

Appendix D: Remote Lab User Survey for Pilot Run in AP10007 (Sem 2 AY 2015/16)

Survey of pilot run on Remote Lab in AP10007 was conducted on 11 April 2016 to collect students' opinion for improvement, including experimental setup, booking system, user interface and other. 109 students completed a survey with 15 Likert-type items from 1 (Strongly Disagree) to 5 (Strongly Agree). A copy of the survey form is attached at the end of this Appendix.

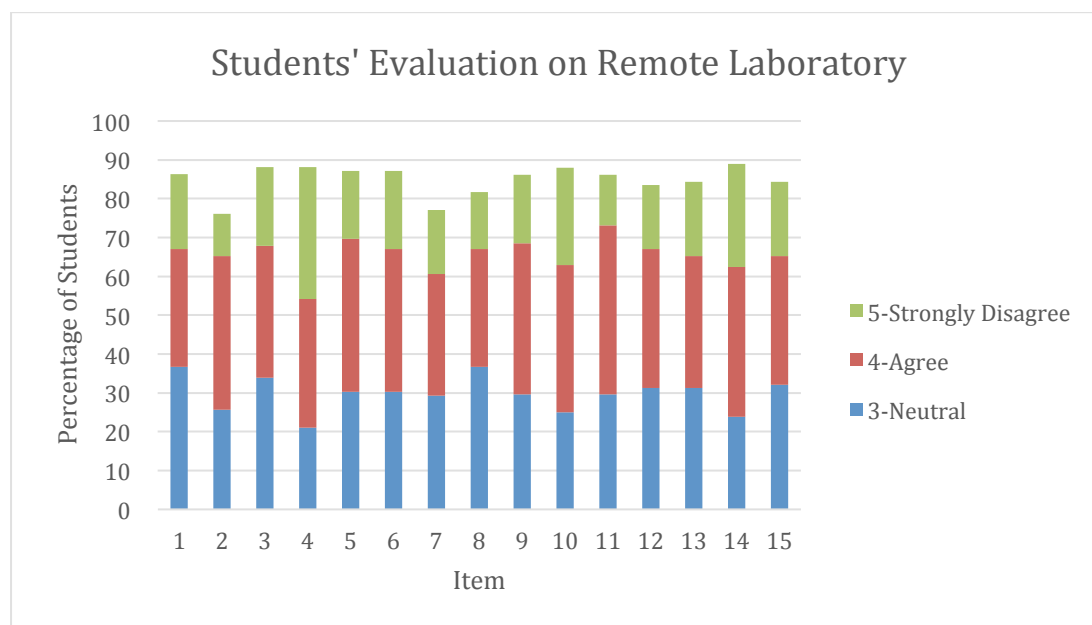


Fig. D1: Students' Evaluation on Remote Laboratory

(i) Highest Scoring Items

As shown in Fig. D1, most respondents chose '3 – Neutral', '4 – Agree' and '5 – Strongly Agree' for all the items, ranging from 76% to 89%. Three highest scoring items were item 4 (Mean (M) = 3.85, standard deviation (SD) = 1.096), item 14 (M = 3.75, SD = 1.081) and item 10 (M = 3.71, SD = 1.068). Around two-third of students 'agreed' and 'strongly agreed' the booking system and experiment of Remote Lab was easy to use and enter. Meanwhile, they commented Remote Lab was a good learning experience.

(ii) Lowest Scoring Items

On the contrary, items obtained lowest scoring were item 7 (M = 3.28, SD = 1.233), item 2 (M = 3.29, SD = 1.116) and item 8 (M = 3.37, SD = 1.042). Low scoring in item 7, "Prefer to use email to notify user of booking time", implies notification by email is relatively low in priority of Remote Lab improvement. 23.85% and 18.35% students 'disagree' and 'strongly disagree' with item 2 and 8, they thought clearer visualization of experimental setup from screen online guidance to conduct experiments were needed.

(iii) Further Comments and Suggestions

Furthermore, 28 out of 109 students gave further comments and suggestions as extracted below.

Good/ Compliment:

- It's a good way to conduct experiments and it's convenient;
- Interesting way to do the experiment outside the lab;
- It is good enough.

Suggested Improvement:

- It would be better if different groupmates could access the remote lab at the same time.

Instruction

- Need more instruction of control and experiment; need extra lecture to handle the remote experiment
- There should be more guidance about remote lab session
- The online guidance is not too easy to understand especially to the topic we have not covered in class.
- I suggest to further checking the lab report. There are some large mistakes in the report which will make the lab perform very difficultly.

Booking

- Booking session should be shorter as the setup is ready to use
- It is hard for booking and hard to do the experiment
- Booked slot is disappeared. Need to re-book again
- Time allocated for each session can be more, so that we have a sufficient of time to finish the laboratory.

User Interface

- There should be some notice when there is problem such as cannot install the software
- Make the system to be easily accessible
- For the magnetic lab, the measured data has great error
- The experiment apparatus is not very easily seen, for example, the magnetic field experiment, the ruler cannot be seen clearly, which will make us result in misunderstanding of the experiment.

(iv) Discussion and Implications

Overall, students' feedback was positive. All items were skewed negatively, meaning that more students 'agreed' than 'disagreed' with the 15 items of the survey. Most students were satisfied with the Remote Lab experience.

According to students' feedback, Remote Lab could be improved by setting more viewpoints that students for visualizing the experiment setup easily, and increase the accuracy of acquired data. Besides, students suggested to have more instruction and guidance, which could enhance their understanding of experiment theoretically and facilitates them to conduct the experiments practically.

Meanwhile, students were benefited from the Remote Lab, it provides sufficient duration and flexibility for students to conduct experiments.

Students could perform the experiments according to their learning schedules. The booking system was simple and the experiment can be completed smoothly. Remote Lab is an undeniable effective platform and serves as a supplementary to normal laboratory.

Remote Laboratory User Survey

The purpose of this survey is to help us to improve the Remote Laboratory.
Please rate the following items on a 1 to 5 marks scale. 5 is "strongly agree".

Experimental Setup	Mark
Interference of Light is suitable for remote control experiments	
Experiment setup can be visualized clearly from screen	
More viewpoints are necessary	

Booking System	Mark
Ease to use the booking system	
Sufficient guidance provided to book Remote Lab	
Time allocated for each session (1. 5 hours) is appropriate	
Prefer to use email to notify user of booking time	

User Interface	Mark
Online guidance to conduct experiments are clear	
Webpage design is user-friendly	
Easy to enter the Remote Lab for experiment	
Instructions to use the Remote Lab are clearly stated in the lab manual	

Overall Comment	Mark
It is an effective way to conduct a laboratory session	
The experiment can be completed smoothly	
It's a good learning experience	
Remote Lab serves as a supplementary to a normal Laboratory session	

When did you perform the experiment (Date/ Time)? _____

Further comments / suggestions

Fig. D2 Survey form used for collecting student opinion.

Appendix E: Focus Group Interview Report

A focus group interview was conducted on 9 Aug 2016. 8 participants were invited to comment and share the experience on Remote Lab. All of them are students of Department of Applied Physics and completed the course AP10007 in Sem 2 of 2015/16.

Advantages of Remote Lab

Most of the students agreed that Remote Lab has certain advantages. They appreciated the flexibility of Remote Lab. They were able to operate setups anytime and anywhere through the internet. The booking system was simple and user friendly. Users were able to book more than one lab session, allowing them to conduct the experiments more than once and obtain better results compare with traditional lab. Moreover, due to the flexible learning schedule, participants could conduct experiment and discuss with groupmates outside regular and specific time of traditional lab sessions. They also commented that the instructions were easy to follow and demonstration videos were clear, which were useful for students with weak scientific background.

Disadvantages of Remote Lab

However, half of the students experienced difficulty in booking lab sessions. Lab session for some experiments were fully occupied near the deadline and one participant mentioned he could not login even he booked the lab session. Peer support was not strong on the Remote Lab platform, as they cannot discuss with other team members. Sometimes, the motivation to conduct experiments was low as the setup was distant and tedious on clicking buttons repeatedly. Two of the interviewed students showed ignorance of theories and meaning of procedures. They agreed that it would be better if there were lectures or relevant materials covering the knowledge of Remote Lab. Some students suggested they might could acquire more hands-on experience if they could connect the setup by themselves.

Suggestions and Improvement

In order to improve the Remote Lab, participants suggested to restrict the number of sessions that can be reserved by each student per day. They proposed to modify the operation procedures of Remote Lab, increase the complexity and authentic feeling of operation instead of simply clicking the buttons. They prefer setting up the apparatus by themselves to enhance their attention in operation and hence developing a stronger impression on the lab experience. They agreed that changing the layout of website with icons looking like real equipment (such as 'turning knob' button to 'switch on/off') equipment would enhance students' interests and understanding on the experiment procedures.

Appendix F: User Survey for Pilot run of Remote Experiments in AP10001, Sem 2 2013/14

(This Appendix is an adoption from the progress report of this project submitted in June 2015, and is attached at here for completeness of the final report).

The interference setup was piloted in AP10001 at 2013/14 Sem 2 (class size ~ 100), and the Earth's magnetic field setup was piloted in AP10007 at 2014/15 Sem2 (class size 25).

In these pilots, short briefing sessions were first conducted in the lectures, and students were instructed to finish the experiments in groups within a given duration (around 2 – 4 weeks, depending on class size). The response of students over the experiment was fairly positive. In particular, over half of the students who performed the interference experiment agreed that they have mastered a better understanding on the topic of wave interference effect. There was less positive response concerning the magnetic field experiment, in the view that nearly 20% (around 5 students) rated all the items 'disagree' or 'strongly disagree' indiscriminately in all questions. We attributed this to the occasional failure of the system during the pilot run. These issues will be fixed to ensure a more smooth running of the experiments in the next round of experiments.

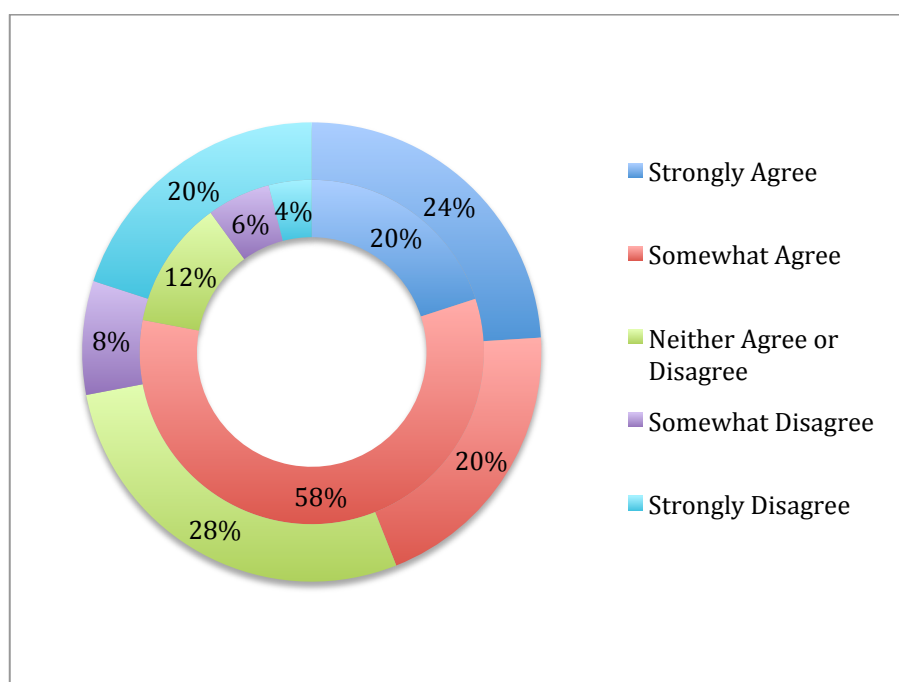


Fig. F1 Response of students about their mastery on topics of interference (inner ring) and Earth's magnetic field (outer ring), after the performance of relevant remotelab experiments.

Appendix G: Evaluation on the Impact of Remote Lab on Student Learning in AP10001

For AP10001, Remote Lab was prescribed to the students as an assignment in Semester (Sem) 2 of 2013/14 and 2015/16. We attempted to measure students' understanding on the specific physics topic by considering their exam results. Academic results of experimental group, i.e. students of AP10001 in Sem 2 of 2013/14, were compared with students who took AP10001 in Sem 1 of the same year as control group.

Then, students' performance on related topics of Remote Lab are compared, i.e. questions 12(a) and 12 in Sem 1 and Sem 2 of 2013/14, respectively.

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig.(2-tailed)
2013/14	1.110	.293	-5.082	303	.000

Table G1: Independent-samples t-test between Semester 1 and Semester 2 of 2013/14 on related topics

As shown in Table G1, two groups of students ($F(1, 303) = 1.11, p = .293$) are comparable and the mean of Sem 2 ($M = 50.14, SD = 31.72$) is higher than that of Sem 1 ($M = 31.90, SD = 29.82$) significantly ($t(303) = -5.08, p < .001$) at 95% Confidence Interval, suggesting the impact of remote lab on student learning.