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Developing a Textbook for Integral Calculus with Applications to Life Sciences

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Project Summary

This project aims to create an open-access textbook for MATH 103-Integral Calculus with Applications to Life Sciences.

- The text will present calculus concisely and meaningfully so that students can understand the concepts they are learning and apply them to real-life situations.
- The text will bring together material (such as differential equations, linear algebra, probability, and statistics) that is not usually found in regular calculus textbooks and present them in the context of real-life problems.
- The textbook will address the needs of all students regardless of their algebraic skills by providing all necessary background and detailed step-by-step solutions.
- Making the book an open education document will ensure all students can access the resources.

Project Rationale and Objectives

There is currently no existing textbook that covers all the topics included in MATH 103. Rather than just being a course on integral calculus, this course was designed to provide basic mathematical skills for students pursuing degrees in Life Science. Therefore, in addition to integral calculus, topics such as differential equations, linear algebra, probability, and statistics are included.

- To motivate students, the textbook will not only cover these topics in depth but also connect the concepts to real-life problems.
- Algebra makes calculus challenging, and we do not want students to get stuck on examples just because they have weak algebra skills. The solution to every example will show all detailed steps (including algebra steps) so that even students with weak algebra backgrounds can follow along and strengthen their skills. Here is an example:

$$\int \sqrt[3]{x}\,dx = \int x^{\frac{1}{3}}\,dx \qquad \sqrt[n]{x^m} = x^{\frac{m}{n}}$$

$$= \frac{x^{\frac{1}{3}+1}}{\frac{1}{3}+1} + C \qquad \int x^n\,dx = \frac{x^{n+1}}{n+1} + C, \quad n \neq -1$$

$$= \frac{x^{\frac{4}{3}}}{\frac{4}{3}} + C \qquad \frac{a}{b} + c = \frac{a+bc}{b}$$

$$= \frac{3}{4}x^{\frac{4}{3}} + C \qquad \frac{a}{\frac{b}{c}} = \frac{ac}{b}$$

Project Benefits and Impact

- The textbook will be used in the UBC Okanagan course MATH 103. Currently, 192 students are enrolled in the course. We anticipate that about the same number of students will take the course in the future.
- The text will replace the paid textbook titled *Calculus for Biology and Medicine by C. Neuhauser and M. Roper.* Textbook being replaced costs (in Canadian dollars) are the following: eTextbook: $64.99 Print: $217.99
- Clear learning outcomes included in the textbook engage student curiosity and initiative.
- Positive feedback from the survey about the textbook will lead to presentations at teaching conferences.
- Mentoring of students hired to support the project. We will hire undergraduate students; the skills acquired will enrich their profiles.

Sustainability Plan

- We will collect feedback from students, TAs, and instructor(s) each year and update the book accordingly.
- The task of maintaining the document will be done by Paul Tsopméné and eventually will be passed along to future instructors.

Project Evaluation

The project will be evaluated using the following metrics.

- **Student Surveys:** These will be developed in collaboration with the Centre for Teaching and Learning.
- **Downloads and Page Visits:** We will publish the textbook as OER in the UBC Library – cIRcle. The DOI/URL generated by the system will be posted on various websites. An increased number of people visiting the page (cIRcle) and/or downloading the book would measure the project's success.

Future Directions

- **Interactive Digital Platform Development:** Expanding the textbook into an interactive digital learning platform that includes simulations, video tutorials, and interactive quizzes.
- **Incorporation of Machine Learning Algorithms:** Utilizing machine learning algorithms to analyze student learning patterns and performance to identify areas of difficulty and customize content delivery.
- **Expansion to Other Disciplines:** Extending the project scope to cover additional courses and disciplines. Future books could focus on calculus applications in engineering, physical sciences, and economics, providing a comprehensive resource pool for a variety of fields.