

POST-COVID JUNIOR PHYSICS LAB: THE NEW NORMAL

Alexander Samarian^a and Svetlana Postnova^a

Presenting Author: S. Postnova (svetlana.postnova@sydney.edu.au)

^aSchool of Physics, The University of Sydney, Sydney NSW 2006, Australia

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Physics laboratory is the most challenging aspect of teaching physics in a pandemic environment: How can we teach experimental skills when students are not in the lab? How do we ensure that both on-campus and online students develop relevant experimental skills and enjoy labs? Finally, how do we ensure COVID safety when students work in groups? In junior physics labs there is an additional challenge of scaling-up any teaching approach to large student cohorts. At the School of Physics, we teach cohorts of ~800 students per semester over four units of study at different levels: fundamental, regular and advanced. In this presentation we will share our experience and lessons learned over the last three-four years moving from teaching labs in the pre-pandemic world to the current new normal that includes both on-campus and online labs with hundreds of students in each stream.

Back in 2019, our Junior Physics Labs were very traditional: printed lab manuals, hand-written logbooks, bench notes as supportive materials, crowded classes, hand-drawn graphs, in-person paper tests, etc. We just moved into a new beautiful lab space and had been working on modifying lab curriculum, as well as lab equipment which had been largely unchanged for 20 years.

However, in early 2020 the COVID-19 pandemic forced universities, including The University of Sydney (USYD), to move all classes online. For us this happened right at the start of semester, so it was necessary to quickly find a way to run labs in an online format. This included both running the experiments and managing all assignments, groupwork, and logbooks online. After some trial and error (including hybrid) over 2020-2021, we have set up completely independent online labs which now run in parallel with the campus labs and receive good feedback from remote students. They also provide a fallback plan for students who are in COVID-19 isolation and cannot attend the labs in-person.

This transition also required a new approach to labs navigation on *Canvas* (web-based learning management system used by USYD) so we designed and developed new pages for both on-campus and online streams so that students can easily find required information and materials for each week. We introduced e-Lab manuals, shared e-logbooks, online quizzes, practical online tests, videos, and simulators which are now used in both in-person and online labs, elevating student experience and simplifying lab coordination and management. The main software tools that we use are *Canvas*, *Zoom*, and *MS Office 365* (or Google Docs/Sheets). In addition to these we use mobile apps, e.g. *Phyphox*, and simulators, e.g. *MultiSim* and *Phet*, for doing or simulating experiments at home.

Fast forward to 2022, physics labs at The University of Sydney have been returned to the fully face-to-face mode, though many students are still overseas. It is likely that many will also prefer to study remotely in the longer-term. In this presentation we discuss the rationale behind incorporating features of online labs into face-to-face labs and discuss how to run engaging and fun labs while maintaining appropriate social distancing and hygiene standards.

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