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Math 3100: Communication and Proof - Assessment

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Math 3100 - Mathematical Thinking: Communication and Proof

Assessment Plan

Abstract: As a group, we hope through this FLC project to develop a course that promotes departmental SLOs, as well as University learning outcomes for a writing-intensive course. We focused on our new foundational course (MATH 3100 Mathematical Thinking: Communication and Proof). This course, designated as a writing-intensive course, introduces students to disciplinary ways of thinking and communicating in mathematics with emphasis on the construction of valid mathematical arguments, critiques of arguments, and structure of professional mathematical writing including typesetting. We would like to develop a library of useful materials that faculty members can adapt in their classrooms in order to increase Inquiry-Based Learning (IBL) practices. Effective materials could be then contributed to the library. We describe samples that illustrate specific ways in which this course promotes departmental SLOs and addresses the University's requirements for a writing-intensive course. We also identify areas in which the course will be used for department assessment of the program learning outcomes for our undergraduate mathematics program.

The course being developed in this project will focus on the following departmental Student Learning Outcomes:

- SLO 2.1: Students will correctly apply mathematical theorems, properties and definitions
- SLO 3.3: Students will critique mathematical reasoning both correct and flawed
- SLO 4.1: Students will demonstrate mathematical communication skills using appropriate mathematical vocabulary and references
- SLO 5.1: Students will understand valid mathematical proofs
- SLO 5.2: Students will produce valid mathematical proofs

These learning outcomes support the following disciplinary learning goals:

- Explore the differences between valid and invalid mathematical arguments
- Construct valid mathematical arguments using fundamental mathematical principles and proof structures
- Build disciplinary pattern finding skills and foster the practice of constructing conjectures based on evidence
- Understanding the purpose of precise mathematical language

This course is structured to focus on connections between student learning and disciplinary writing. Mathematics consists of identifying and describing patterns, i.e., making conjectures, and then creating arguments to support or refute those conjectures. The way in which such arguments are written allows for creativity, but must still follow a structure that is well understood by mathematicians. This process takes time, practice, and experience for students to develop. Learning outcomes specifically tied to writing include the following:

- Use professional standards to review and critique the work of another
- Respond appropriately to feedback on one's own work
- Know and understand the structure of good mathematical writing
- Develop the habit of reflecting and revising
- Communicate mathematics using appropriate mathematical vocabulary and disciplinary writing norms

This course may be a student's first encounter with a course in which the role of written mathematical communication is emphasized. Below are ways in which the course meets the University intensive writing designation.

- "Writing is comprehensively integrated into the course and tied to course objectives and learning outcomes."
    - Assignments in this course focus on developing a student's ability to communicate mathematical ideas and arguments effectively, efficiently, and professionally.

- "Writing comprises a significant part of the course work and reflects genres and writing activities appropriate to the course and discipline."
    - Students will engage in mathematical writing in each class session, as well as prepare weekly writing assignments.
    - Some assignments will include the use of LaTeX for professional scientific typesetting.
    - Students will examine professional (published) writing and identify common norms for mathematical writing and argument structure.

- "Writing is explained and supported in the course: students are engaged in explicit discussions of the relevance of writing to the course and/or discipline, provided guidance in meeting genre and style expectations, and offered opportunities to assert their agency within those terms."
    - Students will be guided in the construction of their own arguments. Instructors will provide feedback for students to incorporate on revisions.
    - Class activities will include collaborative discussion on writing and peer critiques.

- "Writing assignments are scaffolded. Writing and thinking activities are designed to support one another and to feed one another throughout the course."
    - Students will begin with reading formal mathematics. Early assignments will be short and focus on appropriate language and structure. Assignments will transition gradually into longer arguments.
    - Students will give and receive feedback to each other, reflect on that feedback, and share conclusions.

- "Writing is supported by feedback and opportunities for revision. Instructors provide meaningful feedback on writing assignments and incorporate systematic opportunities for writers to work with that feedback."
    - Assignments will be scaffolded in two areas: mathematical content and the writing process.
    - Students will have opportunities to make revisions based on both instructor and peer feedback.

Opportunities to measure student proficiency with SLOs include the following:

1. Students will engage in problems and activities that provide them with experience and/or practice in the following.
    a. Making sense of definitions by formulating examples and non-examples
    b. Constructing and checking the validity of conjectures
    c. Identifying true and false statements
    d. Applying theorems
    e. Working collaboratively on common problems
    f. Presenting arguments to the class

2. Formative and summative assessment will be conducted in multiple ways including the following.
    a. Warm-up problems
    b. Exit tickets
    c. Discussion facilitation and debrief
    d. Homework
    e. Responses to writing prompts
    f. In-class presentations
    g. Concept-based quiz and test items