Virtual laboratories: a panacea for the financial and ethical challenges associated with face-to-face physiology laboratories?

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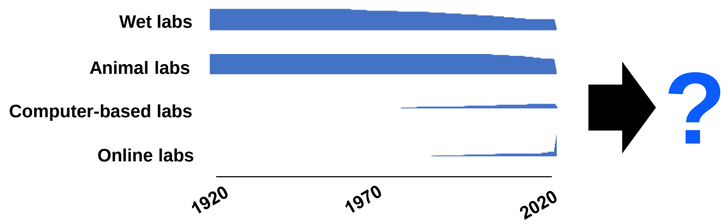
BACKGROUND

- The last century has seen a gradual transition in the delivery format of physiology teaching laboratories, followed by a tectonic shift in 2020 due to the COVID-19 pandemic.

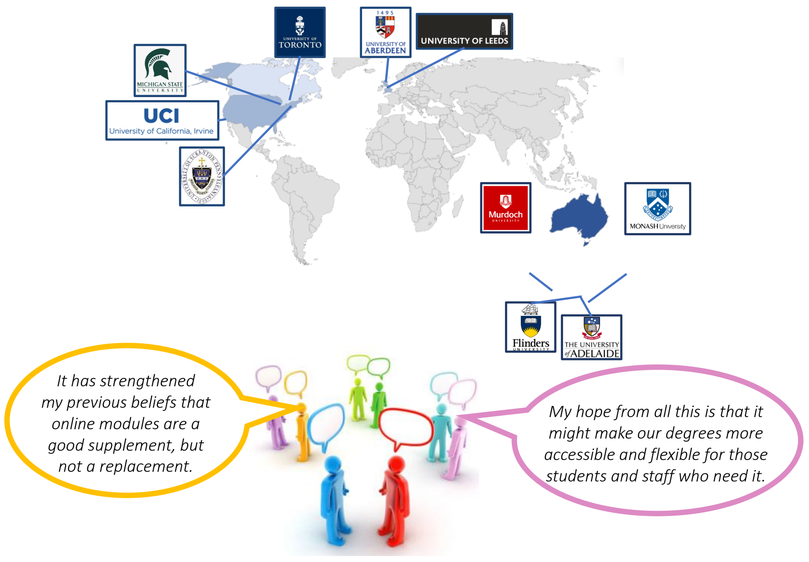


- Reflecting on the rapid transition of on-campus, face-to-face laboratories to remote online mode during COVID-19[1], our group of 10 physiology educators from four countries asked the question:

Does a switch to online laboratories solve the financial and ethical issues typically associated with face-to-face, on-campus, physiology laboratories?

METHODS

- 10 physiology educators wrote reflections on their experiences of the transition to remote online teaching (Mar-Jul 2020) [1]



Financial Implications of Online Physiology Labs

Benefits	Costs and Challenges
Reduces reliance on costly animal models.	**Institutional reluctance to purchase subscriptions** given sector-wide cutbacks, potentially increasing inequities between institutions*.
Wider access for rural, remote, interstate and international students, improving financial viability of courses.	**Reluctance of information technology departments to support external services***
Inbuilt support in digital platforms reduces reliance on non-tenured academic staff.	**Students burdened with license fees** if full costs aren't covered by the institution*.
Allows **capture of complex biological data without cost of longer labs.**	**Possible loss of enrollments** due to higher attrition in entirely online courses[2].
Some **digital platforms and resources can be transferred between courses**, reducing per student costs.	
Improved environmental and sustainability outcomes (reduced carbon footprint due to reduced travel times and consumable use).	

Ethical Implications of Online Physiology Labs

Benefits	Costs and Challenges
Reduces reliance on animal models, and/or specimens are better utilized through use of online resources to prepare students for class.	**Digital inequity between students and staff** i.e., less access to digital devices, compatible computer equipment, internet connectivity.
Enhanced access for geographically diverse student cohorts (e.g., regional, remote) and non-institutional staff (e.g., specialists contributing to course delivery).	**Security concerns related to student data stored in 3rd-party 'cloud'*.** Exposes institutions to cyber security breaches (similar to LMS concerns).
More equitable access for students unable to attend on-campus labs i.e., due to family or work commitments or disability.	**Adherence to government policies relating to digitization of cadaveric specimens,** particularly if assets are downloadable and/or shared.
All students likely to receive a similar level of guidance and support, which does not always happen when on campus.	
Reduces risk of physical harm to students from using biological specimens (i.e., urine/ blood sampling, respiratory measurements) and potential for spread of communicable diseases (e.g., COVID19, hepatitis, HIV).	
Improved environmental and sustainability outcomes (reduced carbon footprint due to reduced travel times and consumable use).	

*Some points relate more specifically to the use of a third-party purchased product rather than the use of online laboratories more generally.

SUMMARY & CONCLUSIONS

- Small group human experimentation in physiology labs is replacing wet-lab animal experiments due to:
  - High costs of wet-labs.
  - Changing student and social attitudes to animal experimentation.
- In parallel, proliferation of software packages and web-based platforms for physiology labs have produced benefits including:
  - ✓ Improved accessibility and equity for students.
  - ✓ Reducing animal usage whilst increasing maximum class sizes.
  - ✓ Reduced curriculum delivery costs including reduced technical and lab management costs.
- Despite this, most of the physiology educators in this study intend to retain a hybrid model (face-to-face & online) of lab delivery, as:
  - Continue the engagement and learning generated in physical labs by providing students with opportunity to record and analyze 'real-life' data and experience biological variability in an authentic way.
  - Serve the diversity of students needs by adjusting teaching for individual students/groups.
  - Embrace the excellent digital alternatives available for data capture and transferable skills development.

REFERENCES

1 Choate et al., (2021). International educators' attitudes, experiences and recommendations after an abrupt transition to remote physiology laboratories (Advances Physiology Education, https://journals.physiology.org/doi/full/10.1152/advan.00241.2020)

2 Herbert, M. (2006). Staying the course: A study in online student satisfaction and retention. Online Journal of Distance Learning Administration, 9(4)