Leveraging Technology for Animal Physiology Practicals

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In 2020, due to the COVID-19 pandemic, animal physiology practical classes at The University of Queensland, were conducted fully online using Lt, a cloud-based platform, ensuring that students were able to achieve the intended course outcomes. However, in 2021, practical classes had to be redesigned to cater for both on-campus and online deliveries and this project investigated the continued use of Lt in animal physiology practical classes focusing on student satisfaction and performance for both on-campus and online students. Student satisfaction with the redesigned practicals were high across all constructs - overall structure, pre-lab materials and incorporation of group work (on-campus students) while student performance outcomes showed an improved performance compared to before the use of Lt and showed no significant differences in the performance of the on-campus versus online cohorts. The findings gave confidence in using Lt as a foundation for delivering animal science practicals equitably for both cohorts.

Keywords: Lt Practical, animal physiology, online practical

Introduction

Traditionally physiology practical sessions have involved students having an opportunity to touch, smell and interact with various items enhancing their learning. In the animal science domain however, this has become increasingly challenging with concerns over animal welfare and ethics (Durand et al., 2019; Monteiro et al., 2021). As part of an ever-increasing technology adoption shift in higher education, animal science education has also been quick to adopt and successful integrate a range of applications for the use in anatomy (Hontoir et al., 2022) and physiology education (Durand et al., 2019). The need to adopt such technology to deliver the quality outcomes has become even more important due to COVID-19. To address this, ADInstruments developed the user-friendly and versatile software called Lt, which allowed students to gather real-time data using on-campus laboratory equipment, collaborate in groups, and remain engaged throughout the entire laboratory process (Dutta, 2016). This platform provided flexibility, allowing educators to create customized lessons using their own resources or access a wide range of interactive activities (Calderon et al., 2022; Dutta, 2016; Halpin, 2022). Additionally, the platform offered simulated data as an alternative to actual data collection (Calderon et al., 2022). During the pandemic, educators teaching various levels of anatomy and physiology courses successfully utilized Lt (Carrazoni et al., 2021; Duszenko et al., 2022). In 2020, with the COVID-19 pandemic at its height, Australian universities had to quickly transit to online teaching (McGaughey et al., 2021) and at The University of Queensland, Lt provided the necessary support to delivery animal physiology practicals online. However, in 2021 with improving conditions in the region, the University of Queensland responded by deciding to resume on-campus teaching with the caveat that all courses be also made available online due to significant numbers of students residing in different states or abroad with different restrictions (Mahdy & Sayed, 2022). Thus, there was an impetus to look at applications like Lt have been able to bridge gaps in the student practical experience due to the shift to online delivery while also supplementing the in-person collaborative experience (Calderon et al., 2022; Halpin, 2022). As we had successfully used Lt in 2020 and the fact that the platform has been used successfully across the physiology space, this project was undertaken to employ Lt as base to redesign undergraduate animal physiology practical classes using student satisfaction and performance outcomes as a measure of its impact.

Practical Redesign

Prior to 2020, course practicals were designed on a weekly basis where students were initially engaged in a pre-lab quiz to be completed prior to the attending the lab sessions. Activities in the lab sessions focused on students working independently submitting their reports at the end of the week. Student feedback reflected poorly on their practical experience specifically highlighting the need for a better structure, alignment with lecture content. In 2020, when Lt was used for the practical delivery, the structure was improved with pre-lab activities along with the provision of simulated data for them to interact with. Additionally, they were required to complete all practical submissions individually. For the 2021 iteration of the course, Lt was once again used to deliver pre-lab activities. The on-campus students also used Lt during the in-person practical sessions where they capture their own data for analysis. To further leverage the capabilities of Lt, group work elements were also introduced for them. Online students engaged with Lt just as students had in the 2020 iteration. The decision to keep them engaged in the practicals individually was due to an understanding of the profile of the online students and potential technological and administrative challenges (e.g., differing time zones).

Pre-Lab Activities

The pre-lab activities were developed by selecting appropriate interactive activities that mirror the concepts being investigated in the practical sessions. This included videos of the techniques, underpinning theories and self-practice questions and were delivered through the Lt platform. This was also pertinent as the students would be engaging in similar activities during the in-class activities and this gave them an avenue to play around with the system and be familiar with what they would be experiencing.

Practical Sessions

During the practical sessions, on-campus students worked on the practical activities in fixed pairs or in groups of three. In accordance with best practices with group work, these groups were intentionally kept small (Cummings et al., 2013), randomised (Muchiri & Njenga, 2020) and retained for the duration of the semester. The practical activities themselves were carefully designed to mirror activities that they would perform in the industry, such as heart rate monitoring and using lab equipment for biological measurements, to allow them to apply their skill and knowledge they garnered from both the pre-lab activities as well as lectures and tutorials. The design of the activities also focused on ensuring that all members of the groups were able to benefit from the activities and that all members had to engage meaningfully in the activities for them to be completed in time (Kirschner et al., 2018). Online students were given access to simulated data and performed all the intended activities albeit individually. To ensure students had as similar an experience to their on-campus peers, the activities on Lt were kept the same and they were also actively engaged through a discussion board to allow them to clarify doubts or ask questions.

Methodology

Student Satisfaction Survey

All 206 students [143 flexible students and 63 external students] enrolled at the point of the study were invited to participate in an anonymous satisfaction survey. At the culmination of the study, a total of 150 (72.8%) completed responses were obtained – 123 flexible students (86.0%) and 27 external students (42.9%). The survey was developed in to determine their satisfaction levels with 3 constructs: (i) Overall Satisfaction – which included various aspects of the practical including its structure and design and its connection with concepts covered in lectures and tutorials. (ii) pre-lab materials – which included the structure, interactivity, and delivery mode of the materials and how useful the materials were for their practicals. Construct 3 was split into (a) practical sessions (on-campus students) – which included aspects of group work, duration, and flexibility and (b) practical session (online students) – which included the developed video guides and activities. Each section had between six to eight statements and students rated their satisfaction by agreeing to each statement using a five-point Likert scale ranging from “Strongly Disagree” to “Strongly Agree”. Students were also given an opportunity to express their thoughts, in open ended questions, on the best aspects and areas for improvement.

Student Performance

The student performance measure in the project was limited to the practical assessment and the final examination as they intentionally assessed the application elements which the practicals were intended to help students. Assessment weightages were amended in 2020 to increase the weightage of smaller assessments in the course to better support their experience and specifically the practical weightage was doubled to reflect the amount of work that was required compared to 2019. This distribution was amended once more for the 2021 cohort as summarised in Table 1 below. As the 2020 cohort engaged in Lt in a collective online mode, the impact of Lt was determined by comparing the 2021 cohort performance with the 2019 cohort.

Table 1 Course Assessment Weightage from 2019 to 2021

Assessment Item	Weightage (2019)	Weightage (2020)	Weightage (2021) *
Practical	10%	20%	18%
Tutorial Exercise	10%	15%	21%
Weekly online quizzes	40%	15%	20%
Final Examination	40%	50%	40%

*1% was given to an employability reflection

Results

Student Satisfaction Survey

All quantitative data from the student satisfaction survey were analysed using SPSS version 27. Questionnaire responses were recoded to the following: Strongly Agree (5), Agree (4), Neutral (3), Disagree (2) and Strongly Disagree (1). To determine construct scores, individual items were summed and averaged prior to statistical analysis. Table 2 summarises the means scores for all constructs in the survey.

Table 2 Means Scores (SD) for Constructs in Satisfaction Survey [N = 123 (On-Campus), 27 (Online)]

Construct	# of items	On-Campus	External
Overall Satisfaction	6	3.73 (0.72)	4.09 (0.76)
Pre-lab Materials	7	3.77 (0.74)	4.05 (0.71)
Practical Session (on-campus)	8	4.10 (0.81)	-
Practical Session (online)	6	-	3.95 (0.90)

Online students rated the practicals higher that the on-campus students in both the overall satisfaction and pre-lab materials constructs and when analysed individually, they rated all statements more favourably than their on-campus peers. In the overall satisfaction construct, on-campus students rated the structure and how essential the practical were to their learning particularly low. In the pre-lab materials construct, it was also found that the on-campus students did not find that find the pre-lab materials adequate or that having pre-lab materials made it easier for them to engage in the practical activities. The on-campus students rated the practical sessions highly though statements related to duration had lower ratings. The online students also rated their practical sessions highly though many indicated that they felt that they missed out by having to do the practicals online. A thematic analysis was carried out on qualitative data by author 1 to identify the common themes raised by the respondents. For the best aspects of the practicals, there were 3 themes identified for the on-campus students - group work, concepts in action and the practical design and delivery while there were 2 themes identified for the online students - access to data and resource availability. For areas to be improved, groupwork was again identified by the on-campus students though the practical duration was identified as a common issue across both cohorts. The themes are summarised in table 3 and 4 below.

Table 3 Thematic Analysis for Best Aspects of the Practicals

Cohort	Theme	# of occurrence	Sample Quote
On-Campus (N=104)	Group work	24	Working in groups, making it easier to understand and gain different viewpoints from other
	Concepts in Action	23	Seeing the real-world examples of concepts discussed in the lectures […]
	Practical Design and Delivery	28	The actual hands-on parts along with online content
Online (N=22)	Access to Data	8	getting to analyse data
	Resource Availability	7	I much prefer doing pracs online - I can take my time and look up information or research random things I find interesting.

Table 4 Thematic Analysis for Suggested Improvements

Cohort	Theme	# of occurrence	Sample Quote
On-Campus (N=87)	Duration	23	Each prac was way to repetitive and took too long. We focused more on getting it done in time than learning
	Groupwork	8	I struggled being assigned pairs as my partner was not very committed or well prepared
Online (N=18)	Duration	10	[…]maybe just less work in the prac?

Student Outcomes

Overall, as summarised in figure 2 below, the 2021 cohort of students performed better that their 2019 counterparts in the practical assessments. The on-campus students also outperformed their 2019 peers in the final examination though this is reversed in the online cohort. Results from the *t*-test analysis are presented in table 5 and 6 below.

Table 5 *t*-test results Comparing On-Campus (OC) and Online (Ol) Student Cohorts

Practical Assessment					Final Examination				
	n	Mean	SD	*t*		n	Mean	SD	*t*
2021 OC	137	70.17	14.60	t(331) = 21.124*	2021 OC	137	87.06	7.84	t(331) = 1.065*
2019 OC	196	59.42	14.60		2019 OC	196	74.05	11.25	
2021 Ol	55	67.30	17.87	t(88) = 6.930*	2021 Ol	55	84.60	13.13	t(88) = 0.609
2019 Ol	35	50.18	27.43		2019 Ol	35	80.41	14.76	
2021 OC	137	70.17	14.60	t(190) = 1.16	2021 OC	137	87.06	7.84	t(190) = 25.382*
2021 Ol	55	67.30	17.87		2021 Ol	55	80.41	14.76	

* p<0.01

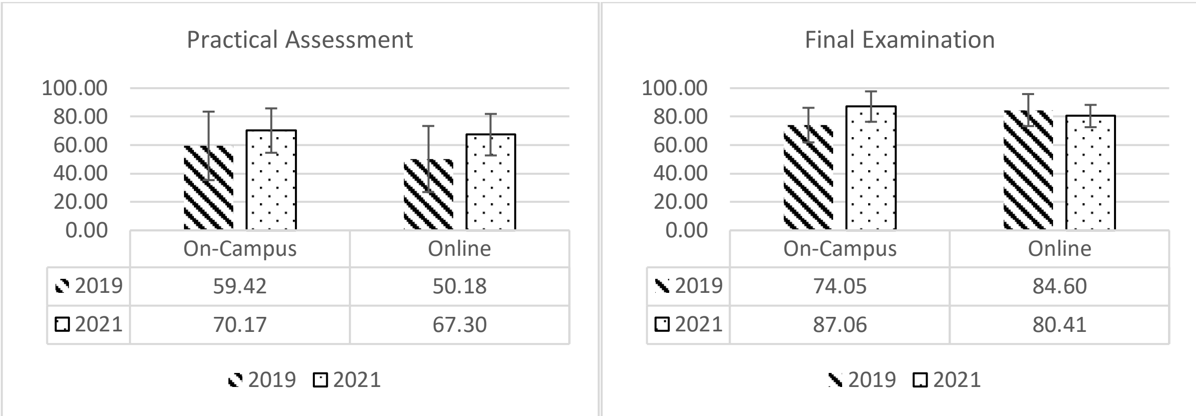

Figure 2 Mean Assessment Scores for 2019 and 2021

Discussion

This project builds upon on previous studies had found the use of Lt to deliver physiology practicals successful (Calderon et al., 2022; Halpin, 2022) by using Lt as a base for redesigning practicals of an undergraduate animal physiology course and investigating the impact on student satisfaction and performance outcomes. Across all constructs, online students were found to rate the course more favorably than their on-campus peers which was reflective of other similar research done where deliberate designs considering the online elements were well received by students (Dumford & Miller, 2018). In context, this was not surprising as prior anecdotal experiences found that online students often felt disregarded when courses are designed and having a deliberate design which capitalises on the affordance of technology and asynchronous learning was appreciated. It was noteworthy however, that the overall satisfaction and satisfaction with the pre-lab materials were consistent which might indicate that their perceptions from the pre-lab extends into the practical sessions. Additionally, in a deliberate design, as they were working in pairs or groups, the on-campus students were required to submit their reports at the end of the session while online students submitted theirs individually by the end of the week. Unfortunately, the duration formed a significant portion of the suggested improvements and had the largest mean difference between the modes. Gratton (2019) illustrated how going through collaborative learning activities shifted student impressions to simply sharing knowledge with one another towards a focus on how they learn and how the group elements supported their learning. This came across clearly where students identified working together with one another as best aspects of the course and how the differing views were eye-opening. The structure and activity design that that the teaching team had put in place could also be a key reason for the perceived success of the collaborative activities. The impact on student outcomes were determined from the practical assessment items and the final examination scores. The positive element with the results was that the incorporation of Lt saw improvements in practical scores from 2019 before it was used. Having no significant difference between the external and flexible students in the 2021 batch supported the conclusion that the Lt was able to give students a comprehensive experience and that their learning is not inhibited by not having in-person practicals. The significant improved performance in the final examinations also lend credence to the impact of the practicals on their learning. However, the poorer performance of the online students, though not significant, is also noteworthy in making future recommendations. With the high satisfaction ratings and the positive impact on student outcomes, this project provides a strong basis for the use of Lt in practical designs where hybrid deliveries are required and serves as an exemplar for other similar courses.

References

Calderon, B., Steel, C., Ford, B., Sue, J., & Bracewell, K. (2022). Lt: A resource to future-proof the laboratory in uncertain times. *The Journal of Undergraduate Neuroscience Education*, *20*(2). https://www.funjournal.org/wp-content/uploads/2022/12/june-20-267.pdf?x36670

Carrazoni, G. S., Lima, K. R., Alves, N., & Mello-Carpes, P. B. (2021). Report on the online course "basic concepts in neurophysiology": a course promoted during the COVID-19 pandemic quarantine. *Adv Physiol Educ*, *45*(3), 594-598. https://doi.org/10.1152/advan.00239.2020

Cummings, J. N., Kiesler, S., Bosagh Zadeh, R., & Balakrishnan, A. D. (2013). Group heterogeneity increases the risks of large group size: a longitudinal study of productivity in research groups. *Psychol Sci*, *24*(6), 880-890. https://doi.org/10.1177/0956797612463082

Dumford, A. D., & Miller, A. L. (2018). Online learning in higher education: exploring advantages and disadvantages for engagement. *Journal of Computing in Higher Education*, *30*(3), 452-465. https://doi.org/10.1007/s12528-018-9179-z

Durand, M. T., Restini, C. B. A., Wolff, A. C. D., Faria, M., Jr., Couto, L. B., & Bestetti, R. B. (2019). Students' perception of animal or virtual laboratory in physiology practical classes in PBL medical hybrid curriculum. *Adv Physiol Educ*, *43*(4), 451-457. https://doi.org/10.1152/advan.00005.2019

Duszenko, M., Frohlich, N., Kaupp, A., & Garaschuk, O. (2022). All-digital training course in neurophysiology: lessons learned from the COVID-19 pandemic. *BMC Med Educ*, *22*(1), 3. https://doi.org/10.1186/s12909-021-03062-3

Dutta, K. K. (2016). Integration of digital/blended pedagogy and a data acquisition system to enhance anatomy and physiology laboratory teaching for allied health students: A learner-centric strategy. *The FASEB Journal*, *30*. https://doi.org/https://doi.org/10.1096/fasebj.30.1_supplement.776.29

Gratton, R. (2019). Collaboration in students' learning: the student experience. *Support for Learning*, *34*(3), 254-276. https://doi.org/10.1111/1467-9604.12261

Halpin, P. A. (2022). Redesigning a face-to-face course to an asynchronous online format: a look at teaching pathophysiology with software that enhances student engagement. *Adv Physiol Educ*, *46*(2), 339-344. https://doi.org/10.1152/advan.00031.2022

Hontoir, F., Simon, V., De Raeve, Y., Dumortier, L., Dugdale, A., & Vandeweerd, J. M. (2022). Can online teaching of radiographic anatomy replace conventional on-site teaching? A randomized controlled study. *J Vet Med Educ*, e20210153. https://doi.org/10.3138/jvme-2021-0153

Kirschner, P. A., Sweller, J., Kirschner, F., & Zambrano, R. J. (2018). From cognitive load theory to collaborative cognitive load theory. *Int J Comput Support Collab Learn*, *13*(2), 213-233. https://doi.org/10.1007/s11412-018-9277-y

Mahdy, M. A. A., & Sayed, R. K. A. (2022). Evaluation of the online learning of veterinary anatomy education during the covid-19 pandemic lockdown in Egypt: students' perceptions. *Anat Sci Educ*, *15*(1), 67-82. https://doi.org/10.1002/ase.2149

McGaughey, F., Watermeyer, R., Shankar, K., Suri, V. R., Knight, C., Crick, T., Hardman, J., Phelan, D., & Chung, R. (2021). 'This can't be the new norm': academics' perspectives on the covid-19 crisis for the australian university sector. *Higher Education Research & Development*, 1-16. https://doi.org/10.1080/07294360.2021.1973384

Monteiro, O., Bhaskar, A., Ng, A. K. M., Murdoch, C. E., & Baptista-Hon, D. T. (2021). Computer-based virtual laboratory simulations: LabHEART cardiac physiology practical. *Adv Physiol Educ*, *45*(4), 856-868. https://doi.org/10.1152/advan.00094.2021

Muchiri, D. K., & Njenga, M. C. W. (2020). Investigating various grouping strategies in teaching and learning of mathematics. *International Journal of Advances in Scientific Research and Engineering*, *06*(03), 227-232. https://doi.org/10.31695/ijasre.2020.33774

Krishnasamy, S. & Narayan, E. (2023). Leveraging Technology for Animal Physiology Practicals. In T. Cochrane, V. Narayan, C. Brown, K. MacCallum, E. Bone, C. Deneen, R. Vanderburg, & B. Hurren (Eds.), *People, partnerships and pedagogies*. Proceedings ASCILITE 2023. Christchurch (pp. 467–471). DOI: https://doi.org/10.14742/apubs.2023.556