Investigating the Usage of Labster and Its Future Implications for Industry and Academia

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Abstract
The unprecedented impact of COVID-19 on engineering education has resulted in lasting changes in the way educators teach as well as the way students learn. One of the most impacted areas was the inability of students to undertake laboratory training, which is crucial for engineering employability. In 2020-21, UCL Biochemical Engineering implemented the use of Labster – a virtual lab simulator that allows students to complete laboratory experiments online, whilst simultaneously exploring complex theories. This project aimed to investigate the impact of using Labster as a lab training tool to evaluate how well it prepared students for industry, and furthermore to understand any implications this may have for academic practice across other departmental programmes. The method for data collection comprised of interviews and survey dissemination to two MSc cohorts and steering committee members who comprise of key industry players. Analysis of the results shows that over 60% of graduates on the MSc reported back that the use of Labster effectively prepared them for the engineering working environment. Similarly, communications with industry suggested that although many companies use in-house virtual software packages, Labster served as a useful tool in helping to bridge the skills gap. The consensus from all students that partook in the study was that the lab simulator was considered to be very useful for practical theory learning which made it easier for them to carry out practical. Based on this, the use of Labster will be rolled out to lab and non-lab-based modules across a range of programmes.

Keywords: Virtual Simulator, Biochemical Engineering Education, Labster

Introduction

Research has shown that the potential skills gap in engineering, exacerbated by the pandemic, has started to show when graduates go out into engineering industries (Hou, 2020). Final year students in the biochemical engineering department at UCL have also expressed worries via personal tutoring sessions about how the gap in lab skills will impact their employability and this has also been discussed in staff meetings, together with resulting increased burden on careers support from the departmental career's liaison officer and the UCL Engineering Careers team.

With the rapid development of technologies supporting education, the main challenge during the pandemic was the teaching of laboratory practical classes and engaging the students in these modules. Thus, many virtual simulators were used and incorporated in many lab-based modules especially during the pandemic.

Labster is one of the examples of a virtual simulator products aimed at implementing virtual laboratories for many scientific topics and medical education. For instance, virtual reality simulator has been used to help surgeon trainees to tailor the simulator according to their goals and to run many simulations to reduce the experiments on animal models (Uranus et al., 2004).

Recently, many programmes and universities have integrated the virtual simulators as part of their modules replacing the need for the students to go to the labs. For instance, the Arizona State University implemented virtual simulator in their programmes to decrease the demand of number of scientists required to be trained at universities and companies after graduation (Yap et al., 2021). According to Zaharudin, in 2019, Taylor's university also have integrated Labster as part of their blended learning activities for undergrade students to enhance the student-centred learning (Zaharudin, 2019).

As part of their study, Yap et al., 2021 investigated the usage of Labster to train students on aseptic techniques for scientific research projects and techniques like cell culturing, expanding and passaging the animal cells before, during and after the pandemic. In their research they investigated the role of labster as a supplementary learning activity (August 2019/before the pandemic) then considered Labster as a replacement learning tool during early pandemic (March 2020) and after the pandemic (August 2020). In their findings, Yap et al., concluded that the virtual laboratory simulation was beneficial for all the cohorts and increased the students' confidence level, however, there was a decrease in the interest of using virtual simulator during the beginning of the pandemic.

More studies during the pandemic, suggested that other virtual simulators like Gizmos program can help the science teachers to carry out their experiments during the pandemic without the students losing motivation (Baris, 2022). Desa et al., 2022, used another virtual simulator (Home discovery) as a tool for biochemistry module.

Many companies and academic institutions have recently developed lab-based virtual learning tools as it has been shown that virtual simulators increase the student knowledge and understanding (Lewis et al., 2014). This technology improved online learning in many fields like STEM education (O'Dwyer), microbiology and pharmaceutical toxicology (Dyrbeg, 2016: Tripepi, 2021).

The aims for this study were to investigate the preparedness of graduates for industry lab practice from alumni and industrialists' POVs and for students for academic lab practice. As well as ascertain the implications for academia and industry to better inform the use of Labster as a teaching and learning tool.

It is holistically believed that the outcome of this project should not only help current and former students but can also help to alleviate some of the pressures on staff and industry.

Research Approach

The study was conducted on two cohorts on the MSc in Manufacture and Commercialisation of Stem Cell and Gene Therapies, made up of 11 students (cohort 1/2020-2021) and applied again in the subsequent academic year on the same programme, this time with a cohort of 7 students (cohort 2/2021-2022). The investigative techniques for this research considered a number of options including (but not limited to) focus groups, questionnaires & surveys, interviews and observations. Quantitative methods such as surveys were heavily considered as a primary data collection method in the first instance due to the need to reach multiple student cohorts including alumni (Surbhi, 2018). With that said, there was also a need to consider perceptions of industry stakeholders via steering committee members and interviews were determined to be the best approach due to the need for more in-depth and analytical information (Polit and Beck, 2010). A semi-structured interview approach would not only allow for questions to be asked in different orders but would also allow for the use of unscripted questions to follow up on points of interest (Williams, 2015).

Questionnaire Formulation And Ethical Considerations

The questions on the survey needed to reflect the intended aims and outcomes of the project.

Objectives

- Investigate the preparedness of graduates for industry lab practice from alumni and industrialists' POVs.
- Investigate the preparedness of students for academic lab practice.
- Ascertain the implications for academia and industry to better inform the use of Labster as a T&L tool.

Outputs

- Survey current MSc students.
- Survey former MSc students (alumni).
- Collecting feedback from Steering committee members.

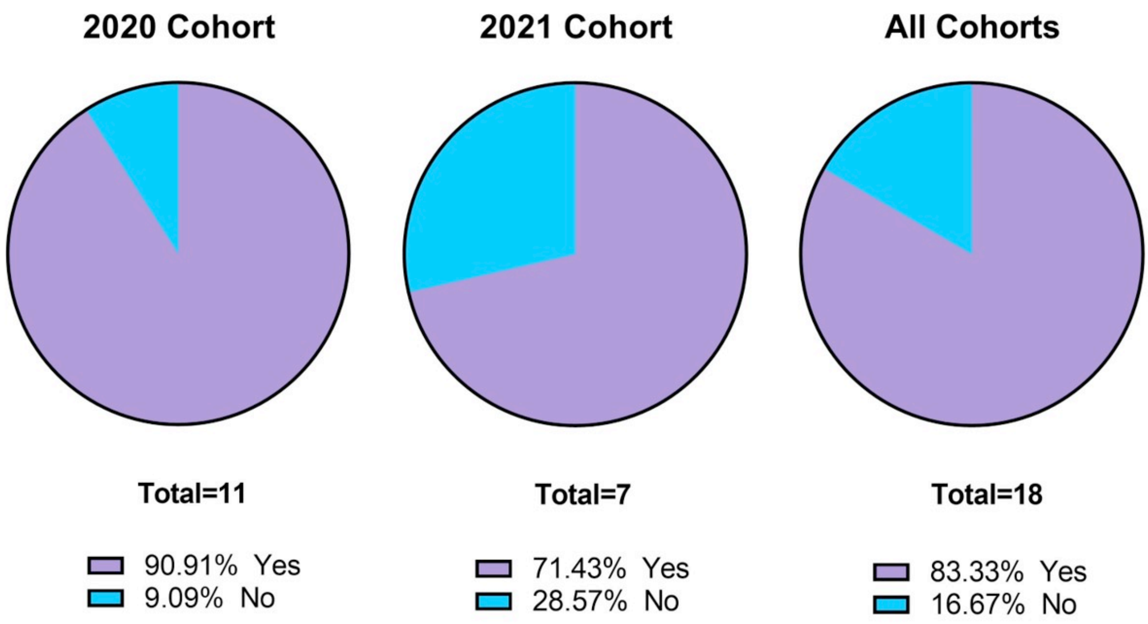
Outcomes

- An improved understanding of the impact of Labster in academia and industry.
- Presentation of results at the Departmental Teaching Committee (DTC) with potential implementation on other modules where relevant.
- Ethical considerations were assessed by UCL change makers. These included informed consent, confidentiality/anonymity/disclosures, data protection and power relationships.

Conclusion

The survey was conducted on cohort 1 (11 students) and cohort 2 (7 students) from which 83.33% of the students had their first experience using Labster as their first virtual simulator (Figure 1).

Figure 1: First Experience working with or learning virtual reality/simulated environment (Graphs generated using GraphPad Prism)

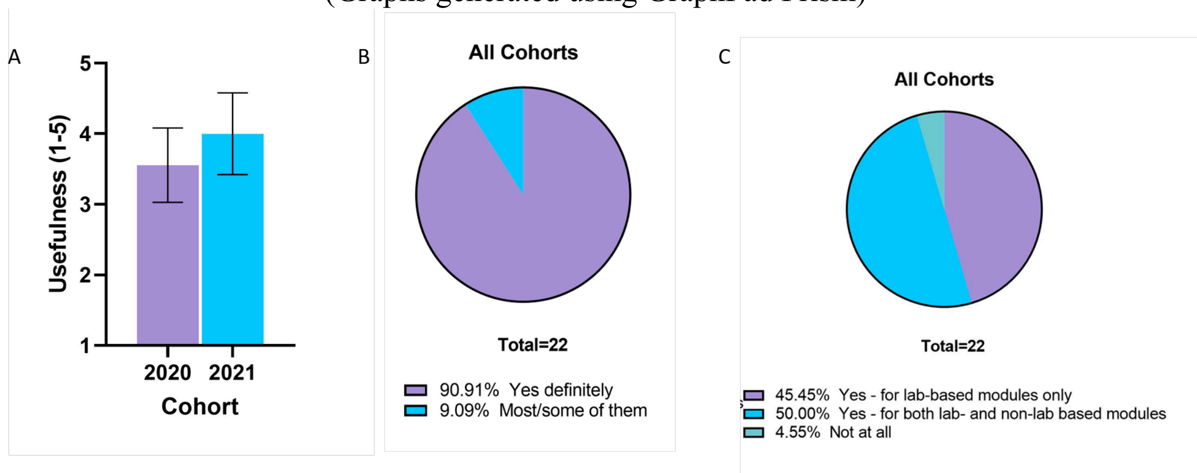


Learning the Practical Theories

The question showed in Figure 2 are the following: A: To what extent was Labster useful for understanding the theoretical aspects of the analytical techniques prior to going into the labs? B: Each simulation was well explained before doing the experiments. C: Would you recommend the use of Labster on other modules?

Both cohorts found that Labster was useful (around 3.8/5) for understanding the theoretical aspects prior going to the labs (Figure 2, A). 90.91% of the students agreed that the theoretical aspects of each simulation were well explained (Figure 2, B) and more than 95 % of the students recommended its use in lab and non-lab-based modules (Figure 2, C).

Figure 2: The role of Labster as pre-lab tool and employment readiness
(Graphs generated using GraphPad Prism)



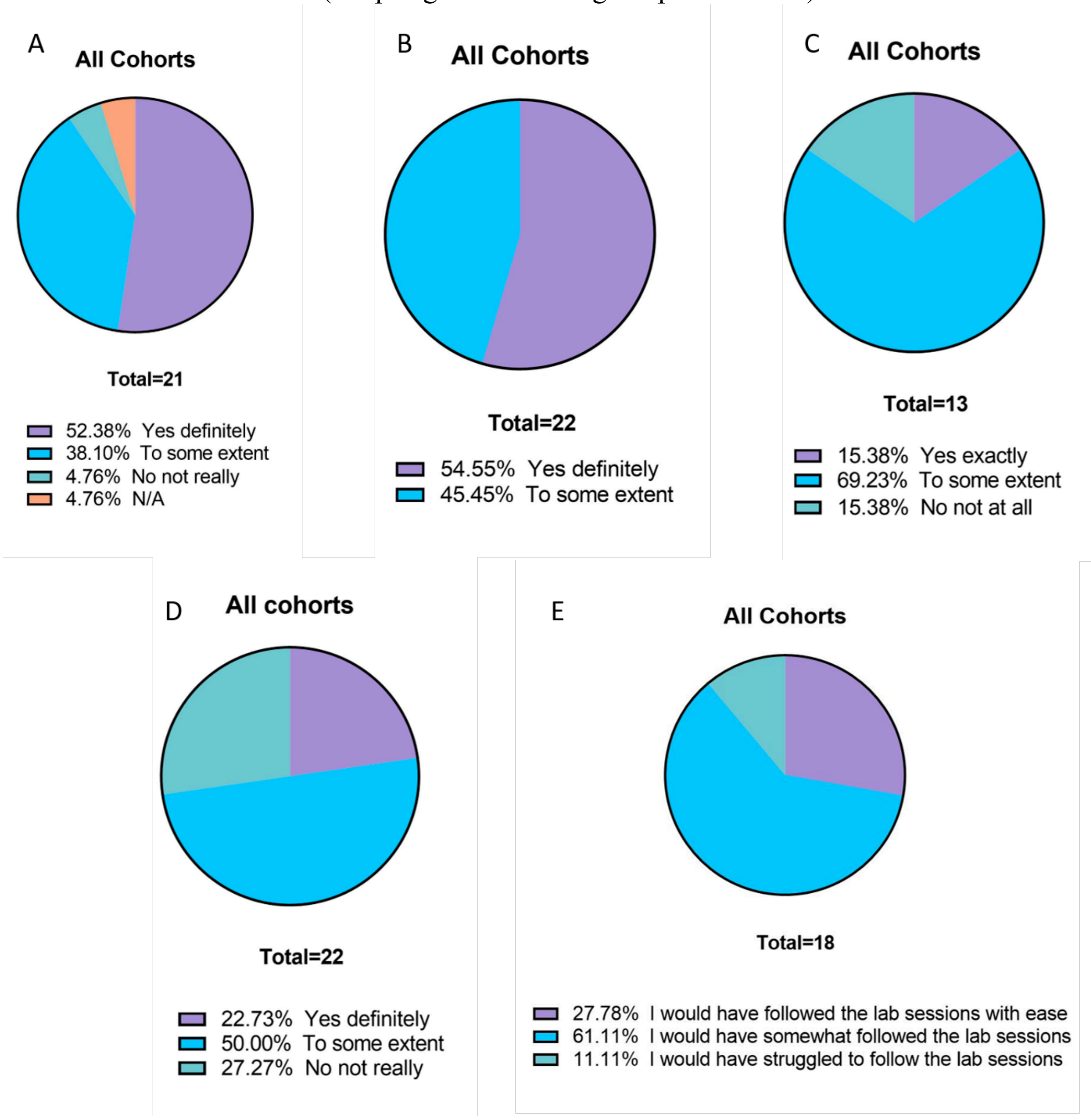
Using Labster a Lab Practical Simulator

Figure 3 represents the question related to the role of Labster as a lab Simulator. The following are the questions: A: Doing the simulation before the lab sessions made it easier to follow the protocols during the practical. B: Doing the simulation before the lab sessions helped to familiarised myself with the lab equipment. C: Performing the experiments on Labster was easy and mirrored exactly how I carried it out in the lab sessions. D: Labster helped me gain lab experience without needing to go to the lab. E: How prepared do you think you would have been for the lab sessions without using Labster beforehand?

52.38 % and 38.10% students think that doing the stimulation made it easier to follow the protocol (yes definitely and some extent respectively), (Figure 3, A).

54.55% of the students found that the simulation helped them definitely to be familiarise with lab equipment (Figure 3, B). Around 85 % of the student agreed that the Labster experiments mirrored the practical experiments (Figure 3, C). 72.73% of the students gained lab experience without going to the lab (Figure 3, D) and 11.11% would have struggled to follow the lab session without using labster (Figure 3, E).

Figure 3. The role of Labster as lab practical simulator
(Graphs generated using GraphPad Prism)

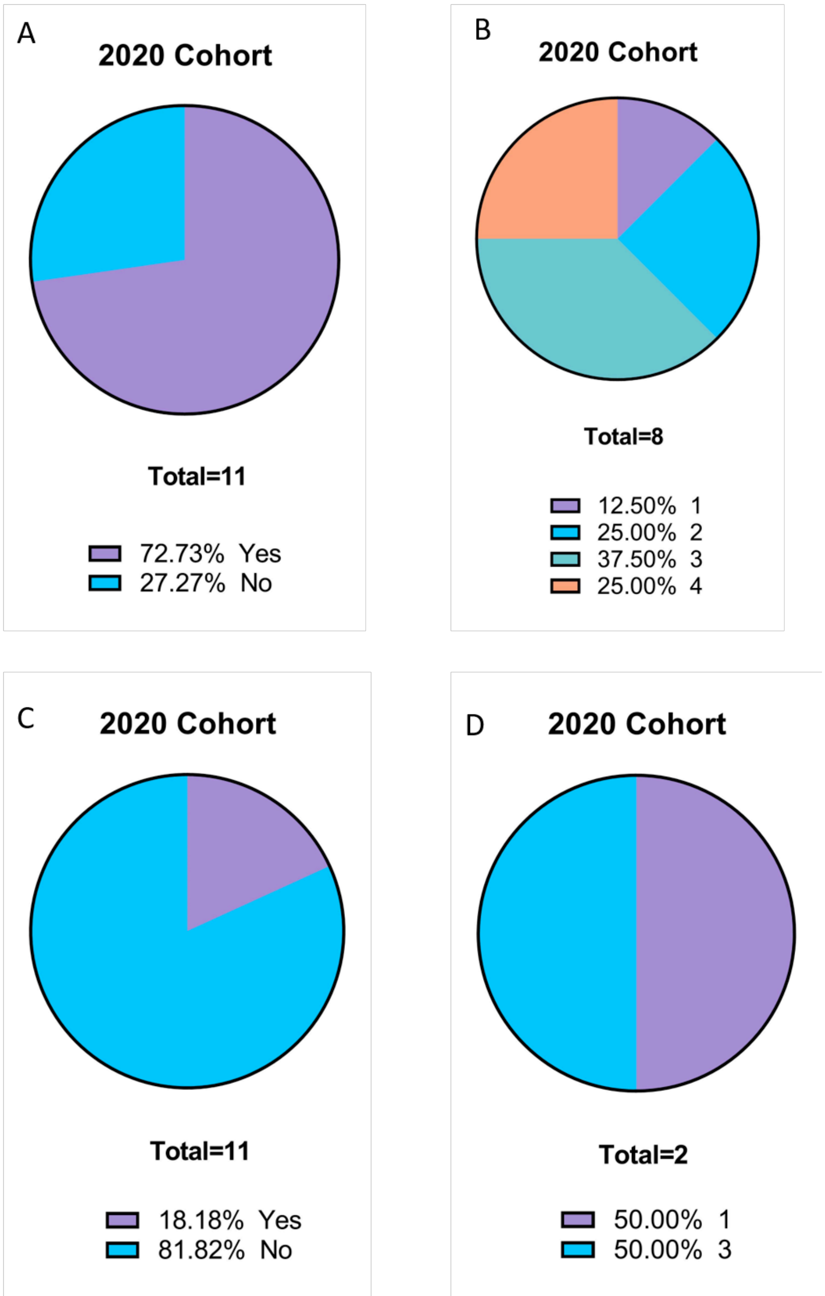


Employment Readiness

We have asked the students the following questions for the data shown in Figure 4: A: Does your graduate job involve you going into labs? B: If you answered yes to the above, how useful was Labster in preparing you for the use of labs in the workplace? C: Does your graduate job involve any virtual reality or simulated learning/working environments. D: If you answered yes to the above, how useful was Labster in preparing or familiarising you for work or training in simulated environments?

72.73% of the graduated cohort have labs as part of their job, however 37.7 % did not find Labster as a pre tool for job preparedness (Figure 4, B).18.18% of the students working in industries use Labster at work (Figure 4, C).

Figure 4. The Effect of Labster on employment readiness
(Graphs generated using GraphPad Prism)



This study investigated whether Labster could be considered as prelab tool that could help the student readiness and prepare them for industry and the potential implementation in non-lab-based modules. According to the students, Labster was considered as a useful prelab tool to know the theoretical aspects of the experiments and makes it easier to follow the protocol and familiarised with lab equipment before the students going to the lab.

However, both cohorts agree that Labster is not considered as a tool to prepare them for job upon graduating. Similar findings were observed where the students favoured this learning tool as it enables them to learn in their own time and pace with no significant difference between the learning outcomes between groups that have done the virtual simulators and those who did not go to the lab (Booth et.al, 2010; Jones et al., 2018).

Labster could be used for practical theory learning (Figure 2). Our students felt confident doing the simulation prior to lab, same was seen in a study done on UG students at the University of Southern Denmark (Dyrberg. 2016) and in a pilot study on Fermentation for Chemical and Biochemical Engineering students (Heras et al., 2021). Simulation based learning has been shown as well to enforce the scientific knowledge and concepts for undergraduate medical students (Jabaay et al., 2020). Virtual simulation is a useful tool in teaching medicine specially anatomy (Galvez et al., 2020), physiology (Jeon et al., 2020) and pharmacology (Rakofsky et al., 2020) and radiology (Shu et al., 2021) modules.

The results from communications with steering committee members and former students currently in employment suggested that various companies tend to use their own in-house lab simulation tools as they are more suited to their in-house equipment, however the consensus from all students (both current and former) was that Labster was considered a highly useful tool for practical theory learning which made it easier for them to follow the practical sessions. Both cohorts also agreed that the simulated lab sessions provide clear explanations and realistic experiences and were in accordance that Labster should be used for both lab and non-lab-based modules.

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