How technology & community can facilitate open-ended lab pedagogy for high school physics teachers

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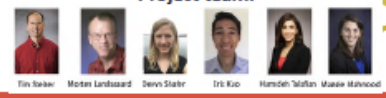
Project team:



INTRODUCTION

Open-ended inquiry labs	Cookbook style labs
• Less structured • Procedure not given • Investigation style • Outcome unknown	• Structured • Procedure given • Verification style • Outcome known

Benefits of Open-ended Labs

- Enhance authentic science learning experiences (NRC, 1996; 2012)
- Authentic science practices - both challenges and uncertainties (Kozminski et al., 2014; Olson & Riordan, 2012).
- Engage students in science learning physically and mentally (NRC, 2000; 2012).

Challenges of Implementing Open-Ended Labs in High School Physics Classes

- **Structural constraints** such as time and institutional factors (Dillion, 2008; Settlage & Meadows, 2002; Valli et al., 2008)
- **Teachers' perceptions of their students' abilities** (Clermont et al., 1994; Levitt, 2002; Mansour, 2009)
- **Lack of lab equipment and lab materials** (Musar, 1993)
- **Lack of a community** for support for context-specific resources

RESEARCH QUESTIONS

What are the **self-reported barriers** to implementing open-ended labs in high school physics classrooms when the teachers are provided with iOLab and a community for support?

What, if any, evidence exists of **shifts in teachers' perceptions** of open-ended lab approaches during their engagement with the community of support?

Is there any evidence of **change from a more structured lab format to a more open-ended lab** approach among physics teachers? If yes, what factors facilitate this transition?

CONTEXT

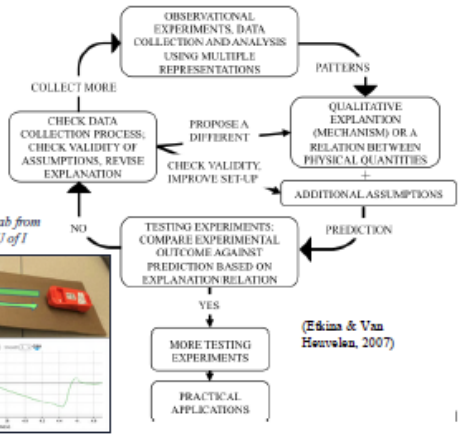
Community

The Illinois Physics and Secondary Schools (IPaSS) Partnership Program aims to open pathways for students into engineering through a partnership between University of Illinois faculty and staff and 60 Illinois high school physics teachers, by:

(1) Delivering an award-winning lab-based university curriculum to high schools;
(2) Acting as a university partner to support high school teachers' implementation of this coursework using a Community of Practice (CoP) model and prolonged professional development (PD);
(3) Supporting the growth of teacher leaders and mentors within the CoP.

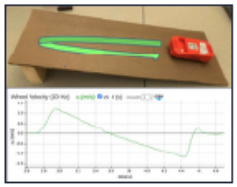
Lab Philosophy

Investigative Science Learning Environment (ISLE)



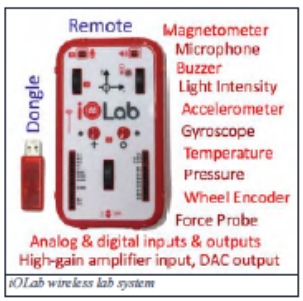
(Etkina & Van Heuvelen, 2007)

ISLE integrated iOLab from intro physics lab at U of I

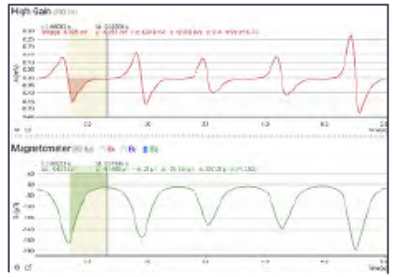


Lab Technology

iOLab wireless lab system



iOLab wireless lab system



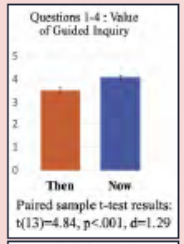
Data collected from iOLab sensors in iOLab software interface, demonstrating Faraday's Law

RQ1: Perceived Barriers to Implementing Open-Ended Labs with iOLab Among High School Physics Teachers

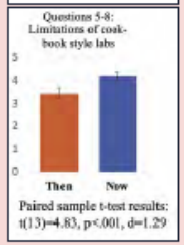
- 21 teachers' open-ended survey responses
- 5 teachers' interactions in two hour-long online PDs
- Axial coding: grounded theory techniques (Corbin & Strauss, 1990)

Category of Barrier	Example	Number of teachers
Structural Barrier (time and populous classes)	*"Large class sizes and the need for smaller group sizes to maximize student participation make it challenging to help individuals."*	10 out of 21 teachers (47%)
Teachers' perceptions of their own abilities (content and technological)	*"I don't know physics enough to let them just go, because then they ask me questions and I don't know how to answer to it. So, it's a comfort level definitely"*	2 novice teachers with non-physics backgrounds
Perceptions of students' abilities	*"Open-ended or less structured labs can be a challenge because students tend to be not confident in the material, which leads to students more frequently giving up."*	13 out of 21 (61%)

(1) GIS Constructs 1 & 2: Statistically significant perceived impacts



Paired sample t-test results: $t(13)=4.84$, $p<.001$, $d=1.29$

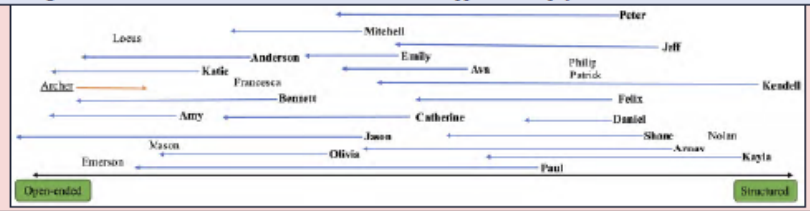


Paired sample t-test results: $t(13)=4.83$, $p<.001$, $d=1.29$

RQ2: Overcoming Barriers: Shift in Perceptions

(1) Retrospective Guided Inquiry Survey (GIS) to 14 teachers (Cheung, 2011); 15 items with three constructs; Comparing perceptions prior to joining IPaSS program
(2) Embodied ranking task: 27 teachers move on physical continuum twice (current vs ideal)

(2) Ranking Task: Teachers' movement between current and desired approaches to physics labs. 18 of 27 moved leftward.



RQ3: Representative Case - Change to a More Open-ended Lab Approach

Dawn's Background

- Three years of teaching experience
- Non-physics background
- Rural high school with 5 students

Data Sources

- 30-minute individual interview
- 2 hours of classroom observation
- Transcription from one-hour online professional development

After two years in the program:

Lab prompt: *Infer the size of an exoplanet using your iOLab!*

Come talk to us about…

- Creating a community of practice
- Running a responsive PD program
- Self-sustaining program efforts

Interview Reflection

I really liked ***watching them think****. Like you could tell when I first gave them the assignment, they were just lost. And then they really built confidence in themselves to be able to think it through.*

Realizing that the perfect teacher I've built up in my head does not exist, and and **you don't have to be perfect to start**. You know that we are still learning. Yeah, every year, even our last year.

CONCLUSIONS

Support from Community of Practice

Physics teachers with a range of experiences and diverse backgrounds cultivated perception and practice changes.

Responsive PD Model provided flexibility in uptake and implementation

References

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