

STLF Report to CWSEI and Mathematics Department

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Specific activities performed by STLF

1) Professional development

- Attended the biweekly CWSEI Reading group meetings.
- Attended the biweekly STLF meetings.
- Met with STLF Brett Gilley for MetaSTLF meetings (May 15, Jul 26).
- Attended Eric Mazur's talk, "The Tyranny of the Lecture," hosted here at UBC by CTLT (Jun 7)
- Participated in the workshop "Mathematical Proof and Proving" at New York University, May 29-31.

2) MATH SEI general meetings/activity

- Met with the MATH-SEI group to review the status of our projects and plan future work (Jul 3, Jul 23, Jul 30, Aug 6, Sep 11).
- Met with Sarah Gilbert and the MATH-SEI group (Jun 19, Aug 19) to review the status of our projects.
- Met with the CWSEI Working Group (Jul 16) to discuss progress and plans in the various CWSEI departments.

3) Course-specific meetings/activities

Tracking Proof Skills Project (MATH 220 – Mathematical Proof and subsequent courses)

1. I instructed the summer session of Math 220 (final exam Aug 15). As I discussed in my previous report, I taught the course in a highly interactive manner, that included all of the following, as well as the usual weekly homework assignments, 3 midterms, and a final exam:
 - Pre-lecture readings and associated online (WeBWork) quizzes
 - Daily worksheets for group problem solving
 - Daily clicker questions
 - Some proof validation exercises.

Overall, I greatly enjoyed teaching the course, and think that the interactive format was a much more enjoyable way of teaching this material for both myself and for the students. The level of feedback in both direction (instructor-student and student-instructor) was much greater than in any "traditional format" course I have taught.

2. While I personally feel that the interactive format I used for Math 220 was successful, it remains to assess the effectiveness more formally. There are 3 methods in which I plan to do this:
 - Compare the performance of students on common midterm and final exam questions. For each of the midterm and final exams I included some questions that were common with previous terms' exams. I plan to code student responses for errors and for quality of solution and compare the results between the two course formats.

- Results of basic proof skills test (BPST) and the Proof Attitude Survey (PAS). These instruments have both been administered at the start and end of term in many sessions of the course and so can be used to compare.
 - Analyze student comments on midterm surveys. Students completed a midterm survey and were asked to rate and comment on the various course components in both this and some previous sessions of the course. This could provide some sense of the student view of the different course formats used.
3. I have in fact already analyzed the results of the BPST in the summer session of Math 220, and the results are shown in the following table, along with the pooled results from previous terms. Note that the score is out of 12 because the precalculus portion of the test is not included here (some sections did not complete it). Also, only students taking the course for the first time and who completed both tests are included. Using a T-test, the pre-test scores between the two groups are not statistically significantly different, but the post-test scores are significantly different (at a p-value of <0.005).

Terms	N (matched students)	Pre-test Mean (out of 12)	Post-test Mean (out of 12)	Normalized Average Learning Gains
Summer 2013	17	7.53	10.12	0.58
Previous Terms Pooled (2011S, 2011 WT1/2, 2012S, 2012 WT2)	253	7.40	9.05	0.36

This gives some evidence that students benefitted from the interactive nature of the instruction. However, as noted above, further analysis needs to be done. In addition, it would be helpful to look at the BPST results on a question-by-question basis to see if the learning gains are improved on only a single element of the test or if multiple skills improved.

4. In Math 220 this term, both sections have chosen to use the workshops developed for the course. There will be 6 workshops in each section, each taking up 1 lecture of regular class time. I will be preparing the workshop materials (problem set, solutions, and quiz question) and scoring the quizzes that students do at the end of each workshop, as well as facilitating the workshops themselves. The first set of workshops took place Sep 11 and Sep 13. They went smoothly and students were very engaged.
5. The Basic Proof Skills Test (BPST) was administered on the first day of class in both sections of Math 220. I have scored the tests and analyzed the results, as well as sent a brief report to the instructors. Results are very similar in the two sections, as well as in keeping with historical pre-test results. In particular, I noted the following key difficulties:
- Weak algebra skills, especially when dealing with inequalities and absolute values.
 - Difficulty interpreting statements including both universal (“for every”) and existential (“there exists”) quantifiers.
 - Very little ability to assess the validity of a given purported “proof.”
 - Students do not know that the contrapositive of a statement is equivalent to the original statement.
 - Many students do not know what a prime number is.

Math Attitudes and Perceptions Survey (MAPS) – joint work with Warren Code and Joseph Lo

1. We have recently collected expert responses on the current version (version 4.0) of the survey. We received responses from 34 faculty members, 2 postdocs and 20 graduate students. Based on the responses from faculty, we have chosen to remove 3 statements from the survey, because they did not have a consistent expert response (less than 80% agreement among faculty). In addition, 1 statement has been removed because a large fraction of respondents (>25%) selected “neutral.” Finally, 2 statements that identify a growth vs. fixed mindset towards learning mathematics will be removed from the “expertise index” of the survey because they did not have a consistent expert response. These 2 statements will remain in the survey as stand-alone statements, because we think they provide valuable information.

Current Project Status (material was prepared by either STLTF or other members of the MATH SEI group)

MATH 220:

Learning Goals: Learning goals have previously been created for this course.

Assessments: The following assessments are planned to be used this term: basic proof diagnostic (pre and post), end-of-term survey (including questions on workshops).

New Methods/Materials: A proof concept test is under development to assess higher-level proof skills.

Plan for immediate future work

MATH 220:

1. Continue working on my papers about the BPST and its use in Math 220.
2. Perform student validation on the portions of the basic proof skills diagnostic that have not been validated.
3. Prepare workshop problem and solutions sets for each of the remaining 5 workshops in each section.
4. Complete the progress report about CWSEI work in Math 220, in order to present and discuss the contents in a focus group later in the term. The goal of this focus group would be to decide which new course components should be adapted as standard practice, and what new CWSEI work (if any) should be planned for this course.

Higher-Level Proof Courses

1. Finish revising the proof concept test and send the final draft to Brian Marcus for review.
2. Create an outline for student think-alouds on the revised proof concept test and begin student interviews.

MAPS

1. Based on the results of factor analysis performed on the survey with the changes noted above (removal of 4 statements and regrouping of some statements) finalize the list of statements and corresponding categories.
2. Begin writing a paper about the development and use of the MAPS instrument.