TRANSFORMING AN ENTIRE PHYSICS ADVANCED LABORATORY SEQUENCE

Benjamin Pollard[a], Jamie Gleave[a], Rory Robertson[a]

Presenting Author: Benjamin Pollard (ben.pollard@auckland.ac.nz)
[a]Physics Department, University of Auckland, Auckland, New Zealand

KEYWORDS: lab courses, epistemology, metacognition, experimental modelling, scientific communication

SUB-THEME: Experiential Learning

ABSTRACT:

Physics lab courses are ubiquitous in undergraduate degrees and represent critical opportunities for students to learn essential skills for future careers in STEM. Such opportunities come from the fact that physics lab courses have learning goals that are distinct from physics theory courses (AAPT Committee on Laboratories, 2014). However, physics labs often struggle to meet such potential (Caballero, Dounas-Frazer, Lewandowski, & Stetzer, 2018).

In response to these needs and challenges, the Physics Department at the University of Auckland embarked on a transformation of their Stage 2 & 3 lab courses in 2024. This transformation represents a rare opportunity to create a cohesive, scaffolded, and connected physics lab curriculum, due in part to a relatively unique course structure: these courses are all taught by the same instructional team, with second- and third-year students working amongst each other at the same time and in the same instructional space.

The transformation started with interviews with departmental stakeholders to identify shared goals. These interviews, combined with past teaching and education scholarship, informed a set of structural changes to the lab courses to make certain types of the “hidden curriculum” more explicit, including experimental modeling (Dounas-Frazer & Lewandowski, 2018), scientific writing (Hoehn & Lewandowski, 2020) and other forms of scientific communication, and reflection/metacognition (Etkina et al., 2010). These structural changes then led to revisions of existing experiments and the creation of new ones. A variety of quantitative and qualitative measures of learning are being collected throughout the transformation process, including administering research-based assessment instruments, collecting course artefacts, and analyzing administrative records. I will discuss the process, goals, and preliminary outcomes of this physics lab transformation, describing the consensus learning goals that emerged and sharing preliminary data on learning measurement uncertainty, epistemology, experimental modeling, different modes of scientific communication, and levels of academic motivation and metacognition.

ACKNOWLEDGEMENTS

Graham Moss and Niman Munasinghe provided technical support for the development of new lab experiments.

REFERENCES

AAPT Committee on Laboratories. (2014). *AAPT Recommendations for the Undergraduate Physics Laboratory Curriculum*. Am Assoc Phys Teach. Retrieved from https://www.aapt.org/Resources/upload/LabGuidlinesDocument_EBendorsed_nov10.pdf

Caballero, M. D., Dounas-Frazer, D. R., Lewandowski, H. J., & Stetzer, M. R. (2018). Labs are Necessary, and We Need to Invest in Them. *APS News Back Page*, *27*(5).

Dounas-Frazer, D. R., & Lewandowski, H. J. (2018). The Modelling Framework for Experimental Physics: description, development, and applications. *European Journal of Physics*, *39*(6), 064005. IOP Publishing.

Etkina, E., Karelina, A., Ruibal-Villasenor, M., Rosengrant, D., Jordan, R., & Hmelo-Silver, C. E. (2010). Design and Reflection Help Students Develop Scientific Abilities: Learning in Introductory Physics Laboratories. *Journal of the Learning Sciences*, *19*(1), 54–98. Taylor & Francis Group.

Hoehn, J. R., & Lewandowski, H. J. (2020). Framework of goals for writing in physics lab classes. *Physical Review Physics Education Research*, *16*(1), 010125. American Physical Society.

Proceedings of the Australian Conference on Science and Mathematics Education, The University of Melbourne, 30 September - 2 October 2025, page 62, ISSN Number 2653-0481.