

# Mathematics

## CWSEI Department Summary

This document summarizes the Mathematics Department’s activities as part of the Carl Wieman Science Education Initiative over the years 2008-2018. In this initial version, it replaces a series of web pages that were updated over the lifetime of the CWSEI. It may be updated in future with more detail on impact.

For questions, please contact:

Costanza Piccolo ([costanza@math.ubc.ca](mailto:costanza@math.ubc.ca)) or Warren Code ([warcodes@science.ubc.ca](mailto:warcodes@science.ubc.ca))

### Contents

- Overview..... 2
- People..... 2
- Activities ..... 3
  - Courses ..... 3
  - Education Research ..... 13
    - Math Attitude and Perceptions Survey (MAPS) ..... 13
    - Two-Stage quizzes ..... 13
    - Prompted self-explanations in first year calculus ..... 14
    - Teaching methods comparison in a large calculus class ..... 14
    - Basic Proof Skills Test and Proof Concept Test..... 14
    - WeBWork analytics ..... 14
- Impact..... 14
  - Transformed course counts ..... 14
  - Impact in terms of seats/registrations ..... 15
- Publications and Presentations..... 15
- Related Department Links ..... 16

# Overview

Starting in 2008, the UBC Mathematics Department is participating in the Carl Wieman Science Education Initiative (CWSEI) to improve undergraduate science education. In 2010 the Math-CWSEI program underwent a major expansion thanks to the generous donation by Prof. David Cheriton, UBC alumnus, now Professor of Computer Science at Stanford University.



[Poster \(CWSEI EOY 2012\): The Carl Wieman Science Education Initiative in Mathematics](#)



[Poster \(CWSEI EOY 2012\): Online homework in Mathematics Using WebWork](#)

An important first step for the Math CWSEI in all the courses involved in the project is to write down a set of learning goals. Learning goals (also called "learning outcomes" or "learning objectives") make explicit what the students are expected to be able to do at each stage of the course. They are useful to instructors in preparing tests, and assessing the success of a course. In lower level courses, where the students and instructors may start out thinking about the material in radically different ways, learning goals can help to focus the instruction at the appropriate level. They provide a communication channel for successive instructors in a given course, so that effort in improving pedagogy is transmitted. Made available to students, they help students assess their understanding and to prepare for exams.

An important last step for all the projects in the Math CWSEI is the archiving of materials in the [SEI Course Materials Archive](#). This archive contains material developed by departments participating in the CWSEI at UBC, and is intended to be an open resource for educators.

**For details on specific courses, see the Courses section.**

The [Math department SEI website](#) has up-to-date details and status of the various projects.

## People

**CWSEI Department Director:** Costanza Piccolo (2010-19), Stephanie van Willigenburg (2009-10), Richard Froese (2008-09)

**STLFs:** Alain Prat (Dec '15-Dec '18), Sandra Merchant (March '10-Feb '16), Kseniya Garaschuk (Sep '14-July '16), Wes Maciejewski (Sep '13-Dec '14), Joseph Lo (Jun '10-Dec '13), Warren Code (Jan '10-Dec '12), Katya Yurasovskaya (July '11-Aug '12), Paul Ottaway (Sept-Dec '09)

**Faculty:** E. Cytrynbaum, L. Keshet, Y-H Kim, M. MacLean, B. Marcus, G. Martin, C. Piccolo, A. Rechnitzer, R. Anstee, J. Bryan, A. Chau, M. Doebeli, R. Froese, J. Gordon, R. Gupta, S. Gustafson, B. Homsy, F-S. Leung, P. Loewen, A. Peirce, S. Ramdorai, Z. Reichstein, D. Schoetzau, G. Slade, S. van Willigenburg, M. Ward, B. Wetton, O. Yilmaz

**TAs and Postdocs:** P. Bell, M. Berube, J. Gou, A. Herrera, R. Hiller, V. Kapoor, I. Karimfazli, D. Karslidis, C. Lee, R. Liang A. Lindsay, T. Milnor, A. Nguyen, M. Raggi, L. Robson, S. Rose, R. Schwarz, A. Raghoonundun (with Skylight support), G. de Oliveira, W. Thompson, M. Willoughby A. Zaman

# Activities

In 2008-2009 our projects were concentrated in two areas:

(1) Computing and computer labs in Math 152, Math 256 (Mech 221), Math 257/316, Math 253 (Mech 222), and Math 307. These courses had all recently introduced computing as an intrinsic part of the syllabus. The Math CWSEI helped in the creation of tutorials and lab materials, assisted in integrating the computational component into the course material and developing testing methods, and assessed the effectiveness of the computational component. (2) Math 180/184 workshops. The introduction of problem-solving workshops in all sections of Math 180 and Math 184 in 2008 brought new challenges in the course management and coordination. The Math CWSEI helped to assess the effectiveness of the program in such large, multi-section courses, and contributed to the development of effective program management strategies.

In 2009-2010 our focus was mainly in-depth assessment of student activities and engagement, improvements to course materials based on data collected in the previous year, and better coordination of workshops and labs with course lectures. The Math CWSEI also provided support for the development of a new computing module in Math 318. Development for work on Math 220, a course dedicated to proof skills, began in early 2010. Study and transformation of this course will be a multi-year project with tracking of skills to later courses.

In 2010, the Math CWSEI expanded to incorporate new, longer term projects, mostly involving tracking and improving key skills throughout the curriculum. Projects are now underway to assess and track proof skills, basic algebra skills, and student attitudes and perceptions of mathematics. The Math CWSEI also continues to support the implementation of effective teaching methods and use of classroom technologies (clickers, online homework, etc.).

**The Basic Skills Test:** The Math CWSEI contributed to the revision of the Basic Skills Test, providing support for a statistical analysis of the test and developing a computer-based version of the test.



[Poster \(April 2011\): Basic Skills in Mathematics](#)

**Pre-Calculus Diagnostic:** (2014-2016) Kseniya Garaschuk, working with Prof. Mark Maclean, developed a pre-calculus diagnostic assignment for all first-year students.

**Guide for Instructor-in-charge:** (2015-) Kseniya Garaschuk, working with Instructor Costanza Piccolo, developed a guide for the Instructor-in-charge of large courses with tips and recommendations on how to manage a multi-section course.

## Courses

Status as of May 2016:

Course	Learning goals	New Assessments	Improved Methods
<p><b>MATH 101: Integral Calculus with Applications to Physical Science and Engineering</b> (Jan '12 - Apr '12)</p> <p><u>Faculty:</u> Rajiv Gupta <u>STLF:</u> Costanza Piccolo, Alain Prat</p> <p> <a href="#">Poster (CWSEI EOY 2013): WeBWorK: An effective online tool for assessment in mathematics</a></p>	No revision	<p>In-class short diagnostic Test on basic differential calculus skills</p> <p>Weekly common homework assignments</p> <p>Study skills survey</p>	Online homework using WeBWorK
<p><b>MATH 102: Differential Calculus with applications to Life Sciences</b> (2012-2015)</p> <p><u>Faculty:</u> Eric Cytrynbaum, Leah Keshet <u>STLF:</u> Kseniya Garaschuk, Wes Maciejewski, Sandra Merchant, Costanza Piccolo</p> <p> <a href="#">Poster (UBC Science Ed Open House 2016): Feasibility and effectiveness of group exams in mathematics courses</a></p>	Course-level and topic-level goals are complete	<p>Online basics math skills diagnostic</p> <p>Pre-lecture assignments</p> <p>Weekly common homework assignments</p> <p>Midterm &amp; End-of-term survey</p> <p>Classroom observations</p> <p>Survey on spreadsheet labs and associated WeBWorK problems</p>	<p>Online homework using WeBWorK</p> <p>Spreadsheet labs converted to Excel and WeBWorK</p> <p>Pre-lecture videos, pencasts and assignments, and interactive teaching methods in class using clickers</p>

<p><b>MATH 104/184: Differential Calculus with applications to Social Sciences and Commerce</b> (Jan '10 - Dec '14)</p> <p><u>Faculty:</u> Mark MacLean ('10-'11), Sujatha Ramdorai ('12), C. Lee (postdoc) <u>STLF:</u> Warren Code ('10-'12), Wes Maciejewski ('14) <u>TAs:</u> M. Raggi ('10), L. Robson ('11)</p> <p> <a href="#">Poster (CWSEI EOY 2013): MAPS: Math Attitude and Perceptions Survey</a> (developed by STLFS Warren Code, Joseph Lo, &amp; Sandra Merchant)</p> <p> <a href="#">Poster (CWSEI EOY 2013): Teaching Methods Comparison in a Large Introductory Calculus Class</a></p> <p> <a href="#">Paper: Teaching Methods Comparison in a Large Introductory Calculus Class</a>, Warren Code, Costanza Piccolo, David Kohler, &amp; Mark MacLean, ZDM, Vol. 46(4), pp. 589–601 (2014)</p>	<p>Course-level goals: second draft complete</p> <p>Topic-level goals: second draft complete and incorporated into weekly “learning guides” for instructors with specific textbook examples for each goal.</p>	<p><i>All sections:</i></p> <p>Attitude survey with short diagnostic test.</p> <p>Instructor interviews.</p> <p><i>MacLean’s sections:</i></p> <p>Midterm and end-of-term surveys</p> <p>Clicker session data</p> <p>In-class activity audio + written</p> <p><i>Methods Comparison ('11):</i></p> <p>Math 104 Calculus Diagnostic to measure student calculus background from high school.</p> <p>Topic quizzes for Related Rates and Linear Approximation.</p> <p><i>Ramdorai’s section ('12):</i></p> <p>Student work from in-class worksheets</p> <p>Clicker and diagnostic data (as previous years)</p>	<p><i>All sections:</i></p> <p>Developed weekly “learning guides” for instructors to enhance coordination; guides incorporate learning goals, practice problems and pedagogical approaches and issues.</p> <p>Developed common online and paper homework assignments.</p> <p>Facilitated weekly instructor meetings</p> <p><i>MacLean’s sections:</i></p> <p>Developed in-class activities and clicker questions.</p> <p><i>Methods Comparison ('11):</i></p> <p>Structured class notes, lesson plans, clicker questions and pre-reading assignments for the Related Rates and Linear Approximation weeks, with evidence of better conceptual learning over more traditional instruction.</p> <p><i>Ramdorai’s section ('12):</i></p> <p>Worksheets for almost all current course topics, some clicker questions to support, used in final 20 minutes of each 80-minute class period.</p> <p><i>Lee’s sections ('14):</i></p> <p>Assignments and quizzes</p>
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			to promote learning multiple differentiation approaches and flexibility in applying them
<p><b>MATH 180/184: Differential Calculus (Workshop component)</b> (Sept '08 - Fall '11)</p> <p><u>Faculty:</u> Rajiv Gupta, Albert Chau, Richard Anstee <u>STLF:</u> Costanza Piccolo ('08-'10), Warren Code ('11) <u>TA:</u> V. Kapoor, R. Schwarz, A. Zaman</p> <p> <a href="#">Poster (CWSEI EOY 2009): The Basic Skills Test in Mathematics</a></p> <p> <a href="#">Poster (CWSEI EOY 2010): First Year Calculus Workshops</a></p> <p> <a href="#">click here</a> to view Math 180 course materials</p> <p> <a href="#">click here</a> to view Math 184 course materials</p>	<p>Course-level goals: complete</p> <p>Workshop goals: complete</p>	<p>Midterm and end-of-term surveys on workshop activities and student attitudes.</p> <p>Weekly quizzes</p> <p>Class observations</p>	<p>Workshops 1-12 complete: added workshop-level learning goals and list of required basic skills; created new problems with course-specific applications; created activities to promote metacognition, developed problem solving strategies.</p> <p>Program Structure and Management: Expanded the administrative structure and TA training; developed problem database (with Skylight support) to ease weekly production of workshop material.</p>
<p><b>MATH 110: Differential Calculus (2010-2015)</b></p> <p><u>Faculty:</u> Fok-Shuen Leung, Costanza Piccolo <u>STLF:</u> Joseph Lo ('10-</p>	<p>Course-level goals: complete</p> <p>Workshop goals: complete</p>	<p>Diagnostic Test on Basic Skills</p> <p>Attitude and study habit survey</p> <p>Midterm class and</p>	<p>New workshop format developed to address low student engagement in workshop activities.</p> <p>Online homework assignments used in all</p>

<p>'12), Warren Code ('12 - '13), K. Garaschuk ('14)</p> <p> <a href="#">Poster (CWSEI EOY 2012): Precalculus Skills</a></p> <p> <a href="#">Poster (CWSEI EOY 2012): What Might Affect Student Performance in a Math Course?</a></p> <p> <a href="#">Poster (UBC Science Ed Open House 2015): Using prompted self-explanations in first-year calculus</a></p>		<p>workshop surveys</p> <p>Class observations of workshops and lectures</p> <p>Focus groups and surveys on use of textbooks ('12 and '13)</p> <p>Survey of student perceptions of learning gains ('14)</p> <p>Student interviews after lectures to monitor difficulties and effectiveness of class activities ('14)</p>	<p>sections.</p> <p>Archiving of course material for future use.</p> <p>Weekly remedial work on basic skills.</p> <p>Use of existing free online text, with collection of supporting web materials ('12-'13)</p> <p>Clicker questions and self-explanation group worksheets ('14)</p>
<p><b>MATH 121: Honours Integral Calculus</b> (Jan '15 start)</p> <p><u>Faculty:</u> Young-Heon Kim <u>STLF:</u> Kseniya Garaschuk</p>	<p>No revision</p>		<p>Expanded and improved weekly homework on WeBWork</p>
<p><b>MATH 152: Linear Systems (Computer Labs component)</b> (Sept '08 – 2010)</p> <p><u>Faculty:</u> Brian Wetton <u>STLF:</u> Warren Code ('09-'10), Costanza Piccolo ('08-'09) <u>TA:</u> A. Lindsay</p> <p> <a href="#">Poster (CWSEI EOY 2011): Redesign of Computer Labs for Engineering Students in a Linear Algebra Course</a></p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>End-of-term lab surveys</p> <p>Pre/post-tests on Matlab syntax and basic programming structures.</p> <p>Pre/post-tests on translation of word problems into linear systems.</p> <p>Lab observations and TA interviews to determine student difficulties and completion rates.</p>	<p>Labs rewritten to tie in more closely with the course material, and revised after a full term of use.</p> <p>Paper-based homework, midterm exam and final exam questions developed to test/practice Matlab syntax and basic programming structures.</p> <p>Lecture notes revised to include Matlab material.</p>

 <a href="#">click here</a> to view course materials			
<b>MATH 200: Calculus III</b> (Sept '12 - Dec '13)  <u>Faculty:</u> Julia Gordon <u>STLF:</u> Joseph Lo	No revision	Diagnostic test on first-year calculus materials  Midterm and end-of-term surveys on online homework, in-class activities and supplementary materials	In-class activities were developed  3D graphics were produced for use in class and interactive supplementary materials on UBC Blog
<b>MATH 210: Introduction to Mathematical Computing</b> (Sept '11 – Dec '13)  <u>Faculty:</u> Dominik Schoetzau <u>STLF:</u> Joseph Lo	Topic-level goals: complete and revised	Diagnostic test on series and first year calculus  Computer-based exams  Student survey  Class and lab observations	Course curriculum has been substantially changed. All standard course materials (course outline, lecture notes, assignments and exams) have been redeveloped.  In-class computer-based activities developed.
<b>MATH 215/255: Elementary Differential Equations I</b> (Sept - Dec '13)  <u>Faculty:</u> Faculty: Stephen Gustafson <u>STLF:</u> Joseph Lo	No revision	Weekly common online homework assignments	Online homework using WeBWork
<b>MATH 220: Mathematical Proof</b> (March '10 - Aug '14)  <u>Faculty:</u> Andrew Rechnitzer <u>STLF:</u> Katya Yurasovskaya (July '11-Aug '12), Sandra Merchant ('10-'14)	Course level and topic level goals are complete	Basic proof skills diagnostic pre/post test  Midterm and end-of-term surveys  Student interviews after lectures to monitor difficulties and effectiveness of class activities.	Small group problem-solving sessions (“workshops”) were created and comprise approximately 25% of lecture time.  Course syllabus and textbook have been standardized from term-to-term.

<p> <a href="#">Poster (CWSEI EOY 2011): Assessing Basic Skills for Mathematical Proof</a></p> <p> <a href="#">Poster (CWSEI EOY 2012): Workshops and the First Course in Mathematical Proof</a></p> <p> <a href="#">Poster (CWSEI EOY 2013): Development and Analysis of a Basic Proof Skills Test</a></p> <p> <a href="#">click here</a> to view course materials</p>		<p>Student problem-solving interviews to assess learning and retention of proof skills</p> <p>Short in-class individual and group quizzes</p>	<p>Pre-lecture quizzes, daily group worksheets, and clicker questions</p>
<p><b>MATH 221: Matrix Algebra</b> (Sept '12 – Dec '13, Sep – Dec '15)</p> <p><u>Faculty:</u> Zinovy Reichstein, Daniel Coombs <u>STLF:</u> Joseph Lo, Kseniya Garaschuk</p> <p> <a href="#">Poster (UBC Science Ed Open House 2016): Feasibility and effectiveness of group exams in mathematics courses</a></p>	<p>No revision</p>	<p>Weekly common online homework assignments and practice tests</p> <p>Midterm and end-of-term surveys on online homework</p> <p>Surveys on group exams</p>	<p>Online homework using WeBWork</p> <p>Group exams</p>
<p><b>MATH 230/335: Mathematics for Elementary Teachers</b> (June '11 – April '12)</p> <p><u>Faculty:</u> Stephanie van Willigenburg, John</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p> <p>Comments by</p>	<p>Diagnostic pre/post test, which also includes survey-type questions on student career plans and attitudes/beliefs regarding mathematics.</p>	<p>A list of study tips for students specific to the course and the audience.</p> <p>A set of study skills and tips relevant to future teachers of elementary</p>

<p>MacDonald STLF: Katya Yurasovskaya</p> <p> <a href="#">Poster (CWSEI EOY 2012): Math Course for Future Elementary Teachers at UBC</a></p>	<p>instructor added as a teaching aid for future instructors.</p>		<p>educations students.</p> <p>A website with resources and useful links has been put together for future departmental use.</p>
<p><b>Math 253 (Mech 222): Multivariable Calculus (Computer Labs component)</b> (Sept '08 – April '12)</p> <p>Faculty: Philip Loewen STLF: Warren Code TA: M. Willoughby, W. Thompson</p> <p> <a href="#">Poster (CWSEI EOY 2011): How do novices spend time programming in MATLAB?</a></p> <p> <a href="#">click here</a> to view course materials</p>	<p>Goals incorporated into weekly learning guides and lab documents. Substantial detail added in the second year.</p>	<p>Weekly surveys of student completion rates and attitudes.</p> <p>Lab observations and TA interviews to determine most significant student difficulties.</p> <p>Automated student session logging to measure time spent on various tasks and frequency of common syntax errors (improved from trial run in Math 256).</p> <p>Pre-lab quiz late in the term to track basic skills and measure interpretation of MATLAB code.</p>	<p>Labs have been updated to tie in more closely with the course material, and have been further revised based on data from the first implementation with evidence of more collaboration, higher completion rates and more positive student attitudes due to the revisions.</p> <p>MATLAB resource web page developed for student reference, especially for those with weaker backgrounds.</p>
<p><b>Math 253: Multivariable calculus</b> (Fall 2012)</p> <p>Faculty: Jim Bryan STLF: Costanza Piccolo</p>	<p>No revision</p>	<p>Weekly common homework assignments</p>	<p>Online homework using WeBWork</p>
<p><b>Math 256: Differential Equations</b> (Jan '15 start)</p>	<p>No revision</p>	<p>Pre-lecture assignments</p> <p>Weekly surveys in WeBWork for student</p>	<p>Pre-lecture videos, readings and associated assignments, coupled with clickers and active</p>

<p><u>Faculty:</u> Eric Cytrynbaum <u>STLF:</u> Sandra Merchant</p>		<p>feedback on pre-lecture resources</p>	<p>learning activities in lectures.</p>
<p><b>Math 256 (Mech 221): Differential Equations (Computer Labs component)</b> (Sept '08 – 2010))</p> <p><u>Faculty:</u> Brian Wetton <u>STLF:</u> Warren Code ('10-'12), Paul Ottaway (Sept-Dec '09), Costanza Piccolo ('08-'09) <u>TA:</u> W. Thompson</p> <p> <a href="#">Poster (CWSEI EOY 2011): How do novices spend time programming in MATLAB?</a></p> <p> <a href="#">click here</a> to view course materials</p>	<p>Learning goals: complete</p>	<p>Lab observations and TA interviews to determine most significant student difficulties.</p> <p>End of term student attitude surveys.</p> <p>Trial run of automated student session logging to measure time spent on various tasks and frequency of common syntax errors.</p>	<p>New labs have been developed and revised based on feedback from the first two offerings.</p> <p>Matlab demonstrations have been used in lectures.</p> <p>Targeted questions have been designed for the final exams and used to assess learning in the lab sessions.</p> <p>MATLAB resource web page developed for student reference, especially for those with weaker backgrounds.</p>
<p><b>Math 257/316: Partial Differential Equations (Computer Labs component)</b> (Sept '08 – Fall '11, Spring '15)</p> <p><u>Faculty:</u> Anthony Peirce <u>STLF:</u> Costanza Piccolo, Kseniya Garaschuk <u>TA:</u> G. de Oliveira</p> <p> <a href="#">click here</a> to view course materials</p>	<p>Topic-level goals: complete</p>	<p>Student survey about attitudes towards the use of spreadsheets and the learning of numerical methods in the course</p> <p>Diagnostic test on infinite series</p>	<p>Course-specific, online Excel tutorials are completed; sets of homework assignments, in-class demos using spreadsheets, and a Powerpoint presentation on numerical methods have been developed.</p>

<p><b>MATH 264: Vector Calculus for Electrical Engineering</b> (Spring 2012)</p> <p><u>Faculty:</u> Ozgur Yilmaz <u>STLF:</u> Costanza Piccolo</p>	No revision	<p>Classroom observation</p> <p>Midterm student survey</p>	This is a new course, all materials were developed from scratch.
<p><b>Math 305: Applied Complex Analysis</b> (Sept '10 – April '12)</p> <p><u>Faculty:</u> Michael Ward <u>STLF:</u> Joseph Lo <u>TA:</u> P. Bell</p>	Topic-level goals: complete	<p>Diagnostic assignment on series</p> <p>End-of-term survey</p> <p>Analysis of grades and comparison between students in Math 300 and 305 based on their enrollment programs</p>	This is a newly-developed course. All standard course material (course outline, lecture notes, assignments, and exams) has been developed from scratch.
<p><b>Math 307: Applied Linear Algebra (Computer Labs component)</b> (Sept '08 – Fall '11)</p> <p><u>Faculty:</u> Richard Froese <u>STLF:</u> Costanza Piccolo <u>TA:</u> A. Raghoonundun</p> <p> <a href="#">click here</a> to view course materials</p>	<p>Course-level goal: revision is completed</p> <p>Topic-level goals: revision is completed</p>	<p>Student surveys</p> <p>Pre-reading/diagnostic quizzes</p> <p>Special homework assignments with extensive use of Matlab</p>	<p>Lecture Notes have been updated extensively.</p> <p>Matlab/Octave resource page has been developed.</p> <p>Basic Matlab/Octave tutorials have been developed, including a set of practice problems on basic syntax and programming.</p>
<p><b>MATH 318: Probability with Physical Applications (Computer-based component)</b> (Jan '10 – Fall '11)</p> <p><u>Faculty:</u> Gordon Slade <u>Postdoc:</u> Richard Liang</p>	<p>Course-level goals: complete</p> <p>Topic-level goals: complete</p>	<p>Tracked scores on computer-based homework exercises and exam questions.</p> <p>Mid-semester and end-of-semester attitude surveys</p>	<p>Octave/Matlab-based questions drafted for each of the homework assignments, as well as to each of the two midterms and the final exam.</p> <p>Octave resource webpage constructed (based on the Math 307 resource page) to assist the students in</p>

			getting started with using Octave.
<b>MATH 342: Algebra, Coding Theory and Cryptography</b> (Jan '14 start)  <u>Faculty:</u> Brian Marcus <u>STLF:</u> Sandra Merchant	No revision	Proof concept test (second draft) on specific proof skills	Proof skills review exercise (run as a 2-stage individual/group test) at start of course
<b>MATH 358: Engineering Analysis</b> (Jan '12 – Dec '12)  <u>Faculty:</u> Bud Homsy <u>STLF:</u> Warren Code <u>TA:</u> I. Karimfazli	New course; topics only finalized during term	Computer lab observations  Pair of student surveys: after second and after final computer lab	Matlab activities for biweekly labs (5 total for the term) which build on paper-based assignments, all developed for this new course. Labs revised based on student feedback.
<b>MATH 360: Mathematical Modeling in Science</b> (Jan '10 – April '12)  <u>Faculty:</u> Michael Doebeli <u>STLF:</u> Costanza Piccolo ('11-'12), Sandra Merchant ('10-'11)	Course-level goals: complete	Computer-based exams  Midterm student survey  Class observations  Student focus group	Matlab-based in-class activities were developed for weekly labs

## Education Research

### Math Attitude and Perceptions Survey (MAPS)

A survey developed by the UBC Mathematics STLFs to characterize students' attitudes and perceptions about learning mathematics.

Code, W., Merchant, S., Maciejewski, W., Thomas, M., & Lo, J. (2016). The Mathematics Attitudes and Perceptions Survey: an instrument to assess expert-like views and dispositions among undergraduate mathematics students. *International Journal of Mathematical Education in Science and Technology (IJMEST)*, <http://dx.doi.org/10.1080/0020739X.2015.1133854>, (preprint [available here](#)).

### Two-Stage quizzes

Kseniya Garaschuk studied the implementation and outcomes of two-stage (individual + group) quizzes in two different math courses.

 [Poster \(UBC Science Ed Open House 2016\): Feasibility and effectiveness of group exams in mathematics courses](#)

Prompted self-explanations in first year calculus

Costanza Piccolo and Kseniya Garaschuk implemented prompted self-explanations in a first year calculus course and measured outcomes and student perceptions.

 [Poster \(UBC Science Ed Open House 2015\): Using prompted self-explanations in first-year calculus](#)

Teaching methods comparison in a large calculus class

Warren Code, Costanza Piccolo, David Kohler, and Mark MacLean conducted a study to compare the learning in an active-learning class vs. a more traditionally taught class.

Warren Code, Costanza Piccolo, David Kohler, & Mark MacLean, Teaching methods comparison in a large calculus class, ZDM, Vol. 46(4), pp. 589–601 (2014), <http://dx.doi.org/10.1007/s11858-014-0582-2>, (preprint [available here](#))

Basic Proof Skills Test and Proof Concept Test

Sandi Merchant developed a Basic Proof Skills Test for use at the second year level and a Proof Concept Test to assess proof skills appropriate for 3rd and 4th year math majors.

 [Poster \(CWSEI EOY 2013\): Development and Analysis of a Basic Proof Skills Test](#)

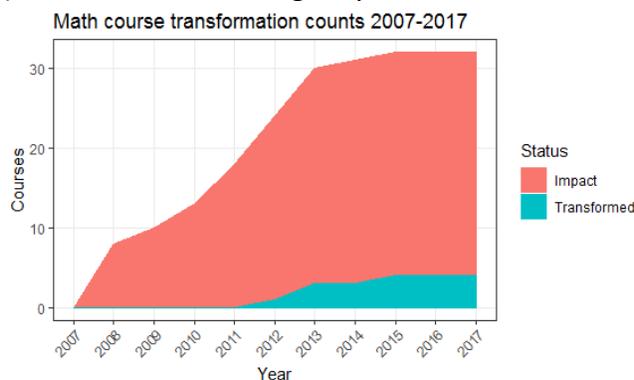
WeBWork analytics

Alain Prat and Warren Code published recently on the use of log data from WeBWork, in IJMEST: <https://www.tandfonline.com/eprint/ADZCQK6FD8DYUF7Z9FYS/full?target=10.1080/0020739X.2020.1782492>

# Impact

## Transformed course counts

As of Spring 2018, we had 32 courses taught by Math with CWSEI and/or Skylight influence (with 12 courses having only had the addition of WeBWork being included in this count):



## Impact in terms of seats/registrations

We can look at this in terms of the **79 undergraduate courses offered by Math in 2017** with LEC, LAB or DST as primary activity and excluding distance ed. sections. In terms of **seats/registrations** (with LEC, LAB or DST as primary activity; excludes distance ed. sections):

EFFECT	Seats.2012	Seats.2013	Seats.2014	Seats.2015	Seats.2016	Seats.2017
Transformed	859	1053	1169	1372	1396	1456
LabOnlyTransformed	1798	1756	1814	1626	1541	1502
Impact	3141	3346	3311	3453	3705	4003
OnlyWebwork	7634	8007	8649	9202	9655	9642
Other/None	2527	2006	2039	2188	2417	2602
EFFECT	Prop.Seats.2012	Prop.Seats.2013	Prop.Seats.2014	Prop.Seats.2015	Prop.Seats.2016	Prop.Seats.2017
Transformed	5.4%	6.5%	6.9%	7.7%	7.5%	7.6%
LabOnlyTransformed	11.3%	10.9%	10.7%	9.1%	8.2%	7.8%
Impact	19.7%	20.7%	19.5%	19.4%	19.8%	20.8%
OnlyWebwork	47.8%	49.5%	50.9%	51.6%	51.6%	50.2%
Other/None	15.8%	12.4%	12.0%	12.3%	12.9%	13.5%

(“OnlyWebwork” means the only substantial change was the addition of WeBWorK to the course to be used as its homework system.)

## Publications and Presentations

Paper	<p><b>The Mathematics Attitudes and Perceptions Survey: an instrument to assess expert-like views and dispositions among undergraduate mathematics students</b></p> <p>Warren Code, Sandra Merchant, Wes Maciejewski, Matthew Thomas, &amp; Joseph Lo (Mathematics, UBC)</p> <p>International Journal of Mathematical Education in Science and Technology (IJMEST), Published online 27 Jan 2016</p>	<p><a href="#">restricted access link</a></p> <p><a href="#">preprint</a></p>
Paper	<p><b>Teaching methods comparison in a large calculus class</b></p> <p>Warren Code, Costanza Piccolo, David Kohler, &amp; Mark MacLean (Mathematics, UBC)</p>	<p><a href="#">To view full text</a></p>

	ZDM, Vol. 46(4), pp. 589–601 (2014)	
Paper	<p><b>Development and Analysis of a Basic Proof Skills Test</b>                  Sandra Merchant &amp; Andrew Reznitzer (Mathematics, UBC)</p> <p>Proceedings of the 16th Annual Conference on Research in Undergraduate Mathematics Education, Vol. 2, pp. 585-589 (2013)</p>	

## Related Department Links

Department SEI Site: <http://www.math.ubc.ca/~cwsei/>

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