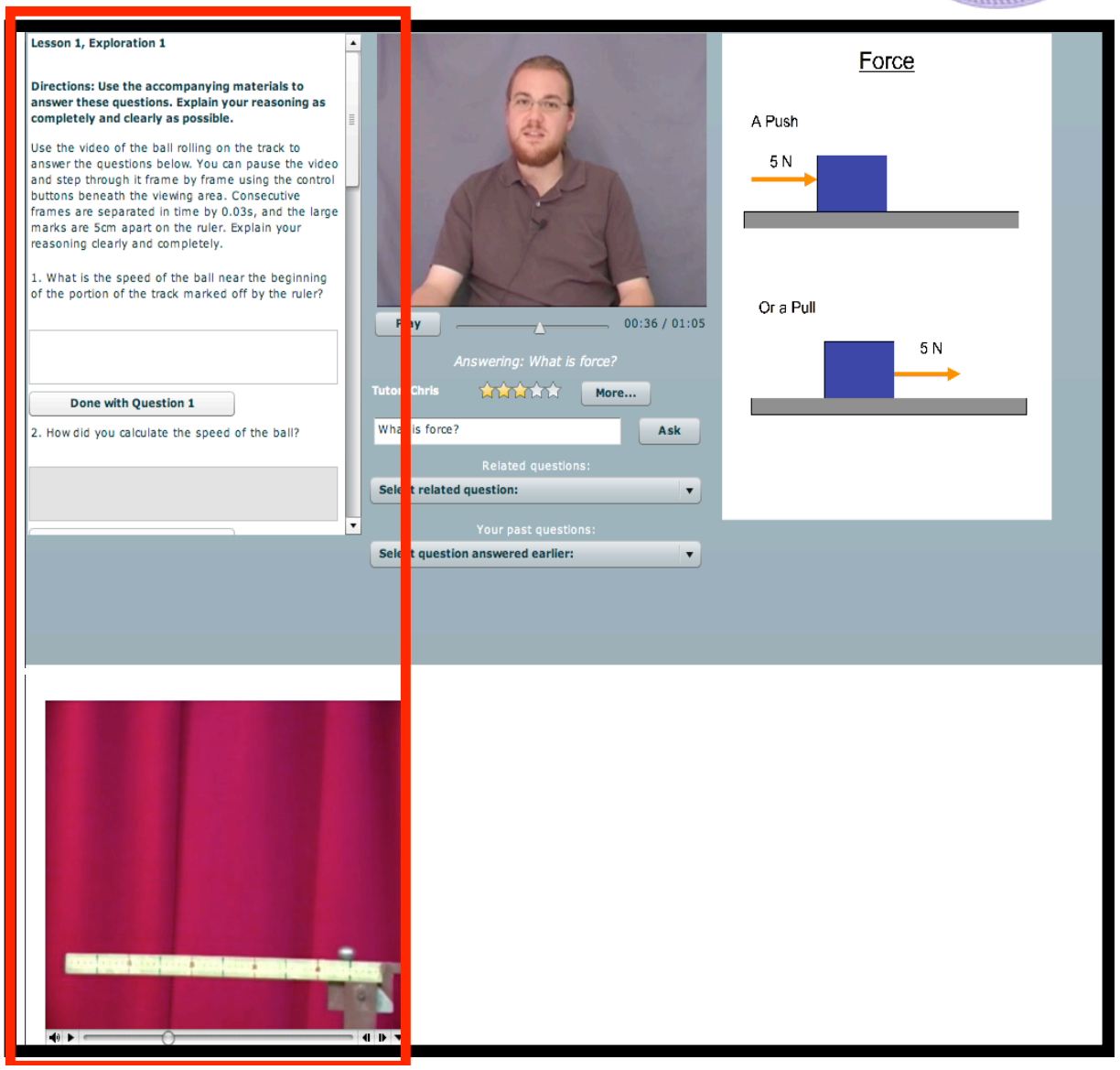

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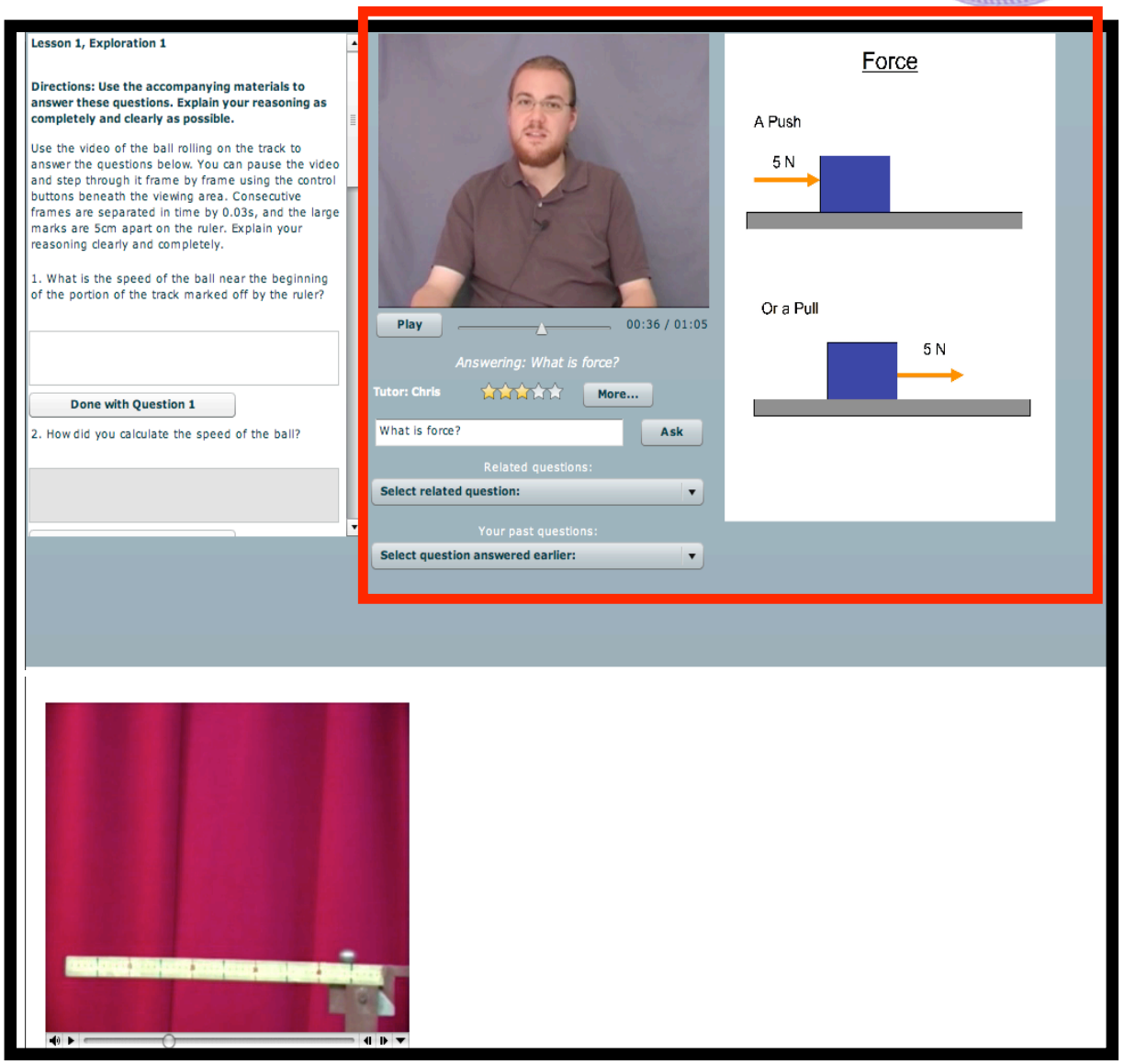
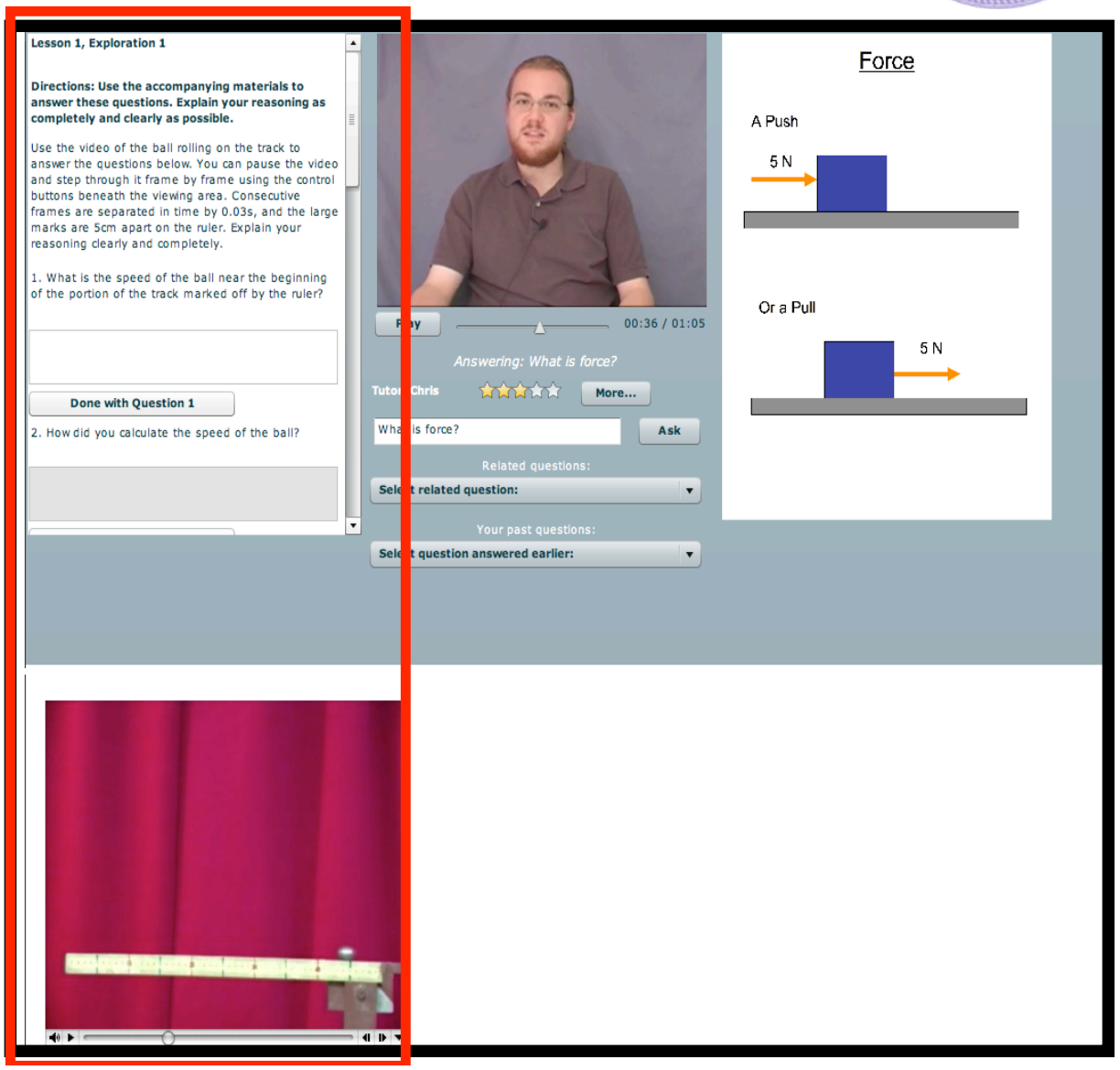


Active Learning Environment

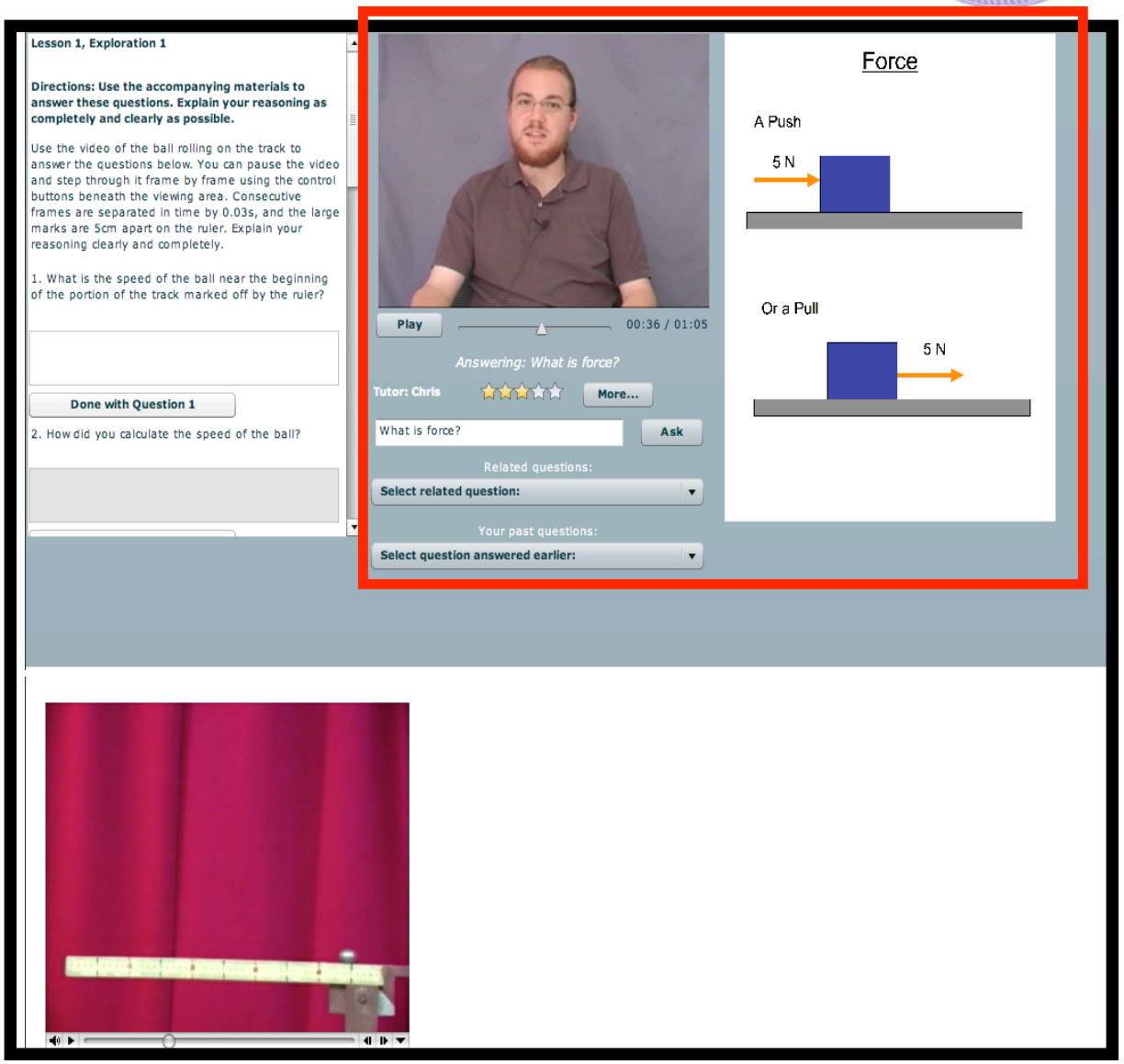
- Three lessons cover Newton's Laws
- Can be thought of as "problems in video contexts"
- Can involve textbook-style problems & questions, observation & measurement, or both
- Connects to the real-world
- Uses established pedagogy[3]



[3] Karplus & Butts (1977)

Active Learning Environment

- Can answer natural language questions
- "Quickstart" menus enable selection of questions
- Multimedia can support tutors' verbal responses
- Attempts to develop a synthetic social interaction[4]
- Currently offers two tutors
- 7 different experiences total



4. Okita et al. 2008

Factors in Testing the PALE

- PALE logs (through student accounts):
  - student responses
  - changes to responses
  - queries to SI tutor
  - several other types of actions
- PALE logs these with a time stamp for time-resolved analysis
- PALE does not log facial expressions, thoughts, feelings, or mutterings

Three-modes of Testing

- One-on-one interview setting

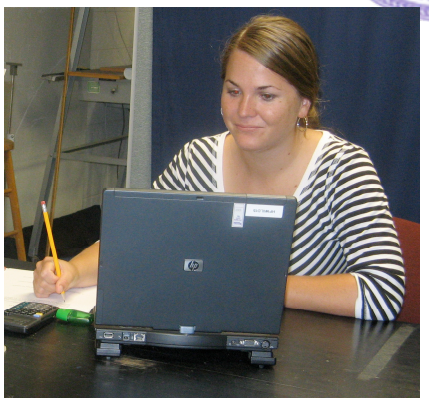


Photo: ©2008 Chris Nakamura, used with permission

- In-classroom setting

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- At-home setting

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Three-modes of Testing

- One-on-one interview setting
  - Observe details of use that the log would miss
  - Get student's immediate feedback
  - Cross-check on physics knowledge
- In-classroom setting
  - Access the student population in a controlled environment and encourage completion
  - Teacher can observe and cite difficulties
- At-home setting
  - Test under ultimate design condition: This is a system that is to be used at home

One-on-one Interview Mode

Testing PALE Fall 2010

- Algebra-based college physics students (N = 22)
- All 7 PALE experiences were used
- Volunteers were solicited for modest compensation
- One session per week for three weeks.
- Worked on a lesson for 1 hr. and discussed the lesson and their work for ~30 min.
- Interviews were conducted by SI tutors

In-class Mode

Testing PALE Fall 2010

- Five classes of highschool physics students (n = 12,13,10, 8,16; N = 59)
- Students completed the lessons in-class under the supervision of the classroom teacher.
- 4 of the PALE experiences were used (One tutor was eliminated)

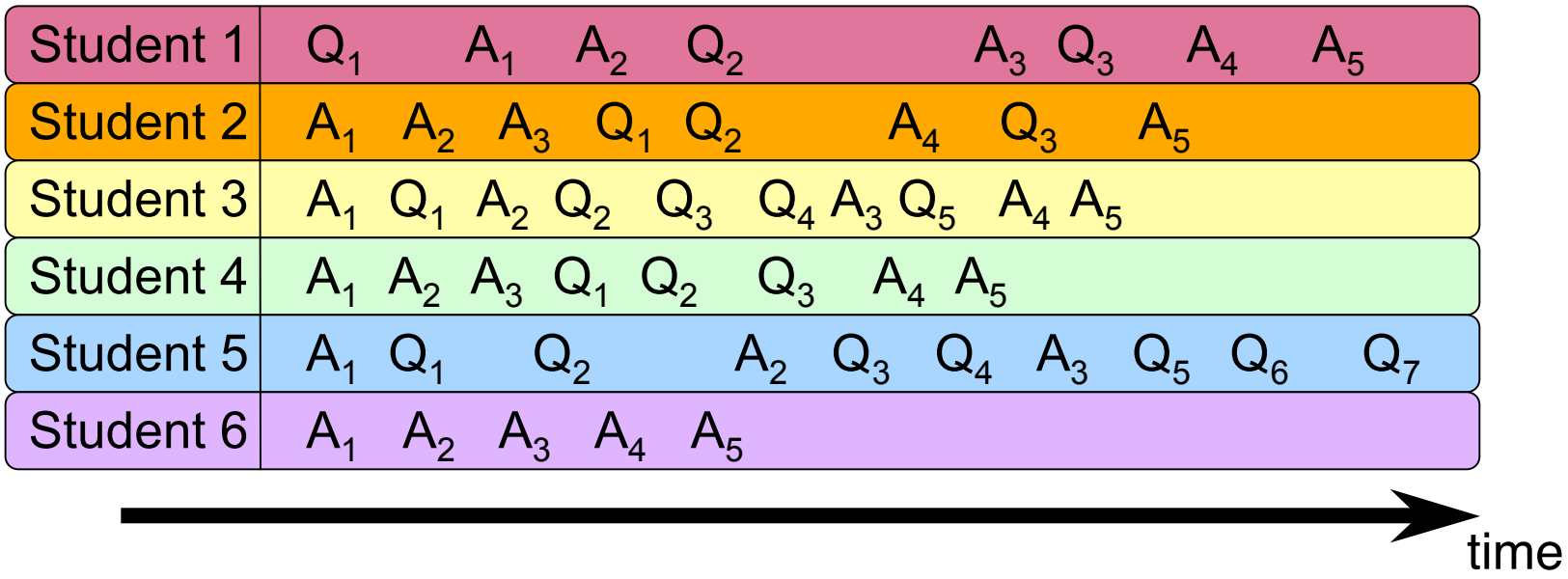
At-home Usage Mode

Testing PALE Fall 2010

- Concept-based college physics students, mostly elementary ed. majors in a large enrollment class (N = 107)
- Students were assigned the completion of one lesson per week for a homework grade
- 4 of the PALE experiences were used (One tutor was eliminated)

Data Analysis

Schematic of a data set



Additionally we have

- Video recordings of algebra-based students' usage
- Transcripts of algebra-based students' interviews
- Teachers' comments and observations

Data Analysis

Multi-faceted analysis procedure is needed

- Quantitative analysis & data-mining of PALE log
- Phenomenographic analysis of interview data
- Integrative procedure to obtain a complete picture
- This is an ongoing effort

Summary & Future Work

Summary

- Collected three complimentary data sets with PALE
- Each addresses different but related aspects of PALE testing
- Multi-faceted analysis techniques will likely be needed to extract a clear picture of PALE's efficacy

On-going Efforts

- Continue data analysis efforts
- Continue acquiring data in different settings with different student populations

References

1. Bloom, B. S. (1984). “The 2-sigma problem: The search for methods of group instruction as effective as one-to-one tutoring,” *Educational Researcher*, 13(6), 4-16.

2. Chi, M. T. H., Siler, S. A., and Jeong, H., (2004). “Can tutors monitor students’ understanding accurately?,” *Cognition and Instruction*, 22(3), 363-38.

3. Karplus, R, and Butts, D. P. (1977). “Science teaching and the development of reasoning,” *Journal of Research in Science Teaching*, 14(2), 169-17.

4. S. Y. Okita, J. Bailenson, and D. L. Schwartz in *Proceedings of the 8th International Conference for the Learning Sciences,* (Lawrence Erlbaum and Associates, Utrecht, Netherlands, 2008), pp. 132-139.

The End

Thank you

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