Student-led learning: Introducing Microfluidics through a Problem-Based Laboratory Course

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Abstract No.: 6000729

Abstract

Microfluidics is a multidisciplinary discipline concerned with the behavior and accurate regulation of the quantities of fluids in microliter and nanoliter amounts. Microfluidics has transformed numerous areas of engineering and applied sciences in the past decade. But little has been done to integrate the advancements in the area of microfluidics to the curricula of the undergraduate level. Here, the proposal aims to revise an existing undergraduate laboratory course, BME3101 Micro and Nanotechnology, to incorporate student-led learning of microfluidic device design using a problem-based learning (PBL) approach involving students in all aspects of microfluidic device design, production, and characterization. A major aspect of the revised course will concentrate on problem-based learning approaches that emphasize all of the Course Intended Learning Outcomes (CILOs). Students will use 3D Computer-aided design (CAD) Design Software software (AutoCAD by Autodesk or Solidworks by Dassault Systèmes) to design and simulate a microfluidic gradient generator. Students then use the state-of-the-art cleanroom facilities in the Biomedical Engineering Department of City University of Hong Kong to prototype the designed devices in polydimethylsiloxane (PDMS) polymer and characterize them using epifluorescence microscopy. Allowing student teams to initiate designs and realise their prototypes through laboratory tasks promotes interactive learning and maximize the benefits of student-led learning, which has been proven to improve engagement and learning outcomes [1]. At the end of the semester, each group of students must analyze their outcomes in seminar-style presentations and compare their experimental results with previously established simulations. The effectiveness of this learning approach will be determined based on a survey on student experience and the TLQ evaluation.