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Creating Engaging Learning Tools with Digital Assessments

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Abstract

- The project developed **open-source digital learning and assessment resources** on PrairieLearn, addressing challenges from university policies prohibiting fee-based tools.
- It provides instructors **flexibility, enhances students' experiences, and enables equitable, inclusive assessments**.
- The platform is fully compliant, **offering randomized questions, instant feedback, and reducing academic dishonesty**.

High costs for textbooks and integrated course software create barriers to education. Open-source digital learning environments can reduce financial burden and increase flexibility for diverse learners. This project specifically developed an open-source question bank for digital assessments in engineering mechanics (Dynamics) and Physics, containing algorithmically generated questions promoting active learning. PrairieLearn's personalized problems, automatic grading, and instant feedback foster understanding and reduce academic dishonesty. Instructors can re-use and expand the question bank without access-time limitations.

Goals of the project

- Facilitating **active learning** and engagement in various class formats
- Providing **instant feedback** in assessments for improved performance monitoring
- **Reducing costs** and **enhancing accessibility** through an open-source platform

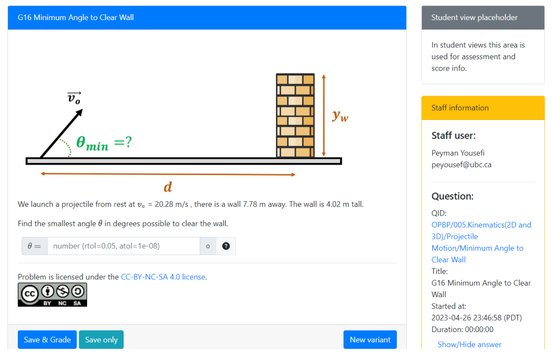
Project Outcomes and Deliverables

- A bank of algorithmically generated questions for the open-source platform, PrairieLearn
- Resources for engaging flipped classrooms and hybrid courses.
- Questions are categorized and tagged by topics and learning outcomes covering the syllabi of APSC181, PHYS111, PHYS112, PHYS121 & PHYS122. Questions can also be used in any other calculus- or algebra-based introductory physics course.
- A “sample course” with these problems for instructors wanting to replicate or adapt this course for their contexts.

Engaging lectures, promote active learning, monitoring students' performance and learning gains.

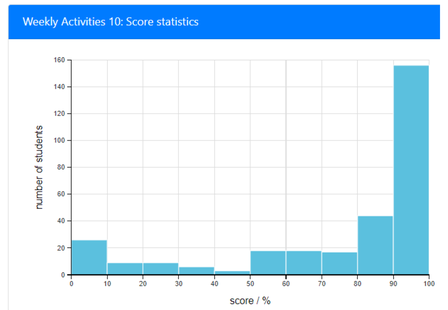
PrairieLearn

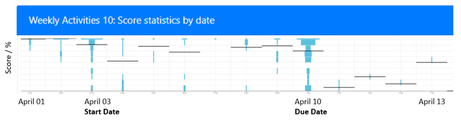
PrairieLearn is an open-source platform for creating interactive assessments. Instructors can generate different question types, like graphing and programming, with randomized parameters and feedback. Questions are written in Markdown and algorithmically randomized using Python. PrairieLearn features auto-grading, graphical drawing, and symbolic algebra, and provides statistics to modify lectures and assess learning gains.



Screenshot of a sample problem in APSC181

	Students	Scores	Mean Score	Mean Duration
Weekly Activities [7%]				
WA1 Weekly Activities - Week 01: Due January 23	328		91%	55m
WA2 Weekly Activities - Week 02: Due January 30	323		91%	1h 50m
WA3 Weekly Activities - Week 03: Due February 6	322		91%	50m
WA4 Weekly Activities - Week 04: Due Febuary 13	317		82%	1h 15m
WA5 Weekly Activities - Week 05: Due March 6	329		85%	1h 4m
WA6 Weekly Activities - Week 06: Due March 13	318		83%	1h 40m
WA7 Weekly Activities - Week 07: Due March 20	315		91%	1h 3m
WA8 Weekly Activities - Week 08: Due March 27	309		91%	50m
WA9 Weekly Activities - Week 09: Due April 3	315		90%	56m
WA10 Weekly Activities - Week 10: Due April 10	306		76%	2h 0m
WA11 Weekly Activities - Week 11: Due April 21 (Optional)	192		41%	31m
WA12 Weekly Activities - Week 12: Due April 21 (Optional)	123		47%	26m
Bonus Practice [OPTIONAL]				
BP1 Chapter 1 Practice	262	71%		15m
BP2 Chapter 2 Practice	223	19%		1h 40m
BP3 Chapter 3 Practice	187	25%		48m
BP4 Chapter 4 Practice	186	23%		1h 6m
BP5 Chapter 5 Practice	201	27%		41m
Exams				
E1 Midterm Exam DRC			53%	1h 56m
E1 Midterm Exam Special			40%	2h 3m
E1 Midterm Exam			52%	1h 21m





The Platform provides the instructor with information about students’ performance and practice time

Sustainability Plan

- The developed resources target fundamental engineering and science courses, **ensuring their relevance in the long term.**
- Instructors and TAs can easily **update the content to accommodate syllabus changes**, keeping it current.
- **Detailed instructions are provided** to instructors & TAs for adding new questions to the resource.
- Solutions & hints are accessible to students after a set due date.

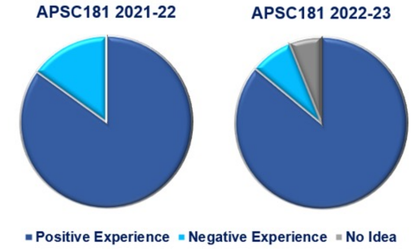
The project offers:

- A tailored Canadian version **accessible with UBC CWL** (ca.prairielearn.com)
- Advanced features for creating dynamic, auto-graded questions and handling various tasks, making it ideal for engineering education.
- A large, dedicated community with partners in the United States, Canada, and China, ensuring its availability for the foreseeable future.
- Compatibility with plain text (Markdown) for easy conversion to other platforms if necessary.

Project Evaluation

Post-course survey measures student satisfaction. Documentation and sample course created for Open Problem Bank. Courses currently using the OPBs: **Dynamics (N=337), Physics 111 (N=287), Physics 112 (N=389), Physics 121 (N=139), Physics 122 (N=236).**

Participants: 120 (2021-22) & 114 (2022-23)



Question: *I feel that "Lecture Activity" assignments in this course helped me learn Dynamics...*

	2021-22	2022-23
Strongly Agree	**49.6%**	**48.3%**
Somewhat Agree	**41.3%**	**38.7%**
Neither Agree nor Disagree	**5.8%**	**10.3%**
Somewhat Disagree	**1.7%**	**2.5%**
Strongly Disagree	**1.7%**	**0%**

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Acknowledgement

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