Student Framing and Real-World Connections in Physics Tutorials

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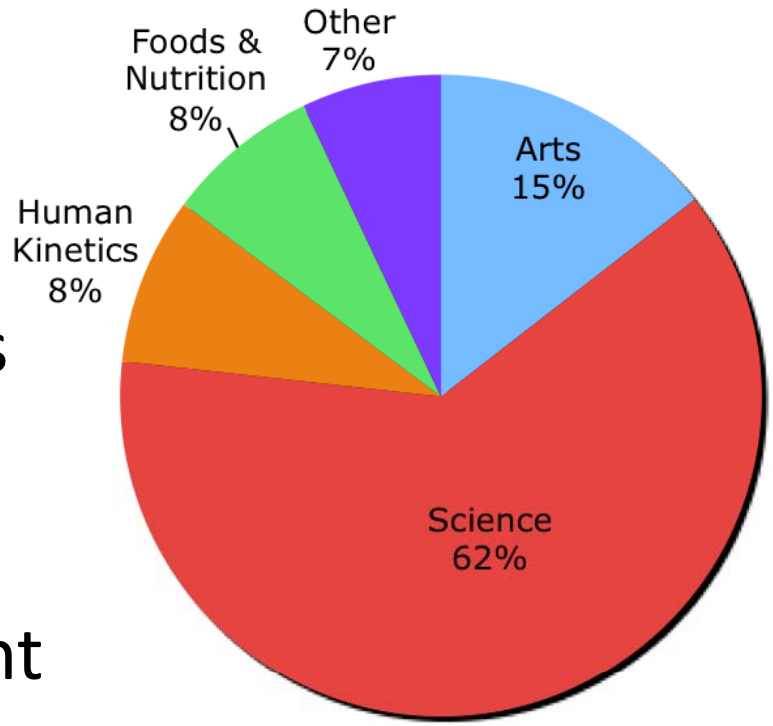
Physics 100

- Introductory course for students who did not take Physics 12 in high school
- ~850 students in 3 sections
- Presents physics in real-world context with connections to environment whenever possible



Tutorials in Physics 100

- Designed to promote:
  - Development of modeling skills
  - Connections between physics and everyday knowledge
- Weekly, 1 hr long, groups of 4 students
- Context Rich:
  - Problems are set in realistic situations
  - Rich in detail (just like real life)

Research Questions

The research is focused on **outside knowledge**: anytime students mention knowledge drawn from outside the tutorial room.

- How does students' ***framing*** of their tutorial activity regulate their use of ***outside knowledge***?

- What external factors prompt or inhibit students' access to ***outside knowledge***?

What is “Framing”?

- A student’s frame is his or her implicit sense of “what is going on here?”
  - e.g. A student may frame a tutorial as “an opportunity to get some marks” or as “an opportunity to learn some physics”
- Your frame affects how you interpret the situation, and what knowledge and beliefs are brought to bear.
- Students can quickly switch from one frame to another in response to outside influence. (e.g. the TA arrives)

Study of Framing in Tutorials

- Students were audiotaped during their group tutorial sessions.

- Tapes are analyzed to identify
  - Emergent categories of students' frames
  - Connections to outside knowledge

Coding Scheme:

Students' Framing of Tutorials

1. Engaged in Discussion

Students' focus is on each other. They speak clearly and are clearly listening to each other

a) Discussion of how to complete the task of the tutorial.

Speech is focused on interpreting and meeting the requirements of the worksheet:

Student 1: "Hey, maybe we need to include something like this."

Student 2: "A motion diagram? Yes. A motion diagram is probably a good idea"

Coding Scheme:

Students' Framing of Tutorials

1. Engaged in Discussion cont.

Students' focus is on each other. They speak clearly and are clearly listening to each other

b) Trying to understand or explain the physics

Speech is focused on discussing and understanding the physics of the situation.

Student 1: "just picture it. It's like a car, a normal car going. And then this guy's like, driving slower, right?"

Student 2: "yes. and you wanna know how much slower"

Student 1: "and then, this guy finally stops"

Student 2: "you wanna see how much slower he has to go given his, the difference in reaction time in order to stop at the exact same time. Like in order for both their cars to stop at the exact same time basically "

Coding Scheme:

Students' Framing of Tutorials

2. Working on a Worksheet

Students' focus is on the worksheet. They speak indistinctly, or in clipped sentences. This frame often occurs when reading or writing.

3. Listening to the TA

Students' focus is on the TA. They engage in little discussion with each other.

4. Joking Around

Students are off topic, or may make tentative statements about the problem.

Coding Scheme:

Types of Reference to Outside Knowledge

1. Unelaborated Judgments of a result or quantity

   Student 1: "six seconds. so we can make a reasonable assumption that his reaction time would be six seconds as opposed to, like, three seconds for another driver."

   Student 2: "that's long"

2. Elaborated Judgment of a result or quantity

   "oh. 12 m/s is actually like 40 k an hour. Because olympic sprinters, right? They take 10 seconds to sprint 100 meters and that's about 40 km/h, right? that seems reasonable."

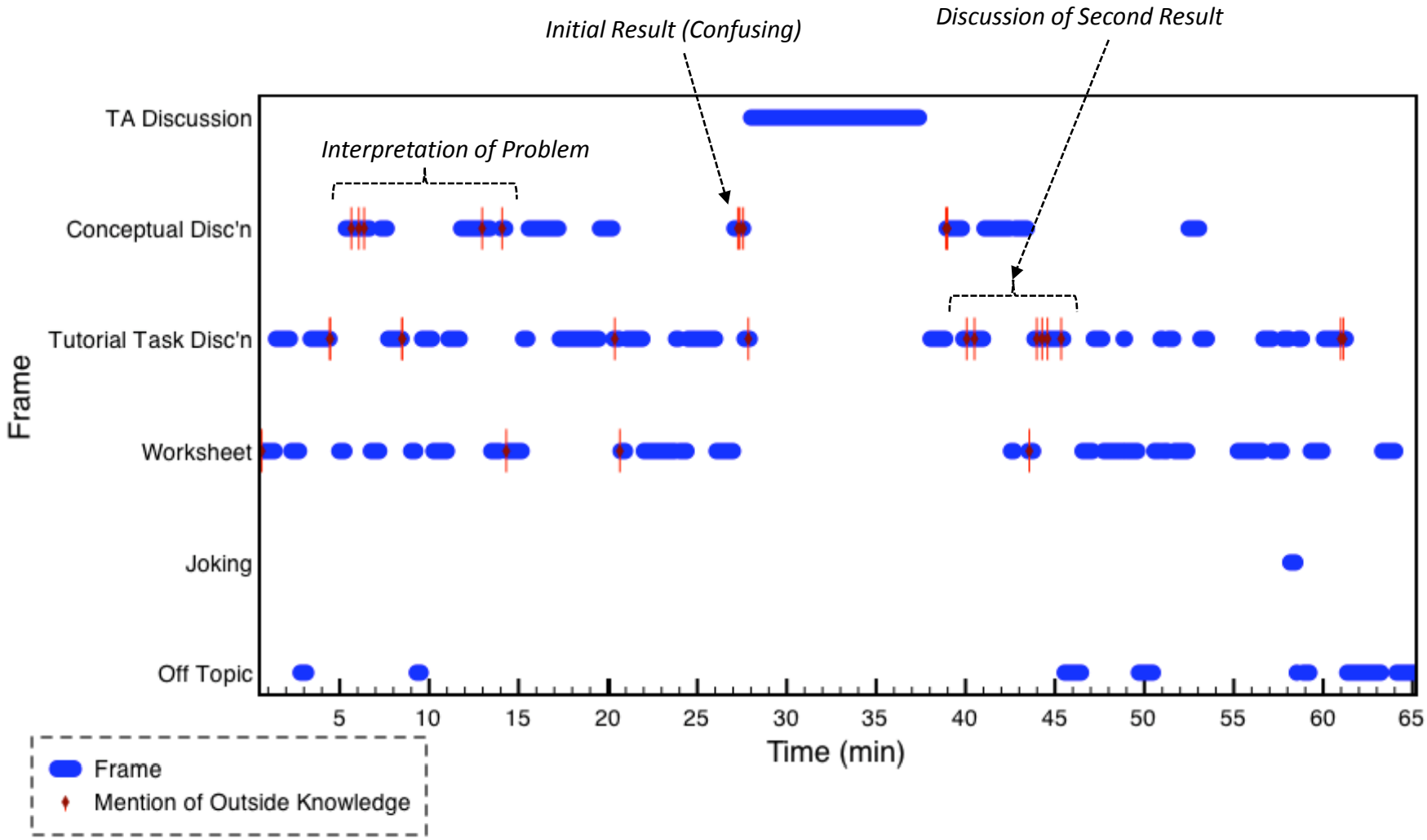
3. Reference to outside knowledge to make an assumption or argument

   "oh yeah we have to assume no friction, right? so it's not raining?"

4. Evaluation of the plausibility of the problem itself

   " 'You will need to make an important phone call and talk on the phone all the way across town.' That's illegal now."

Example Tutorial Analysis



Preliminary Results:

Factors that Prompt use of Outside Knowledge

- Students are required to make assumptions
- Students obtain a numerical result that is in a realm they are familiar with (e.g. speed of a car)
- Students are explicitly asked to evaluate plausibility of result
- Students are required to invent plausible scenarios that correspond to equations. (aka "Jeopardy Questions")

Preliminary Results:

Factors that Inhibit use of Outside Knowledge

- Time pressure
- Student beliefs that physics is strictly about calculations
- TAs' comments: "Don't worry about that. Just write down the answer"
- Implausible motivation for calculations

Future Work

- Complete analysis of 38 audiotapes of students working on 9 different tutorials
- Study frequency of outside references during different tutorial phases, different frames, and under different prompts.
- Identify relationships between tutorial elements, student framing, and use of outside knowledge.