FWI Funding Statement – Project Report

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Faculty/Area: Science/Biology
Project title: Integrating First Year Students in Primary Biological Research: A Feasibility Study

Introduction:
Biology 1A03 is an introductory course in Molecular and Cell Biology. The objective of our FWI project was to integrate students into authentic, primary biological research via a redesign of the laboratory component of the course. The new lab design included introducing the students to research methodologies and research ethics, as well as the collection and analysis of original data from their experiments. In addition, the students are their own subjects as they are collecting data about themselves. The labs were designed and coordinated so that each weekly lab revolves around a central theme. The theme that was chosen for the lab redesign is the evolution of the gene for human salivary amylase protein, which is coded by a multiple copies in the genome. The course has now run three terms with the new lab. Overall, the students noted in the end of course evaluations that they enjoyed the organization around a central theme. It helped them to see connections between the laboratory content and techniques on a week-to-week basis, and helped them to realise the connections with the course’s lecture content. Feedback as submitted by the students was very positive and the lab experience was given a mean score of 8/10, the highest mean score given to any component of the course. The redesign of the Biology 1A03 laboratory component occurred in conjunction with the redesign of the Biology 1A03 lecture component into a blended format with some of the lecture content delivered online. Given this, we felt that it was important for the face-to-face lab time to be as engaging and enriching as possible.

1. How has the project fostered collaboration and interdisciplinarity?

The Department of Biology is itself interdisciplinary, being the home of ecologists, molecular geneticists, physiologists, and microbiologists. A team of faculty, staff, and students was assembled to undertake the redesign of the course so that it demonstrated the role of molecular biology tools and knowledge across all of these fields of research. During the planning process it was decided that the newly developed labs should be built around the theme of evolutionary biology. This has fostered communication and collaboration with the instructional team that teaches the Biology 1M03: Biodiversity, Evolution, and Humanity course. The success of a thematic approach in the Bio1A03 labs has lead to a project to redesign the Biology 1M03 tutorials around a central theme. There are also plans to incorporate the student-collected data and the concepts taught in the Bio1A03 labs directly into the 1M03 tutorials. The Biology 1A03 laboratory redesign was also discussed with members of the Department of Anthropology and further discussions with the Department of Anthropology will occur during the redesign of the Biology 1M03 tutorials.

The success of the Bio1A03 labs is in part due to the fact that students are collecting and analyzing data about themselves. We are currently incorporating this idea into the development of genetics research projects that allow students to participate in personal genome testing as part of Biology 2C03: Genetics. This project is currently funded by a Teaching and Learning grant from MIIETL.

2. How has the project exposed students to new or emerging research?

The central theme of the labs is investigating the evolution of gene structure and expression in the context of our environment over many generations. The students look at current research that examines this question in the context of a variety of genes. In their own study of the amylase gene, the students are using equipment and techniques that are current and seen in the published papers that they are reading. Engaging first year students in authentic research questions with original and personal data is rarely seen, with students more usually following cookbook labs to replicate data year after year. The Department of Biology has stepped beyond the norm to truly teach students by allowing them to do the research themselves.

The newly designed Biology 1A03 laboratory component exposes the students to recent research, the research process, and research ethics. The students are educated on the need for the review of current research and current
literature, the need for an appropriate research design, and the requirement of ethics approval prior to the commencement of experimentation and collection of data. The introduction of these new curriculum components also fulfills a departmental program learning objective that was not previously being met.

3 and 4. How has the project offered students an experience beyond traditional borders? And, how has the project challenged the confines of existing programming and advanced new paradigms of research or education?

Traditional university Biology labs aim to teach students different techniques each week that illustrate a collection of apparently disconnected ideas. The Department of Biology at McMaster University seems to be the first in Ontario (and perhaps Canada) to introduce a lab that has a central theme uniting the weekly labs and that uses the students themselves as the subjects. The lab is also unique in that we are working towards collecting this novel student data on a yearly basis and using it to address the question of the relationship between cultural histories and gene evolution. This lab design has greatly improved the Biology 1A03 student experience. This is observed in the end of term surveys that are completed by the students. Students report that they enjoy the topic of the labs and skills that they are developing.

The Biology1A03 labs are the first application of this thematic approach to lab material in the Department of Biology. We believe that this will be the first step towards re-envisioning a variety of our lab courses in Biology.

5. How will the outcomes of the project be sustained or expanded?

It was predicted that the newly designed Bio1A03 labs would be more costly to maintain for the Department of Biology than the ones that were previously offered. The resources required for these new undergraduate labs will be maintained by proceeds from the sale of the newly designed lab manual to the students. The new lab manual is being sold at a cost of $10 per unit via a process that is similar to the sale of lab manuals to students who are enrolled in first year chemistry courses. The proceeds from the sale of the newly designed lab manuals has successfully offset the increased cost of the newly designed labs, as well as allowed for the purchase of additional equipment that will directly benefit the students. It is often noted in the student surveys that equipment availability during labs is sometimes problematic, and that it negatively affects their experience. Proceeds from the sale of the lab manuals will eventually allow us to resolve this problem, via continued enhancement of, and investment in the course.

6. Please outline any barriers or challenges that may have prevented you from achieving some of your project goals.

The development of the new labs has created significant technical and logistical challenges. Due to the thematic and connected nature of the labs, it is important that students attend and complete all laboratory exercises. Biology 1A03 is a high enrolment course and a substantial number of students are absent from labs each week. This has created the need for additional lab times during which absentee students can attend and complete the lab work that they have missed. This has at times become a logistical challenge, as it requires many different lab exercises to be occurring simultaneously. It has also increased the amount of preparation required by the course technician. Although these are significant challenges, the positive feedback received from the students far outweighs the technical and logistical challenges that have arisen. It has been decided that introducing first year biology students to primary research is indeed feasible.

Conclusion

The Department of Biology views Biology 1A03 as its flagship course. It is hoped that the development of the newly designed labs will enhance the student experience, create an interest in research, and attract students to Biology programs. It is also hoped that the newly designed Biology 1A03 lecture and laboratory experience will be a recruiting tool for the Faculty of Science and McMaster University. The team that redesigned the Biology 1A03 lecture and laboratory components believes that the first year biology student experience during Biology 1A03 is truly unique, and the best in Ontario, and perhaps in Canada.