

Mathematics Masters of Science

Assessment Report 2021-22

I. SUMMARY OF MS PLO ASSESSMENT

A. Program Learning Outcomes (PLO)

| Students graduating with a MS degree in Mathematics will be able to: | |
|--|---|
| PLO 1 | Evaluate and create proofs in graduate level mathematics using the fundamental definitions and theorems. (ILO Thinking and Reasoning: Quantitative Reasoning.) |
| PLO 2 | Create solutions to problems using techniques in graduate level mathematics. |
| PLO 3 | Communicate Graduate Level Mathematics Effectively. (ILO Communication) |

B. Program Learning Outcome(S) Assessed

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|-------|--|
| PLO 1 | Evaluate and create proofs in graduate level mathematics using the fundamental definitions and theorems. |
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C. Summary of Assessment Process

Instrument(s): The department used two comprehensive exam questions and a rubric. The rubric was used to score the exam questions in the areas of readability, validity and fluency.

Sampling Procedure: Two comprehensive exam questions were identified as typical problems for the exam that demonstrates the PLO to be assessed. The problems were chosen by the assessment teams.

Sample Characteristics: The course selected is a course required for all math master's students. The exam question was selected carefully to ensure it included essential program content. This selection was done during one of the assessment team meetings.

Data Collection: Comprehensive exams were collected by the department assessment coordinator. The problem was scored by the faculty for readability, validity and fluency using the rubric found in Appendix A.

Data Analysis:

Course Assessed:

MATH 692 Graduate Capstone

Math 692, PLO 1/Masters

Problem : Use the complementary slackness theorem to check if something is an optimal solution to a system of linear equations.

| | Missing | Emerging | Developing | Mastering |
|--------------------|----------------|-----------------|-------------------|------------------|
| Readability | 0% | 0% | 33% | 67% |
| Validity | 0% | 33% | 67% | 0% |
| Fluency | 0% | 0% | 100% | 0% |

These scores indicate that 67% of the students have mastered the ability to write a readable proof, 67% are developing writing a valid proof and 100% are developing writing a fluent proof. The department should consider strategies to increase the percentage of students mastering writing valid and fluent proofs.

Problem : Prove a set is open and/or closed in a topology.

| | Missing | Emerging | Developing | Mastering |
|--------------------|-----------|------------|------------|------------|
| Readability | 0% | 0% | 50% | 50% |
| Validity | 0% | 25% | 25% | 50% |
| Fluency | 0% | 0% | 75% | 25% |

These scores indicate that 50% of the students have mastered the ability to write a readable and valid proof and only 25% of the students have mastered writing a fluent proof. Most of the students are still developing writing a fluent proof and 25% of the students are still only emerging to write a valid proof. The department should consider strategies to increase the percentage of students mastering this important component of graduate level mathematics.

D. Summary of Assessment Results

Main Findings: This year a large proportion of the students were only emerging on writing a valid proof and most of the students have not mastered writing a fluent proof.

Recommendations for Program Improvement: The department needs to work on ensuring that strong proof writing skills are developed within the coursework of the program. High expectations need to be set and communicated to the graduate students.

Next Step(s) for Closing the Loop: The department is updating expanded syllabi for semester courses which will include more details regarding course topics, depth of study, grading guidelines, and assessment expectations at the introductory, developing or mastery level for readability, validity and fluency in student work. Professors will be encouraged to share the assessment rubrics with their students. This is time consuming and ongoing work. The department is also revisiting the timing for the different comprehensive exams.

Other Reflections: The work described above is a huge project. We have guidelines ready but we will need to continuously improve our course packets for instructors.

E. Assessment Plans for Next Year

Year 2: 2022-2023

1. Which PLO(s) to assess PLO 2
2. Is it aligned to an ILO? No
3. If yes, list ILO.
4. Course name and number MATH 692 Graduate Mathematics Capstone
5. SLO from course 692: Students who successfully complete MATH 692 will have mastered creating solutions to problems using techniques in graduate level mathematics.
6. Assessment activity Comprehensive Exams
7. Assessment Instrument Re-score comprehensive exam questions using the Readability, Validity and Fluency Rubric
8. How data will be reported Quantitative
9. Responsible person(s) Math Assessment Committee
10. Time (which semester(s)) Spring 2023
11. Ways of closing the loop Data will reported in Mathematics Department Annual Report and discussed in faculty meetings to continuously improve the program.

Appendix A - Rubric

Communication RVF Rubric – Readability, Validity, Fluency

| | Missing (0) | Emerging (1) | Developing (2) | Mastering (3) |
|-------------|--|---|--|--|
| Readability | Informal or non-mathematical language is used. There is misuse of notation/symbols. | Some improper mathematical language or notation is used. | Mostly proper mathematical language and notation is used. | Proper mathematical language and notation is used. |
| Validity | Significantly inaccurate or irrelevant statements in definitions, techniques and/or theorems are present. Important information is missing. | Mostly accurate statements in definitions, techniques and/or theorems are present. May include some irrelevant or unjustified statements. | Statements in definitions, techniques and/or theorems are accurate and relevant. | Statements in definitions, techniques and/or theorems are accurate and relevant and connected/deduced correctly. |
| Fluency | No coherent flow of ideas Listing facts without a sense of how to link them to obtain or apply a valid definition, technique or proof of a theorem. | Partially coherent and organized, but inconsistent. Appeals to intuition. Some unjustified or improperly justified statements/conclusions in definitions, techniques or proofs of | A correct and essentially complete definition, solution, or proof given. Logic and flow overall sound. Some small gaps in presentation may require “benefit of the doubt.” | A correct and complete definition, solution, or proof given. Elegance or mathematical maturity present. |

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| | | theorems are present. | | |
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