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Enhancing student learning through trans-disciplinary project-based assessment in bioengineering

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Abstract:

The Bioengineering Systems major offered at the University of Melbourne aims to enable students to rigorously integrate mathematics and modelling concepts with the fundamental sciences of biology, physics, and chemistry in order to solve biomedical engineering problems. This requires mastery of core concepts in engineering design, programming, mechanics, and electrical circuits. Historically, these concepts have been sequestered into separate subjects, with minimal cross-curricular references. This has resulted in the compartmentalisation of these concepts, with students often failing to appreciate that these seemingly disparate ideas can be synergistically combined to engineer larger, more capable systems. Building the capability of students to integrate these trans-disciplinary concepts is a unique aspect of the major that seeks to prepare students to solve real-world problems in the digital age (Burnett, 2011).

We previously implemented trans-disciplinary design in the second-year subject Biomechanical Physics and Computation by integrating the teaching of mechanics and programming (typically covered in separate subjects in standard engineering degrees). This integration was explored largely through assessment redesign that focuses upon authentic learning (Bozalek et al., 2014). In these assessments, students have to model real-world mechanical systems using programming, for example, the construction of an animated physics-based model for a bicep curl. Here, an understanding of either the mechanics or programming component is insufficient to properly complete these assessments – students necessarily have to master both in order to perform well. Student feedback surveys have indicated that student learning has benefited from this redesign, as they have helped put programming concepts in a real-world context by demonstrating their utility in solving complex physics problems. Quantitatively, trans-disciplinary design has contributed to improvements in the following survey scores from 2017 (pre-redesign) to 2019: "I found the assessment tasks useful in guiding my study": 3.85 to 4.43, "I learnt new ideas, approaches, and/or skills": 3.88 to 4.32, "I learnt to apply knowledge to practice": 3.63 to 4.13 (averages, maximum: 5).

To further model trans-disciplinary design, we have established a collaborative curriculum design team (Laurillard, 2012) to develop a coordinated set of learning activities and assessments centred around the design, construction, and control of a bionic limb. Using design-based research (McKenney & Reeves, 2019), our team will model a design-based research approach within the curriculum over a two-year project timeline. By integrating these learning activities across four core subjects in the Bioengineering Systems major, students will

be involved in an authentic learning project that integrates the concepts taught in the context of a larger system. The project involves hands-on design and fabrication of a bionic limb facilitated by a learner-centric ecology of resources (Luckin, 2008), including an ePortfolio consisting of Jupyter Notebook, GitLab, MS Teams and Adobe Spark. The intended learning outcomes are to enhance students' capacity to integrate trans-disciplinary knowledge by providing continuity in assessments and learning objectives across our curriculum.

The presentation will outline the methodology behind the collaborative trans-disciplinary curriculum design project focusing upon the initial exploration, analysis, and rapid prototyping stages. The presentation will also explore how the team is navigating the impact of COVID-19 on a traditionally lab-based project in a hybrid mode.

References

Bozalek, V., Ng'ambi, D., Wood, D., Herrington, J., Hardman, J., & Amory, A. (2014). *Activity theory, authentic learning and emerging technologies: Towards a transformative higher education pedagogy*. Routledge. https://www.routledge.com/Activity-Theory-Authentic-Learning-and-Emerging-Technologies-Towards/Bozalek-Ngambi-Wood-Herrington-Hardman-Amory/p/book/9781138778597

Burnett, R. (2011, 19 June). Transdisciplinarity: A new learning paradigm for the digital age? *Critical approaches to culture + media*. http://rburnett.ecuad.ca/2011/12/27/transdisciplinarity-a-new-learning-paradigm-for-the-digital.html

Laurillard, D. (2012). *Teaching as a design science: Building pedagogical patterns for learning and technology*. Routledge. http://www.routledge.com/books/details/9780415803878/

Luckin, R. (2008, February). The learner centric ecology of resources: A framework for using technology to scaffold learning. *Computers & Education, 50*(2), 449-462. https://doi.org/10.1016/j.compedu.2007.09.018 (Development, Disruption & Debate - Selected Contributions from the CAL 07 Conference)

McKenney, S., & Reeves, T. (2019). *Conducting educational design research* (2nd ed.). Routledge. https://doi.org/10.4324/9781315105642