Development of a Pocket Laboratory for Increasing Gender Representation in Mechanical Engineering Undergraduate Programs

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From undergraduate studies to professional careers, Engineering has historically been a male-dominated field. Women comprise only 23% of undergraduates enrolled in engineering programs in Ontario, and only 14% of students within the discipline of mechanical engineering identify as women. Furthermore, only 13% of licensed engineers in Canada are women. This unequal gender representation in the engineering community results in limited diversity of ideas and experiences, affecting the inclusivity of engineering solutions in the past and present.

A prerequisite for undergraduate engineering programs is high school-level Physics – getting more girls interested in physics from an early age may increase the likelihood of them selecting Physics for Grade 11 and 12, and hopefully become inspired to pursue engineering as a profession. The objective of my research was to create a small, low-cost device that can be used to demonstrate concepts of materials and mechanical engineering, with the demonstration conducted by a group of undergraduate mechanical engineering students of equal gender representation. The accessibility of the device is ensured in three facets: instructions for the device and its list of components are open source so that it can be reproduced easily; the materials used to build the device are affordable and readily available; after the initial download of the device literature, the device can be used remotely and offline.

Data was gathered on current Grade 9 and 10 science curricula, available on the Government of Canada website, to create a device that suited the students' levels of learning. Design concepts for several devices were explored and a working model was developed for the final design. Finally, an interview was conducted with a current high school physics teacher from the Toronto District School Board (TDSB) for feedback on the device, demonstration, and feasibility of the idea as a whole. The final design of the device consists of a linear actuator connected to an Arduino Uno microcontroller placed vertically on a 3D-printed stand and powered by a 12-volt supply. Three objects of different states of matter can be introduced to the class: a solid, liquid, and non-Newtonian fluid. The class can then form hypotheses for what would happen to each when crushed by the press, how much force each object would require before it is crushed by the press, and to compare the results after crushing.

Having this demonstration conducted by a group of undergraduate engineering students of equal ratio of men to women would help break down stereotypes of who can be an engineer – it shows girls that engineering is for women as much as it is for men. The experiment would hopefully encourage girls' interest in physics, enough to choose to take the course in both Grade 11 and 12 as a prerequisite to undergraduate engineering programs. Having more women in engineering programs and professional engineering careers will lead to a more diverse engineering community; the professional experience of women engineers can bring new perspectives and ideas to both research and industry, as well as result in more inclusive design solutions.