Impact of Preparatory Videos on Laboratory Experience in a Large-Enrollment Introductory Physics for the Life Sciences Course.

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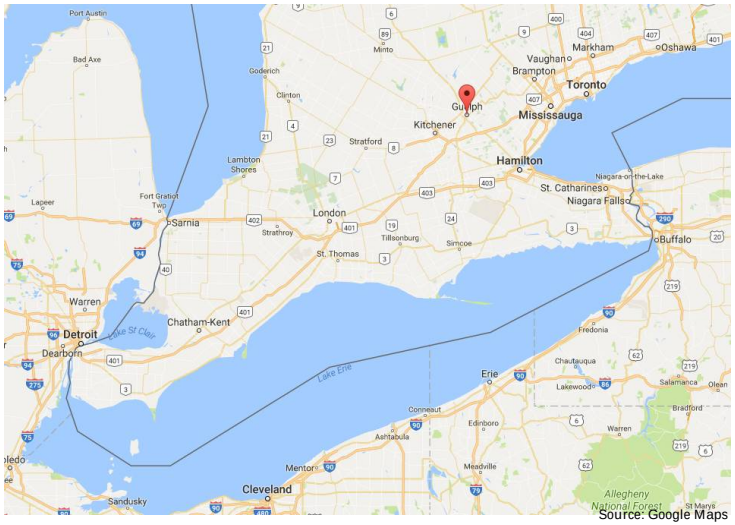
Background

- University of Guelph
  - About 25,000 students, with about half of those in the sciences



Source: Google Maps

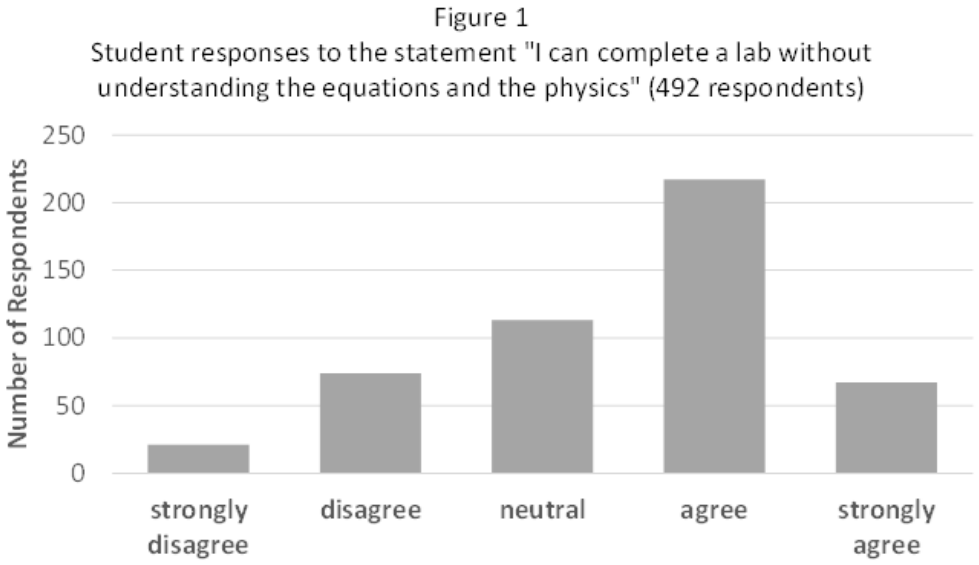
- First year IPLS courses
  - Mandatory full Physics credits for all science majors
  - All IPLS courses combined serve ~2500 students per year
  - PHYS*1080 – Physics for Life Sciences
    - Half credit course that pairs with one other IPLS course to provide the full Physics credit
    - ~800 students each semester

Background – PHYS*1080 labs

Labs for PHYS*1080 are:

- Self Directed – students sign up for times of their own choosing.
- Packed – sessions available for signup run Monday – Friday, morning – evening, all semester.
- Lightly TA'd – one TA at any time in a lab room that has 12 stations and as many as 36 students per session.
- Not Marked – completing a lab (and having a TA sign off) gives the student the ability to write a corresponding quiz.

Motivation (Pedagogical)



- Lab preparation is not prioritized
  - Students don't believe that preparation is key to success in a lab setting.
  - Lab preparation mostly comes from reading a manual
  - Preparation is critical for learning in labs[1]

- For students, preparation = reading the lab manual over, if at all.
  - Not ideal, if our goal is to have students arrive ready to learn form these labs.

Motivation (Departmental)

- Enrollment is growing.
- Lab space and departmental budgets are not.
- We looked for a way to give all students the full laboratory experience in a way that
  - preserves the creativity and spirit of inquiry;
  - does not interfere with the self-guided study → lab → quiz system;
  - encourages students to complete and understand the labs in a more timely fashion;
  - doesn't add frustration to the students' experience of physics labs.

Proposal – the Half Flip

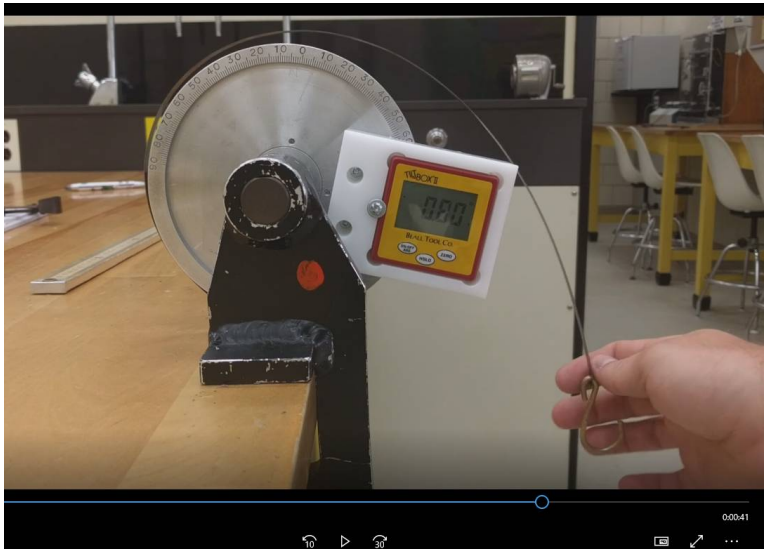
- Can't do a full flip
  - Courses are designed for independent learning
  - Labs are gateways to the quiz system

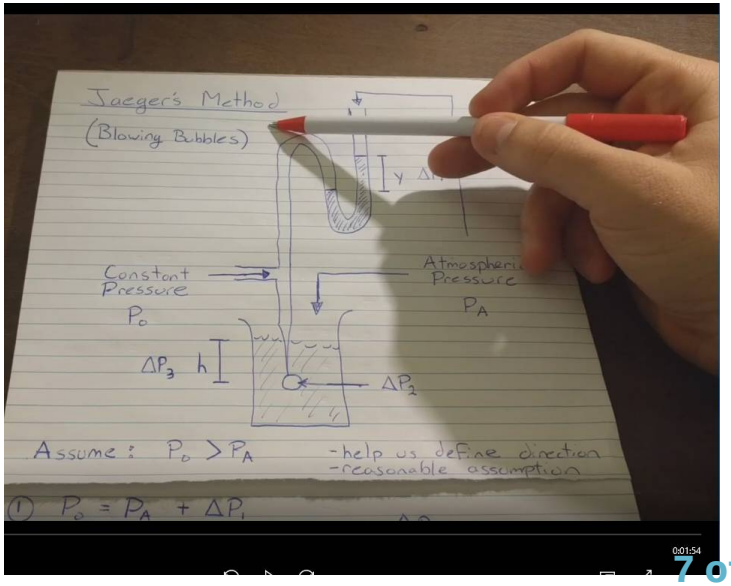
Try a half flip? Keep the lab system, the manual, and the design the same, but augment in a way that could increase engagement, and maybe even learning?

Before-and-After: Fall 2016 and Winter 2017 semesters

The Half Flip

- Preparatory videos developed for all PHYS*1080 labs
  1. Motivation: a discussion of why the lab is being performed and **how it is connected to Biology.**
  2. Method: a step-by-step walkthrough of all portions of the lab.
  3. Analysis: an introduction to all equations used in the data analysis for the lab.

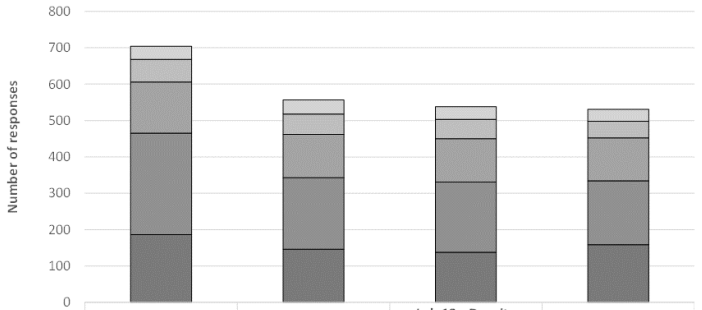




Results - Uptake

- All data – video views and self-reported student preparatory habits – suggested that the videos were viewed by no more than half of the students in PHYS*1080

Figure 3
Student responses to statement "I carefully reviewed the prep-lab videos" for all four laboratory exercises during the Winter'17 semester.



	Lab 10 - Forces and Torques	Lab 12 - Elasticity	Lab 13 - Density and Surface Tension	Lab 14 - Viscosity
Strongly Disagree	36	39	35	33
Disagree	62	56	53	46
Neutral	141	119	119	118
Agree	279	197	193	175
Strongly Agree	186	146	138	159

Figure 4
Comparison of student responses to survey question "I carefully watched the prep-lab videos" with videos views from Courselink.

	Students responded "Yes" to having watched the prelab videos		Video views from Courselink			
	Lower Bound [1]	Upper Bound [2]	Introduction	Method Part 1	Method Part 2	Problem Analysis
Lab 10 - Forces and Torques	465	606	518	473	419	375
Lab 12 - Elasticity	343	462	406	392	356	292
Lab 13 - Density and Surface Tension	331	450	393	378	-- [3]	383
Lab 14 - Viscosity	334	452	369	353	333	282

[1] Sum of "Strongly Agree" and "Agree"
[2] Sum of "Strongly Agree", "Agree" and "Neutral"
[3] Lab 13 did not have a second Method video

Results – Time to complete labs

- No consistent reduction in the time students took to complete the labs with the videos in place
  - Some exercises done more quickly, some took more time.

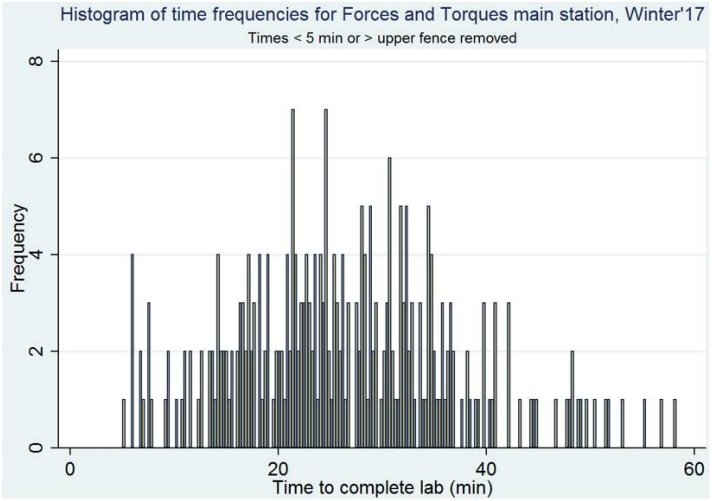


Figure 6
Comparison of mean timing values for Fall'16 and Winter'17 semesters for all lab exercises.
Significance: *** p < 0.001 ** p < 0.01 * p < 0.05

Experiment	Description	Semester	N	n	Mean (min)	Standard Deviation (min)	Difference of means (min)
10	Forces and Torques - main station	Fall	357	278	26.43	10.50	
10	Forces and Torques - main station	Winter	352	259	34.62	17.40	8.19 ***
10	Forces and Torques - scales	Fall	163	135	15.46	6.02	
10	Forces and Torques - scales	Winter	296	202	19.70	8.71	4.23 ***
12	Elasticity - main station	Fall	276	216	41.92	29.06	
12	Elasticity - main station	Winter	249	160	49.41	31.50	7.48 **
12	Elasticity - Station B1	Fall	140	114	20.19	10.60	
12	Elasticity - Station B1	Winter	83	66	35.50	28.80	15.31 ***
12	Elasticity - Station B2	Fall	92	74	18.65	10.72	
12	Elasticity - Station B2	Winter	67	52	16.31	7.79	-2.33
13	Density and Surface Tension	Fall	271	203	44.84	29.66	
13	Density and Surface Tension	Winter	161	129	53.98	31.87	9.14 **
14	Viscosity	Fall	247	195	75.92	22.18	
14	Viscosity	Winter	317	261	68.57	30.45	-7.34 **

Results – Student feedback

- A great deal of student feedback and opinions on lab manageability, insight gained, and overall experience.
  - Some evidence that the insight gained has increased – students may be taking more time because they are more engaged and thinking more about the labs.

Figure 7
Student responses to statement "Although there was a significant amount of material needed to successfully complete the lab (equipment, procedure, physics concepts/equations). Overall, I found the requirements for this lab to be manageable" for all four labs in both semesters.

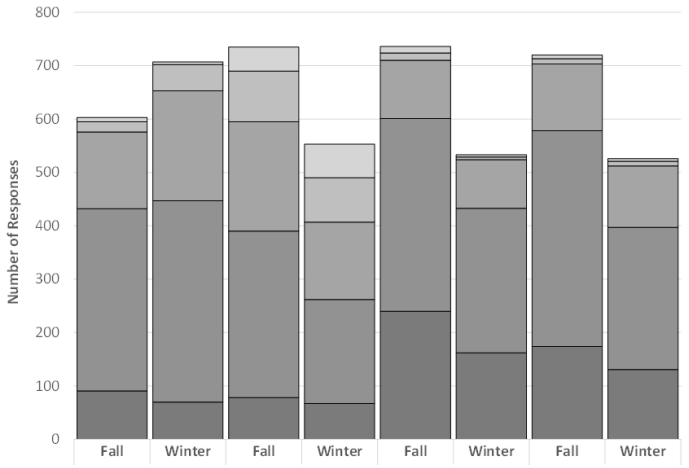
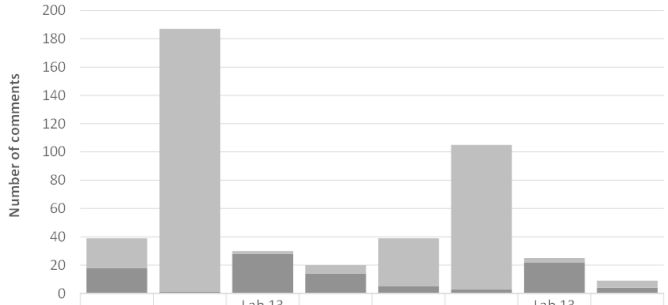


Figure 17
Summary of student comments relating to **time to complete lab**, all labs and semesters.



	Fall				Winter			
negative	21	186	2	6	34	102	3	5
positive	18	1	28	14	5	3	22	4

Figure 13
Significance of difference in responses between all four labs in the Fall'16 semester to the statement "I gained usefiul insight on the physics topic presented in this lab".

	Lab 10 - Forces and Torques	Lab 12 - Elasticity	Lab 13- Density and Surface Tension
Lab 12 - Elasticity	Yes *		
Lab 13- Density and Surface Tension	No	Yes **	
Lab 14 - Viscosity	No	Yes ***	No

Significance determined through Kruskal-Wallis test for equality of populations, followed by Dunn's pairwise comparison of individual lab responses, using Bonferroni's correction for > 2 treatments, in Stata.

Conclusions

- More work needed on engagement and uptake of the videos – a way to encourage students to **use** the preparatory resources they have available.
- Partial success (lab-specific) in increasing student knowledge about labs:
  - As measured by time spent in the lab room, improvement in some labs and not in others.
  - As measured by student comments, improvement in other labs but not in some.

Next steps

- Keep the videos in place; work on ways to encourage students to watch them. Weave the video system more strongly into the fabric of the course.
- Gather another data set for both the Fall and Winter cohort for PHYS*1080.

Thanks!

1 **The students' attitude and cognition change to a physics laboratory.** A H Johnstone, A Watt and T U Zaman**.** Physics Education, Volume 33, Number 1 (1998)