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A novel format for active-learning lectures and seminars in undergraduate physics

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Oral presentation

Abstract

This presentation reports on the experiences of changing the course structure of a small undergraduate physics course to a novel active learning format. “Quantum phenomenology and radiation physics” [1] is a third-year undergraduate course primarily taken by students in the medical radiation physics program at the Department of Physics. The number of enrolled students typically ranges between 5 and 20, and many students view the course as tough: it covers foundational aspects of quantum mechanics, surveys a wide range of applications, and includes challenging technical and problem-solving components. Before 2020, the course was taught in a traditional format of lectures and tutorials that were, respectively, led by the lecturer and the Teaching Assistant (TA).

Motivated by the effectiveness of active learning methods in small STEM classes [2] and prompted by the switch to online teaching in 2020, the course was restructured to an interactive format. Long lectures were replaced by short (~30 min) introduction lectures delivered live, recorded and made available online. Students were given reading assignments, followed by interactive seminars that included active-learning problem-solving sessions and, more importantly, student-directed lecture-like components. Written hand-in assignments, traditionally graded by the TA, were replaced by peer-reviewed “Explainer video” hand-ins, allowing the students to practice oral communication skills and emphasising context and clarity, in addition to quality, of solutions. Particularly challenging aspects were covered in detail in recorded “Technical Videos”, available together with worksheets online for optional self-studies.

The new format had a distinctly positive impact on student performance and satisfaction. In the consistently positive course evaluations over the past four years, students have highlighted the course structure as the most positive aspect of the course. Arguably, the course structure strengthens the students’ communication skills, metacognition, and agency in physics. Adapting this format to larger courses is an interesting challenge for the future.

References

[1] https://www.su.se/english/search-courses-and-programmes/fk5015-1.412650?semester=HT23&eventcode=47708

[2] Freeman et al., PNAS June 10, 2014 111 (23) 8410-8415