LABATORIALS – A CONCEPTUALLY DRIVEN APPROACH TO PHYSICS LABS

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OVERVIEW

1. Motivation
2. The Labatorial Concept
3. Research on Labatorials
4. Conclusions

Traditional cookbook labs, at isolated parts of the physics course, tackle superficial applications and processes and leave students with fragmented knowledge.

- Karelina & Etkina, 2007; Lochhead & Collura, 1981; Roth, 1991; Thornton & Sokoloff, 1998

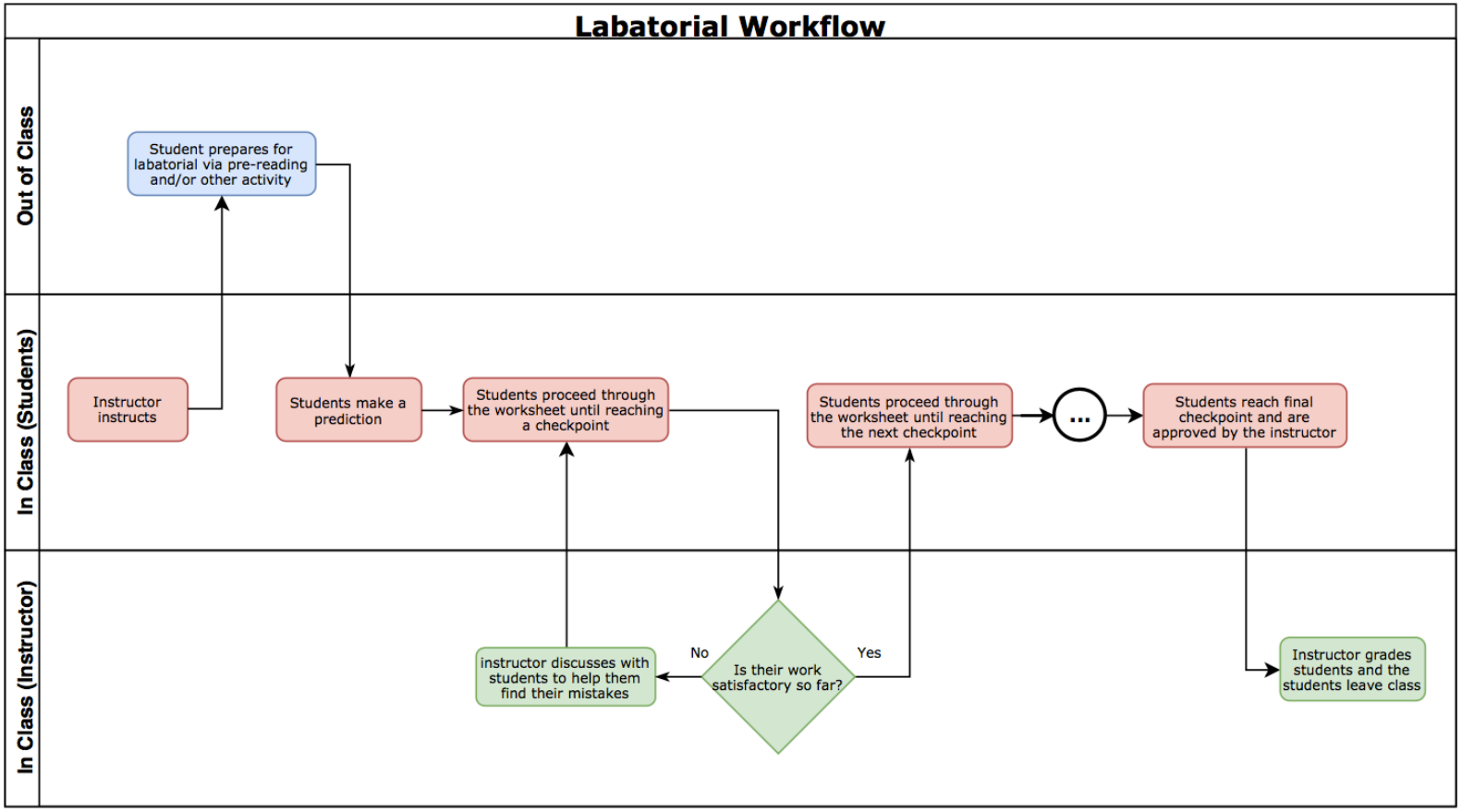
Students are typically dissatisfied with the traditional physics lab experience.

- Deacon & Hajek, 2011; Tlowana, 2017

What is a Labatorial?

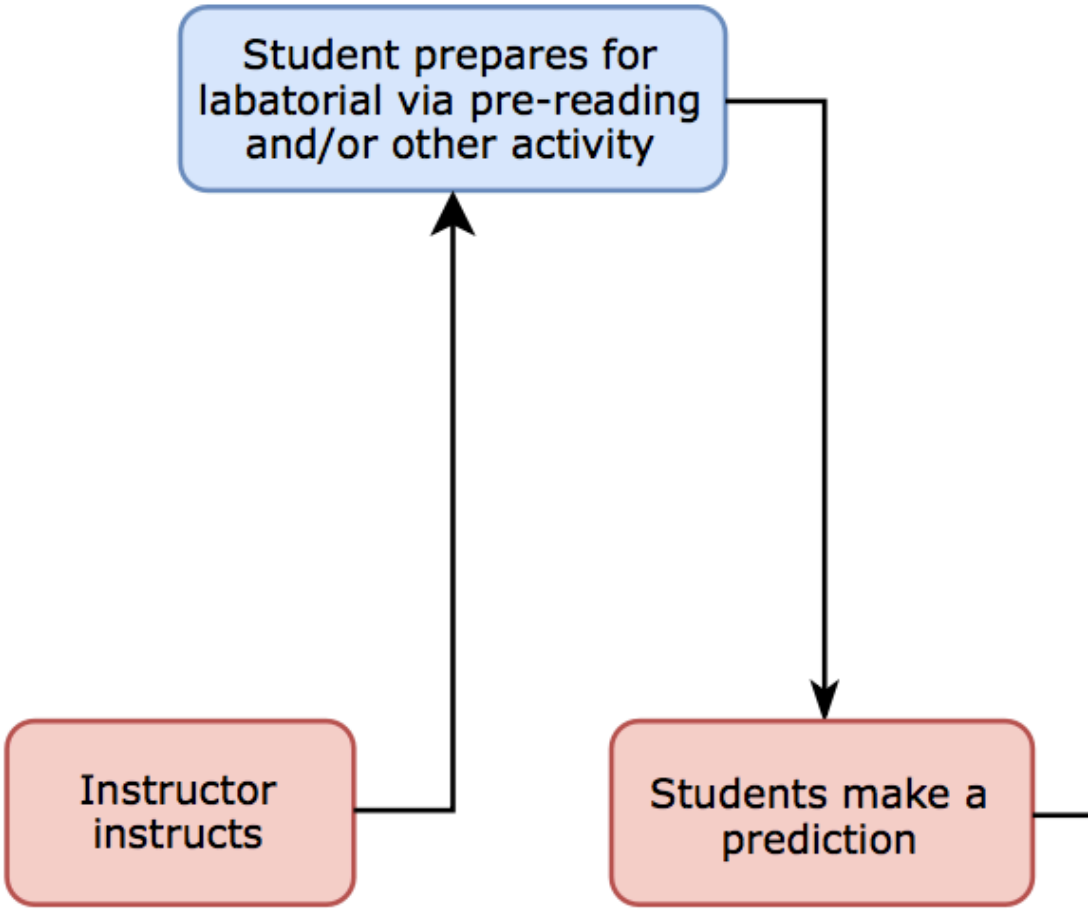
- Developed at the University of Calgary in 2009
  - Ahrensmeier et al., 2009
- Lab activities targeting misconceptions, promoting inquiry and group discussion (3-4 students) with the instructor
  - Conceptual questions, calculations, experiments, simulations, etc.
- Labatorials emphasize conceptual understanding and problem solving skills over experimental techniques

What Happens in a Labatorial?

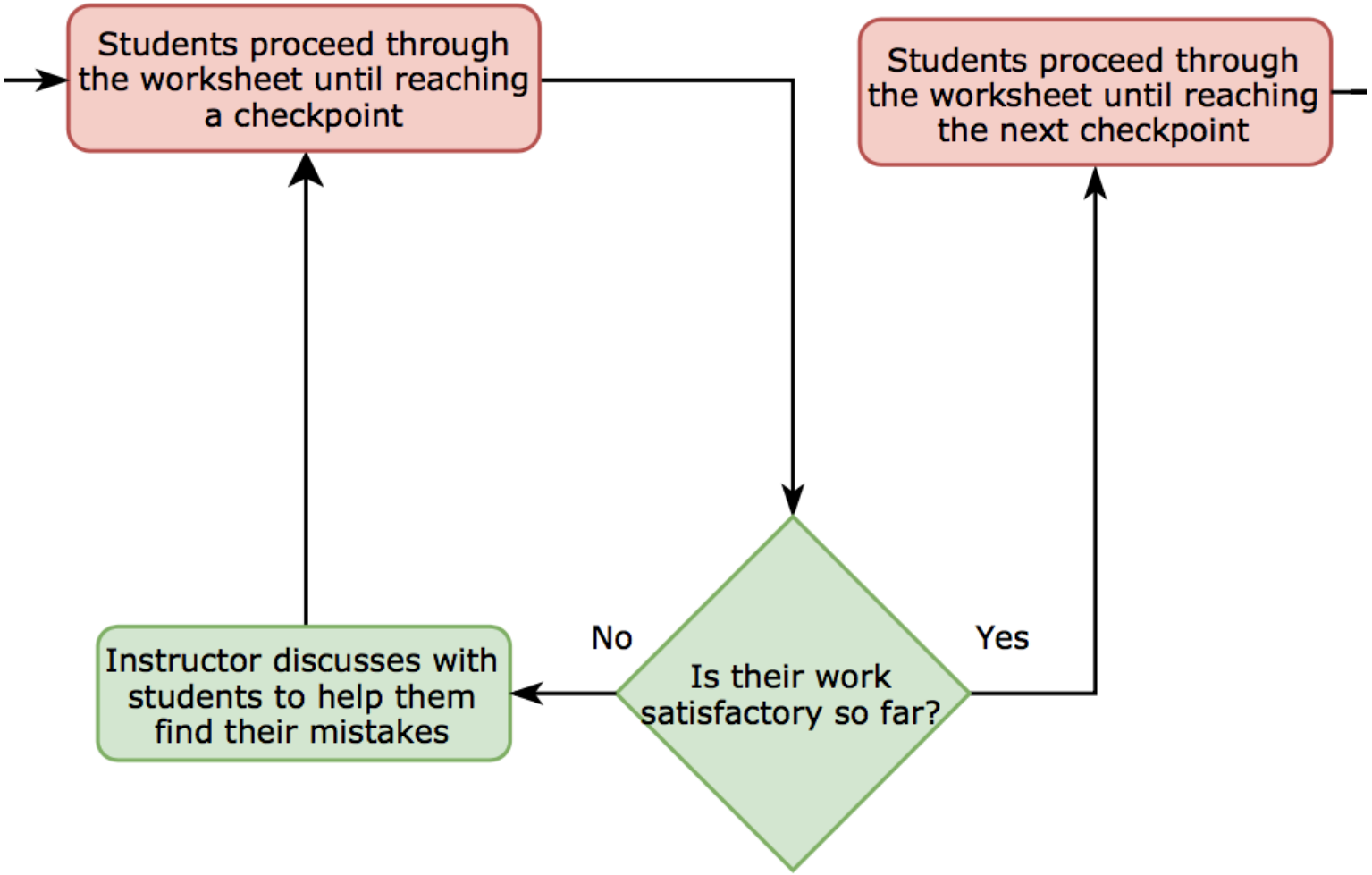


Workflow inspired by: Dr. Jeremie Choquette

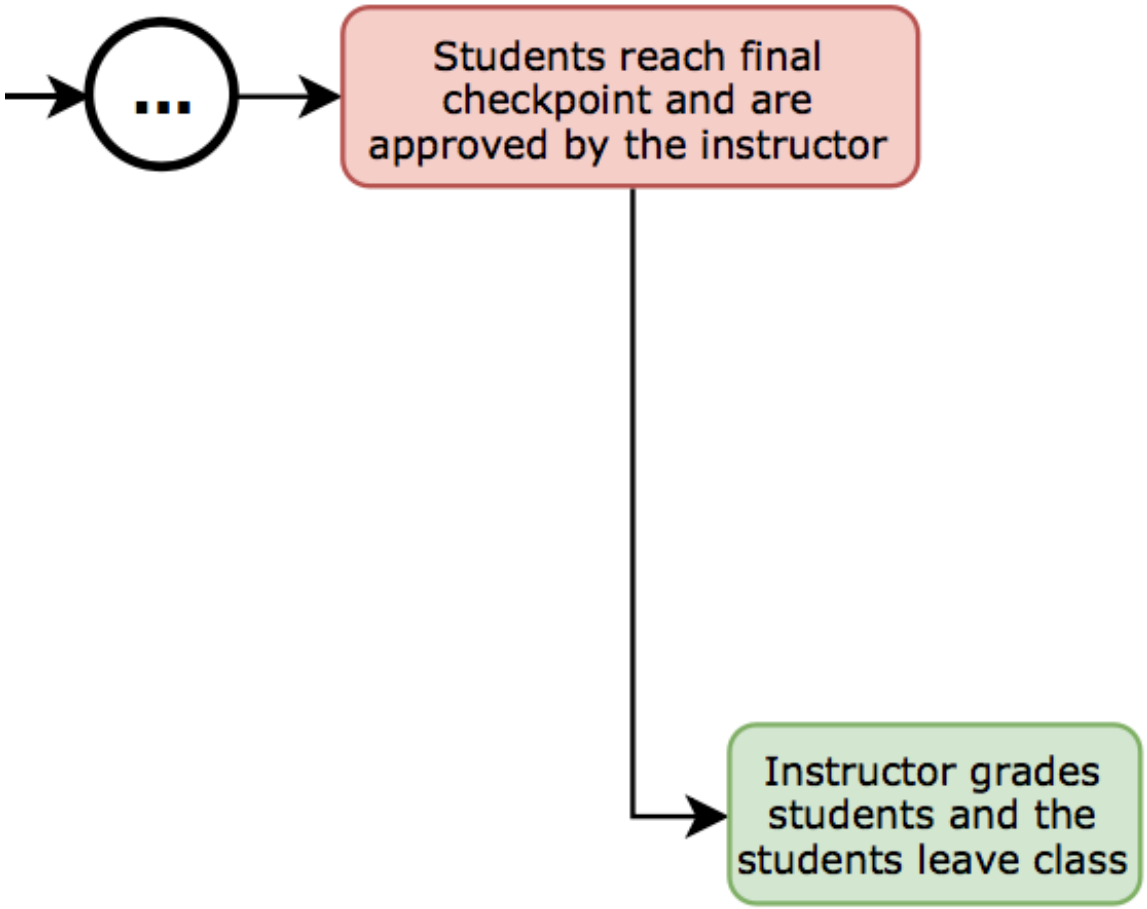
What Happens in a Labatorial? (1)



What Happens in a Labatorial? (2)

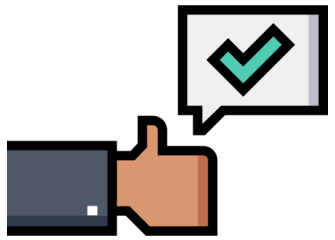


What Happens in a Labatorial? (3)

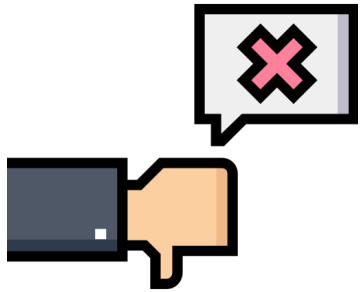


The Pros and Cons of Labatorials

- Advantages:
  - Students receive immediate feedback
  - No lab reports: reduced workload for instructor
  - Students have the freedom to explore their ideas without the risk of losing marks
    - Sobhanzadeh, Kalman, & Thompson, 2017



- Disadvantages:
  - Team effectiveness may diminish with larger groups
  - Students' progress is delayed at a checkpoint if instructor is not available
  - Might be only appropriate for introductory level



Prior Work on Labatorials

- Studying the effects of labatorials and reflective writing on students' epistemological beliefs
  - Kalman, Sobhanzadeh, Thompson, Ibrahim, & Wang, 2015
- Studying how labatorials scaffold students to a deeper understanding of physics concepts
  - Sobhanzadeh, Kalman, & Thompson, 2017
- Studying the effects of labatorials and reflective writing on high school students' conceptions of force and motion
  - El-Helou, Kalman, Lattery, & La Braca 2019 (Poster-presentation to be given at this conference)

My Research Questions

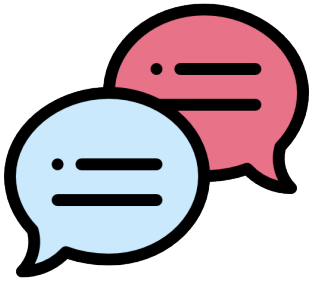
How does the experience of learning differ between labatorials and traditional labs?

In what ways do labatorials and traditional labs promote the development of conceptual understanding?

Labatorials at Concordia: The Pilot

- The context: PHYS 224 - Introduction to Experimental Mechanics, Winter 2019
- Participants: highly diverse academic backgrounds
- 6 labatorials mirroring the traditional content
- Methods of data collection:
  - Student semi-structured pre- and post- interviews, TA post-interview, final exam

Student Feedback



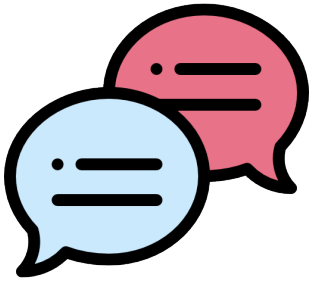
Pre-interviews:

- Student A: *"I would much rather do more thinking than do something [where] I don't know what I'm doing."*
- Student B: *"[The atmosphere in the lab was] fairly low stress. It's pretty chilled out, collaborative."*

Post-interviews:

- Student A: *"I learned more than in the [traditional labs because we] taught each other [instead of] just reading a manual and doing it exactly as it says."*

TA Feedback



“I would actually put money that they understand better in labatorials because of the [reports] that I read from the traditional [course sections].”

Design of Current Study (Future Work)

- The context: PHYS 224, Summer 2019
- Participant groups:
  - Experimental: 3 labatorial sections (33 students)
  - Control: 2 traditional sections (25 students)
- Establishing equivalence of groups: FCI sampling
- Methods of data collection:
  - Qualitative: TA and student interviews/surveys
  - Quantitative: post-tests and final exam

Conlusions

- Lessons learned so far:
  - Individual students greatly affect team performance
  - Creating balanced groups is challenging
  - Care must be taken in training TAs
- Labatorials are proving to be an effective approach for promoting conceptual growth and improving the student experience

Thank you! ☺

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