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Improving lab experience for students in PHYS2080

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STEM Instructional Program 2019-20

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Introduction

University Physics II (PHYS 2080) deals with providing hands-on experience with the experiments of electricity and magnetism. It aids students to develop computational thinking in physics through analysis of experimental and theoretical data using python programming language.

In Fall-2019, I taught the newly designed PHYS2080 class for the first time as per the requirements. During Spring-2020, I implemented some subtle changes using the skills that I gained through various teaching training. These changes are described in Methodology section. Data clearly shows improvement that was observed without lowering the expectations or changing the curriculum of the class.

Problem:

- University Physics II (PHYS 2080) is newly designed lab. Students are presented with a platform to understand physics better along with learning to code using python. Students find physics difficult and requirement of learning to code makes the lab experience to be strenuous.

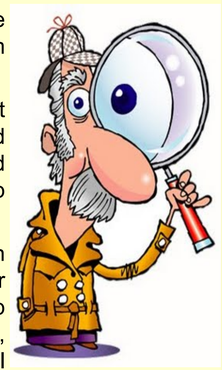
TA faces following difficulties:

- Not finishing the lab session on time.
- Incomplete, incorrect or undone prelabs (as the work is not graded).

- Dislike for physics & coding seen in students and difficulty experienced by students in understanding what is to be done in lab or how is it to be done.
- Students feel there are more than necessary things expected from them.

Hypothesis:

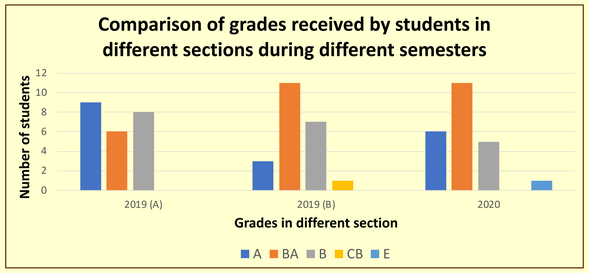
- Clarifying the guiding set of instructions will help reduce students' struggles.
- Motivating them to do the prelab correctly, will help them do the lab more efficiently
- Reminding students about how much time has past and how much is remaining will aid students to finish the lab session on time.
- Dividing the lab activities in several sections will appear simplified to students and help them achieve good grades, despite maintaining same level of expectation,



Methodology

- ❖ Although pre-labs are not graded, it is important to do it before lab, for being able to do the lab activities correctly and efficiently. During fall 2019, I observed that majority of students, either did not do the pre-lab at all or did only some part of it. This semester I checked everyone's pre-lab work and placed 0 or 1 on their work, leaving an impression to them that I graded their work and they should maintain the work if they received 1 and work harder next time if they got 0 or 0.5.
- ❖ Uploading a video to guide them with pre-lab questions, in Spring 2020. I scheduled 2 hours of my weekly help-room hours (student-hours) such that it ended 1 hour before class. I sent an email before 1 day of lab session to remind them about the doing the prelab along with encouraging them to come during help-room hours to discuss the doubts, if any.
- ❖ Explaining grading scheme and its connection to learning objectives and providing sufficient guidance on how to accomplish the goals.
- ❖ Constructive feedback is provided using guided inquiry-based teaching at the end of each lab session. I tracked the students' utilization of feedback to improve their final work. I gave more detailed feedback in the beginning of the semester and gradually decreased the feedback to avoid students become feedback dependent. This made students realize the "what", "how" and "why" of the learning experience.
- ❖ Adding detailed set of guiding instructions increased transparency about expectations.
- ❖ Formative assessment was carried out in each lab session during various activities like pre-lab work, writing hypothesis, performing experiment to collect the data, generating theoretical data and analysis of data, during the class, along with keeping them up to date with time.

Results



Observed positive changes

Question	2019		2020
Overall, I would rate this instructor as:	3.71	3.62	3.67
The grading system was clearly explained:	3.71	3.62	4.17
My instructor is available outside of class for consultation.	3.43	3.85	4.00
My instructor gives appropriate/timely feedback on each student's performance.	3.57	3.69	3.67
My instructor treats all students with respect.	3.57	3.92	4.33

Above scores are taken from wmich.campuslabs.com and are out of 5

Some more observations

Question	2019		2020
Overall, I would rate this course as:	3.00	1.92	1.83
I learned a great deal from my instructor:	3.57	3.08	3.00
The course appears to be well organized:	2.86	2.38	2.50
The climate of this class is conducive to learning:	3.29	2.69	2.83
Grading is clear & tied to key learning objectives.	3.71	3.38	3.17
This course improves my understanding of concepts and principles in this field.	3.57	2.46	2.33

Above scores are taken from wmich.campuslabs.com and are out of 5

Using the results of this work and my experience from running the lab sessions, following are my suggestions on how we can further improve this revised laboratory.

- Designing activities to induce interest for physics and coding in students.
- Incorporating few moments of metacognition, at the end of each session where students can do self-reflection and TAs can aid them connect with learning objectives.
- Spending few moments in the beginning of class to revise the key take-aways from previous labs can bring the feeling of continuity in the subject.

Year	No. of students enrolled	Response rate to survey (%)
Fall 2019 (A)	22	32
Fall 2019 (B)	23	57
Spring 2020	23	26

Conclusions

- Even though students found that building the computational models was challenging, they see value in them as they can be helpful in other subjects as well as for further studies.
- Students are able to divide the tasks (preparing experimental setup to collect data, build hypothesis through discussion, etc) and are working on separate tasks within their groups, during each lab session.
- Majority of students found the experience to be interesting despite challenges as they got the chance to see the physics concepts through their own experience which is different from ideal cases mentioned in textbook.
- Students are able to recognize the patterns of data obtained and use appropriate analysis libraries, along with understanding the "What", "How" and "Why" of the learning experience.
- Skills like cognitive empathy and cultural humility acquired through STEM Instructional program help me connect well with students.
- Students completed their pre-lab work before coming to class. Majority of answers of the pre-lab questions were correct. This prepared students for their in-lab activities and enabled them to finish several labs in class .

Acknowledgements

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