

Program-Level Assessment: Annual Report

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| Program Name (no acronyms): Mathematics | Department: Mathematics and Statistics |
| Degree or Certificate Level: MA / PhD | College/School: College of Arts and Sciences |
| Date (Month/Year): September 2022 | Assessment Contact: Benjamin Hutz |
| In what year was the data upon which this report is based collected? AY 2021-2022 | |
| In what year was the program's assessment plan most recently reviewed/updated? AY 2021-2022 | |
| Is this program accredited by an external program/disciplinary/specialized accrediting organization? NO | |

1. Student Learning Outcomes

Which of the program's student learning outcomes were assessed in this annual assessment cycle? (Please list the full, complete learning outcome statements and not just numbers, e.g., Outcomes 1 and 2.)

- MA Program
 - **PLO #1:** Graduates will be able to demonstrate the ability to learn high-level mathematical concepts and techniques.
 - **PLO #2:** Graduates will be able to demonstrate ability to apply methods of direct and indirect proof to solve problems at the master's level.
 - **PLO #3:** Graduates will be able to demonstrate ability to effectively communicate mathematics in both a written and oral setting.
 - **PLO #4:** Graduates will be able to demonstrate master's-level depth of understanding of mathematics at the foundation of contemporary applications.
- PhD Program
 - **PLO #1:** Graduates will be able to demonstrate fundamental knowledge in the areas of algebra, analysis, topology, and differential geometry.
 - **PLO #2:** Graduates will be able to demonstrate mastery in three of the four areas in PLO #1.
 - **PLO #3:** Graduates will be able to demonstrate ability to identify and solve new research problems in pure or applied mathematics.
 - **PLO #4:** Graduates will be able to demonstrate ability to effectively communicate new research in both a written and oral setting.
 - **PLO #5:** Graduates will be able to demonstrate ability to manage a large research project and prepare a manuscript.

2. Assessment Methods: Artifacts of Student Learning

Which artifacts of student learning were used to determine if students achieved the outcome(s)? Please describe the artifacts in detail and identify the course(s) in which they were collected. Clarify if any such courses were offered a) online, b) at the Madrid campus, or c) at any other off-campus location.

Samples of student work were requested from instructors soon after the end of the Spring '22 semester. Seven of the eight instructors responded. One course (STAT 5084) was then excluded from assessment since it does not address this learning outcome.

Student completion data of PhD level exams and thesis defenses was examined. Student completion of MA oral exams and thesis defenses was examined.

3. Assessment Methods: Evaluation Process

What process was used to evaluate the artifacts of student learning, and by whom? Please identify the tools(s) (e.g., a rubric) used in the process and **include them in/with this report document** (please do not just refer to the assessment plan).

Student work was evaluated by the following rubric:

- Opening
 - Novice (0 points): No opening statement of what is being proved. No mention of use of standard method, where relevant (e.g. induction).
 - Apprentice (1 points): There is a statement of what is being proved (inc. mention of a standard method, if relevant), but it comes later and/or is incomplete.
 - Practitioner (2 points): Clear, correct opening statement of what is being proved, with statement of method if a standard method is used.
- Clarity
 - Novice (0 points): Overall, the argument is hard or impossible to follow.
 - Apprentice (1 points): Can follow it with some effort. Some parts may be clearer than others.
 - Practitioner (2 points): Clear and easy to follow throughout.
- Reasons
 - Novice (0 points): Significant steps presented without justification.
 - Apprentice (1 points): Some significant steps are justified, but at least one is not.
 - Practitioner (2 points): Reasons are given for all significant steps.
- Logical correctness
 - Novice (0 points): The answer given is fundamentally wrong.
 - Apprentice (1 points): The approach is generally correct, but there is at least one significant error.
 - Practitioner (2 points): Other than perhaps a minor slip, the proof is complete and correct.
- Stating the conclusion
 - Novice (0 points): Argument ends abruptly, without stating or acknowledging a conclusion.
 - Apprentice (1 points): Argument ends with some form of concluding statement, but it is not clear and definitive.
 - Practitioner (2 points): Argument concludes with a clear and concise statement indicating that the desired result has been established.
- Overall evaluation
 - Novice (0 points): Overall, this is not a good answer.
 - Apprentice (1 points): The answer is fairly good, but there is room for improvement.
 - Practitioner (2 points): Discounting small, minor slips, this is a good answer.

The sum of the scores from the six areas was determine in the range 0-12.

The exams and thesis defenses were evaluated based on pass/fail outcomes.

4. Data/Results

What were the results of the assessment of the learning outcome(s)? Please be specific. Does achievement differ by teaching modality (e.g., online vs. face-to-face) or on-ground location (e.g., STL campus, Madrid campus, other off-campus site)?

All courses and exams were conducted in person on the Saint Louis campus so location and modality were not considered.

- **MA PLO #1, #2, #3** and **PhD PLO #1, #2**: There were six courses in the assessment data set, there were 10 different students and 17 student/course pairs. Of these, 16 had a proof sample collected. The one omitted student was an undergraduate in a 5-year ABM program. Overall, then, the data collection gives a good picture of current graduate student ability to perform the learning outcome.

Of the 16 proofs assessed, 12 scored 10-12 points and could be considered practitioner level of ability. Three scored in the 6-9 range, and could be considered apprentice level of ability. Only one example proof was below 6, and could be considered novice level. Of note, all five students in the most advanced course MATH 6420 showed "Practitioner" level of skill in their mathematical writing.

- **MA PLO #3, #4:** 2 students attempted comprehensive oral exams in Spring 2022. Both students passed.
- **PhD PLO #2:** Results from comprehensive exams was examined for the Spring 2022 and Summer 2022 exams (earlier data was not available). Six students took PhD comprehensive exams: 3 in algebra, 1 in analysis, 1 in topology, and 1 in differential geometry. All students passed their exams demonstrating mastery in that subject.
- **PhD PLO #3, #4, #5:** One student attempted a thesis defense. This student successfully completed their ph.d. thesis and its defense.
- **PhD PLO #5:** One Ph.D. student dropped out of the program in AY 2021-2022 for personal reasons.

5. Findings: Interpretations & Conclusions

What have you learned from these results? What does the data tell you?

In AY 2021-2022 our graduate students were very successful and demonstrated progress towards their learning objective across the entire program. Performance of students near completion of their degree was especial strong. Since it is data from a single year, or only a single semester for certain topics, this is not enough data to be able to draw conclusions. We need to consistently gather this data across several years before drawing conclusions.

6. Closing the Loop: Dissemination and Use of Current Assessment Findings

A. When and how did your program faculty share and discuss these results and findings from this cycle of assessment?

The assessment report was discussed in the September 21, 2022 department meeting of the faculty.

B. How specifically have you decided to use these findings to improve teaching and learning in your program? For example, perhaps you've initiated one or more of the following:

Changes to the Curriculum or Pedagogies

- Course content
- Teaching techniques
- Improvements in technology
- Prerequisites
- Course sequence
- New courses
- Deletion of courses
- Changes in frequency or scheduling of course offerings

Changes to the Assessment Plan

- Student learning outcomes
- Artifacts of student learning
- Evaluation process
- Evaluation tools (e.g., rubrics)
- Data collection methods
- Frequency of data collection

Please describe the actions you are taking as a result of these findings.

- With the introduction of the 5 year BA + MS program, we need to include the undergraduate students in that program who are currently enrolled in graduate course work in our future assessment data.
- This assessment was initiated after instructors had completed their courses. Instructors will be notified at the start of the course that assessment information on proof writing ability will be collected.

If no changes are being made, please explain why.

7. Closing the Loop: Review of Previous Assessment Findings and Changes

A. What is at least one change your program has implemented in recent years as a result of assessment data?

None.

B. How has this change/have these changes been assessed?

N/A

C. What were the findings of the assessment?

N/A

D. How do you plan to (continue to) use this information moving forward?

N/A

IMPORTANT: Please submit any assessment tools (e.g., artifact prompts, rubrics) with this report as separate attachments or copied and pasted into this Word document. Please do not just refer to the assessment plan; the report should serve as a stand-alone document.