The Carl Wieman Science Education Initiative in Mathematics

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History

- The CWSEI-Math program started in 2008 on a limited budget.
- A major expansion took place in early 2010 thanks to a generous donation by Prof. David Cheriton, UBC alumnus, now Professor of Computer Science at Stanford University.
- Following the 2010 expansion, the program has been running steadily at full capacity and is expected to continue up to 2014/15.

People Involved

- 4 full-time Science Teaching and Learning Fellows (STLFs): postdoctoral fellows with a background in Mathematics (not Education)
- A permanent faculty member assigned to each main project, with partial teaching releases for the larger projects.
- Depending on the project, a graduate TA or other postdoctoral fellows.

Four Main Areas of Work

www.math.ubc.ca/~cwsei

1. Improving 1st year Calculus courses.
2. Incorporating online homework and problem-solving workshops effectively.
3. Integrating scientific programming skills in applied math courses.
4. Tracking and improving key skills throughout the curriculum: proof skills, skills in infinitive series.

1. First-year Calculus courses

MATH 104/184

- Differential Calculus for business and social sciences students
- ~1300 students, ~10-15 instructors/sections,
- Common final exam
- many novice instructors, high instructor turn over each year

Goals

- Cohesion of learning goals/assessment across sections
- Develop business-focused course materials to provide meaningful context to students
- Develop effective instructional methods involving more active learning ★

★ see poster: “Teaching Methods Comparison in a Large Introductory Calculus Class

1. First-year Calculus courses

MATH 110

- Differential Calculus
- ~300 students
- Weak basic skills
- Two semesters
- Terminal course for many students

Goals

1. Assess and improve basic skills ★
2. Identify student difficulties ★
3. Assess the effectiveness of the two-term model vs the traditional single term course

★ See posters: 1) “Pre-calculus skills” 2) “What might affect student performance in a math course?

2. Online homework

Online homework currently used in

MATH 100/180 – Differential Calculus
MATH 104/184 – Differential Calculus
MATH 110 – Differential Calculus (two terms)
MATH 101 – Integral Calculus
MATH 105 – Integral Calculus

Goals:

- Free up TA time to use it more effectively and efficiently while continuing to provide feedback on homework ★

★ See poster: “Online homework in Mathematics using WeBWorK”

2. Problem-solving workshops

Workshop programs currently in

MATH 180 – Differential Calculus
MATH 184 – Differential Calculus
MATH 110 – Differential Calculus
MATH 220 – Mathematical Proof ★

Goals:

- Provide more practice
- Implement effective teaching methods fostering collaborative work and active learning
- Provide expert feedback in a low-stake environment

★ See poster: “Workshops and the first course in mathematical proof”

3. Scientific programming skills

Computer labs or computer-based homework (virtual labs) developed/revised in MATLAB:

MATH 152 – Linear Systems
MATH 210 – Introduction to Mathematical computing
MATH 253 – Multivariable Calculus (Mech 2 program)
MATH 256 – Ordinary Differential Equations
MATH 257/316 – Partial Differential Equations (Excel spreadsheets)
MATH 307 – Applied Linear Algebra
MATH 358 – Engineering Analysis
MATH 360 – Mathematical Modeling in science

Goals:

Integrate learning activities that support the development of scientific programming skills

4. Tracking and Improving Key Skills in Mathematical Proof

MATH 220

- Introductory course in Mathematical proof
- Gateway course to upper-level courses
- High failures (~25%)

Goal:

- Identify key skills in constructing proofs
- Investigate student difficulties in proofs
- Improve learning in the introductory course
- Tracking students in upper-level courses

Other Projects

- Math for future elementary teachers ★
- Develop new applied math courses
- MAPS ★
- Online Basic Skills Test
- Assessing skills in Infinite Series: measure retention of key skills in series acquired in 1st year and needed again in later courses.

See posters: “Math course for future elementary teachers at UBC,”

★ “Mathematics Attitudes and Perceptions Survey (MAPS)

Future directions

1) • Revise selection criteria for first year students: Are high school grades reliable?
   • Introduce interactive teaching methods on a broader scale (one section of large course)
2) • Extend the use of online homework to all large 1st and 2nd courses
   • Assess the effectiveness of workshops on learning
3) Identify program-level learning goals for key computing/programming skills
4) Identify and assess key skills in mathematical modeling