

AY 2017 – 2018 Assessment

Program – Mathematics Bachelor of Science Program

College: Arts and Sciences

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Northwestern Mission. Northwestern State University is a responsive, Student-oriented institution that is committed to the creation, dissemination, and acquisition of knowledge through teaching, research, and service. The University maintains as its highest priority excellence in teaching in graduate and undergraduate programs. Northwestern State University prepares its Students to become productive members of society and promotes economic development and improvements in the quality of life of the citizens in its region.

College of Arts and Sciences' Mission. College of Arts and Sciences' Mission. The College of Arts & Sciences, the largest college at Northwestern State University, is a diverse community of scholars, teachers, and students, working collaboratively to acquire, create, and disseminate knowledge through transformational, high-impact experiential learning practices, research, and service. The College strives to produce graduates who are productive members of society equipped with the capability to promote economic and social development and improve the overall quality of life in the region. The College provides an unequalled undergraduate education in the social and behavioral sciences, English, communication, journalism, media arts, biological and physical sciences, and the creative and performing arts, and at the graduate level in the creative and performing arts, English, TESOL, and Homeland Security. Uniquely, the College houses the Louisiana Scholars' College (the State's designated Honors College), the Louisiana Folklife Center, and the Creole Center, demonstrating its commitment to community service, research, and preservation of Louisiana's precious resources.

Department of Mathematics. The Department of Mathematics is dedicated to the development of students for roles in academic, professional, and research careers in the various areas of the field of mathematics. The department also fosters the mathematical development of all students through our offerings in general education and support courses for other degree programs. We are committed to providing a modern, effective education to all students using traditional practices and current technology throughout our course offerings. The department delivers Bachelor of Science degrees in Mathematics with available concentrations in Healthcare Informatics and Actuarial Mathematics. A minor in Mathematics is also available.

Mathematics Program Mission Statement: The Department of Mathematics offers a Bachelor of Science in Mathematics. The coursework includes a foundation in the classic coursework in mathematics covering Calculus, Foundations, and Algebra which is enhanced with a strong student research component. All coursework is delivered

AY 2017 – 2018 Assessment

using appropriate, modern technology. Mathematics coursework is supplemented with a strong selection of courses in the Biological, Physical, and Computer Sciences. Choice of upper-level electives allows for customization of the degree emphasizing preparation for graduate school or a professional career or a mixture of both. The concentrations in Healthcare Informatics and Actuarial Mathematics also require an Internship experience further preparing the student for a professional career.

Methodology: The assessment process for the BS program is as follows:

- (1) Data from assessment tools (both direct – indirect, quantitative and qualitative) are collected and returned to the department head;
- (2) The department head will analyze the data to determine whether students have met measurable outcomes;
- (3) Results from the assessment will be discussed with the faculty;
- (4) The Department Head, in consultation with the Advisory Committee, will propose changes to measurable outcomes, assessment tools for the next assessment period and, where needed, curricula and program changes.

Student Learning Outcomes:

SLO 1. Students will gain a strong understanding of the fundamental ideas, concepts, and applications of mathematics

Course Map: Tied to course syllabus objectives.

MATH2110: Analytic Geometry and Calculus II

MATH3100: Modern Algebra I

MATH4950: Mathematics – A Capstone Course

Measure 1.1. (Direct – other)

MATH2110 is taken at the end of the freshman year. MATH3100 is the last explicitly required course before the student begins taking upper-level electives in mathematics. MATH4950 is the senior research project course taken shortly before graduation. By looking at the pass rate in each of these courses, we get a sense of whether our majors are making progress. Our targets are 75% of Mathematics majors earn a Grade of C or higher in 2110. 90% of Mathematics majors earn a Grade of C or higher in 3100 and 4950.

Finding: Target NOT met

- MATH2110 – 3 of 3 math majors met the goal – 100%
(1 of 1 in Fall 2017, 2 of 2 in Spring 2018)
- MATH3100 – 2 of 2 math majors met the goal. – 100%

AY 2017 – 2018 Assessment

(2 of 2 in Fall 2017, not taught Spring 2018)

- MATH4950 – 2 of 4 math majors met the goal. – 50%
(2 of 3 in Fall 2017, 0 of 1 in Spring 2018)

Analysis: In AY16-17, the **Target was not met**

We have met our goal in 2 of 3 courses for AY17-18 as we did in the previous year. We sustained the improvement we had made in MATH2110. We met our goal for 3100 which we had not the past 2 years. It is somewhat disheartening that we missed our goal so dramatically in 4950 which we had consistently met for 4 years.

We are pleased that we again met our goal in MATH2110. To solidify our improvement in this course in AY16-17, we began an experiment in the spring semester with including a unit at the end of the course which was entirely dependent on usage of technology for data analysis and computation. This seems to have been a success.

After two years of missing our goal in MATH3100, we decided to implement some small changes in the course. Students had repeatedly mentioned that a large amount of homework was assigned in the course. These assignments were shortened by 20-30%. This seems to have improved performance.

The failure to meet the goal in MATH4950, our capstone course is concerning. Both students who failed to complete this course had complications in their personal lives, but the main obstacle they encountered was trouble in choosing a topic for their research project. Although this had happened from time to time in the past, we had seen it as a weakness in our approach until now. Our plans for revamping our rubrics for evaluating this course were on-hold this year. See the end of the document for more details.

Action - Decision or Recommendation: Our plans for these three courses:

The emphasis in using technology in MATH2110 seems to have been effective. We will attempt to formalize the piloted approach from this spring, so we can continue this approach in subsequent semesters.

We will continue to refine the homework assignments in MATH3100. In addition to keeping the total workload lower, we will emphasize the importance of cogent writing in mathematics. Hopefully, this will help solidify our progress in this area.

We will be expanding MATH4950 to a two-semester sequence as part of the current QEP next year. Both students who did not successfully complete the course struggled with choosing a project. The first semester of our new sequence will now be devoted to that aspect of a research project which will hopefully help students with this issue.

AY 2017 – 2018 Assessment

Measure 1.2. (Indirect – Attitude)

Students make a self-assessment of their preparation in the Graduating Senior Survey. We examine responses to questions on the ability to “reason abstractly” and “Use numerical data and statistics.” Our targets are 75% or more of Mathematics majors will report "Satisfied" or "Very Satisfied" to the questions regarding how their education has helped them in these areas.

Finding: Target met

100% of students reported “Very Satisfied” in both areas.

- (0 of 1 response in Fall 2017, 1 of 1 response in Spring 2018)

Analysis: In AY16-17, the target was also met:

Although the target was met for responding students, most students had not completed the survey. Based on the results of this analysis, for AY17-18 we made efforts in MATH4950, our capstone course, to remind students to complete this survey. The target was met again in AY17-18 and overall, a higher number of students completed the survey, however an insufficient percentage of students are completing the survey.

Action - Decision or Recommendation: We consistently are seeing responses that meet our target for this measure as 100% of responding students over two years met the target, but we are not seeing most of our students complete the survey. Reminding student in the capstone course seems not to have been sufficient. In AY18-19, faculty will remind our students to complete the survey in all upper-level courses. Unfortunately, having such small numbers makes it hard to draw clear inference about success.

SLO 2. Students will demonstrate a college-level proficiency in oral communication of mathematical concepts.

Course Map: Tied to course syllabus below.

MATH1010: Introduction to Mathematics

MATH2080: Fundamentals of Proof

MATH4950: Mathematics

Measure: 2.1. (Direct – Skill/Activity)

All mathematics majors take MATH1010 the first fall semester they are a major. Since MATH1010 is a pass-fail graded course, we only have successful/unsuccessful grades on their assignments. Their final project is to make a presentation on a career in mathematics which they have researched. Our target is for 75% of mathematics majors to give a successful final presentation.

AY 2017 – 2018 Assessment

Finding: Target met

This course is only taught in the fall semesters. This fall, we had 12 mathematics majors. Of these, 11 made a passing grade on the final presentation for a 92% success rate.

Analysis: The results from AY16-17 were **the target was met:**

In AY17-18, we met our target but dipped below 100% as we had achieved last year. It is regrettable that we have dropped below 100% success, I still believe our discussion about the importance of being able to speak about mathematics in this course is helping. One issue we have struggled with is this course is graded Pass/Fail. This somewhat blunts the impact of constructive criticism of their progress in that they know they only have to do well enough to not fail.

Action - Decision or Recommendation:

Between AY16-17 and AY17-18, the target for this measure was met. To improve the achievement of proficiency in oral communication in mathematical concepts in AY18-19, we have been granted permission to evaluate this course with grades instead of Pass/Fail. This will allow more granular analysis of student performance which should have a positive impact on student performance.

Measure: 2.2. (Direct – Skill/Activity)

Mathematics majors take MATH2080 the fall of their sophomore year. In this course, students are required to present solutions of proofs on the board. Students only receive credit for the presentation if it is correct and complete. At least 75% of mathematics majors in MATH2080 will complete the required quota of presentations (this quota varies from year to year based on the size of the class).

Finding: Target met

This course is only taught in the fall semesters. This fall, we had 2 mathematics majors enrolled in the class. Of these, both met the quota for a 100% success rate.

Analysis: The results from AY16-17 were **the target was met:**

We had 2 mathematics majors both of which met the quota for 100%.

We have met our target at 100% for the second year in a row after narrowly missing it two years ago. This year we have increased the number of discussions with this class on the importance of being able to effectively communicate about mathematics. This seems to be having a positive effect.

Action - Decision or Recommendation: Given our success with this approach of discussing the importance of being able to speak about mathematics, it will now be our standard approach. We have concerns that our assessment of their progress at this level is not comparable to measures of the same sorts of skills in subsequent classes.

AY 2017 – 2018 Assessment

Long-term plans for revising our rubrics for measuring success in this outcome are discussed at the end of this document.

Measure: 2.3. (Direct – Skill/Activity)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. At least 75% of mathematics majors in MATH4950 will score 7 out of 10 or better on the presentation rubric on their final presentation.

Finding: Target not met

Fall 2017 – There were 3 mathematics majors enrolled in the course. Of these, 2 scored 7/10 or better (the remaining one did not make a final presentation). Spring 2018 – There was 1 mathematics major enrolled in the course. This student did not make a final presentation. For the academic year 2 of 4 met the goal for a 50% success rate.

Analysis: The results from AY16-17 were **target was met:**

For the academic year 5 of 6 met the goal for an 83% success rate.

In AY17-18 we had the worst outcome on this measure we have ever had. There were extenuating circumstances with both the students in question, but it still is a disheartening set back. We had been meeting this goal regularly, but we feel that our rubric might not adequately measure what we are trying to measure. Our plans for modifying the rubric which had been on hold are discussed at the end of the document.

Action - Decision or Recommendation: The failure to meet the goal in MATH4950, our capstone course is concerning. To address this shortcoming, and to improve students' oral communication of mathematical concepts, in AY18-19, we will be expanding that course to a two-semester sequence as part of the current QEP next year. This should help to address the issue. Both students who did not successfully complete the course struggled with choosing a project. The first semester of our new sequence will now be devoted to that aspect of a research project which will hopefully help students. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

SLO 3. The students will demonstrate proficiency in written communication of mathematical concepts.

Course Map: Tied to course syllabus below.

MATH3100: Modern Algebra I

MATH4950: Mathematics – A Capstone Course

AY 2017 – 2018 Assessment

Measure 3.1. (Direct – Skill/Activity)

MATH3100 is the last required course before majors begin their upper-level elective courses in mathematics. Responses to questions on the final exam will be analyzed to determine if students are writing about mathematics at the appropriate level. At least 75% of students will display the ability to write cogently and logically.

Finding: Target met

This course is only taught in the fall semester. There were 2 mathematics majors in the course in the fall 2016. Of these, 2 displayed written skills at an acceptable level in this course. This is a success rate of 100%.

Analysis: The results from AY16-17 were target was met:

There were 5 mathematics majors in the course in the fall 2016. Of these, 4 displayed written skills at an acceptable level in this course. This is a success rate of 80%.

Even though we met this goal in AY16-17 based on our analysis of the data, we decided to implement some small changes in the course to further improve upon students' ability to write cogently and logically. Students had repeatedly mentioned that a large amount of homework was assigned in the course. These assignments were shortened by 20-30% with mostly routine computational problems being removed. The increase in the percentage of students meeting the target for this SLO shows that the course changes made in AY17-18 improved student performance and allowed the students to focus on producing a higher quality of work while gaining a deeper understanding.

Action - Decision or Recommendation: In AY16-17, the target for this measure was met, although not at 100%. As a result, course changes were made to further improve student writing in mathematics and in AY17-18 those changes resulted in a 100% success rate in meeting the target for this SLO. Since the target was met for this SLO for past two years, in AY18-19 we will refine our assignments in this course. We also plan to include specific discussions with the students about the importance of being able to write about mathematics. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

Measure: 3.2. (Direct – Skill/Activity)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. At least 75% of mathematics majors in MATH4950 will score 10 out of 14 or better on the rubric for their final paper.

Finding: Target not met

Fall 2017 – There were 3 mathematics majors enrolled in the course. Of these, 2 scored perfect 14/14 well exceeding the target (the remaining one did not turn in a final paper).

AY 2017 – 2018 Assessment

Spring 2018 – There was 1 mathematics major enrolled in the course. This student did not turn in a final paper. For the academic year 2 of 4 met the goal for a 50% success rate.

Analysis: The results from AY16-17 were **target was met:**

For the academic year 5 or 6 met the goal for an 83% success rate.

We had been meeting this goal regularly, but we feel that our rubric might not adequately measure what we are trying to measure. Our plans for modifying the rubric which had been on hold are discussed at the end of the document. In AY17-18 we had the worst outcome on this measure we have ever had. There were extenuating circumstances with both the students in question, but it still is a disheartening set back.

Action - Decision or Recommendation: The failure to meet the goal in MATH4950, our capstone course is concerning. Both students who did not successfully complete the course struggled with choosing a project. As a result and to drive improvement in achieving this SLO, we will be expanding that course to a two-semester sequence as part of the current QEP next year. This should help to address the issue. The first semester of our new sequence will now be devoted to that aspect of a research project which will hopefully help students. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

SLO 4. Students will demonstrate proficiency in use of technology for problem solving and communication

Course Map: Tied to course syllabus below.

MATH2110: Analytic Geometry and Calculus II

MATH4950: Mathematics – A Capstone Course

Measure 4.1. (Direct – Skill/Activity)

MATH2110 is the second semester of Calculus. The use of technology is integrated into this course. A survey of questions on the final exam which require technology to answer will allow us to assess whether mathematics majors have mastered the appropriate skills. Our target is 75% of students will display competency with technology.

Finding: Target met

Fall 2016 – There was 1 mathematics major enrolled in the course. Of these, 1 displayed proficiency. Spring 2017 – There were 3 mathematics majors enrolled in the course. Of these, 3 displayed proficiency. For the academic year 4 of 4 displayed proficiency for a 100% success rate.

AY 2017 – 2018 Assessment

Analysis: The results from AY16-17 were **target was met:**

For the academic year 16-17, 5 of 5 displayed proficiency for a 100% success rate. This area has traditionally been a weakness for us, but this is our second consecutive year of meeting this goal at 100%. To solidify our improvement in this course in AY16-17, we began an experiment in the spring semester with including a unit at the end of the course which was entirely dependent on usage of technology for data analysis and computation. This seems to have been a success.

Action - Decision or Recommendation: We incorporate such a unit into our course on a regular basis. We have concerns that our assessment of their progress at this level is not comparable to measures of the same sorts of skills in subsequent classes. Long-term plans for revising our rubrics for measuring success in this outcome are discussed at the end of this document.

Measure 4.2. (Direct – Skill/Activity)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation using presentation software. The “organization” portion of the presentation rubric evaluates the ability to integrate equations, mathematical symbols, graphs, and other illustrations into an electronic presentation. Our target is 75% of mathematics majors will earn a score of 2 out of 3 or better on Organization on their final presentation.

Finding: Target not met

Fall 2017 - There were 3 mathematics majors enrolled in the course. Of these, 2 scored a perfect 3/3 on Organization (the remaining student did not make a final presentation). Spring 2017 – There was 2 mathematics major enrolled in the course. This student did not make a final presentation. For the academic year 2 of 4 met the goal for a 50% success rate.

Analysis: The results from AY16-17 were **target was met:**

For the academic year 16-17, 6 of 6 met the goal for a 100% success rate.

In AY17-18 we had the worst outcome on this measure we have ever had. There were extenuating circumstances with both the students in question, but it still is a disheartening set back. We had been meeting this goal regularly, but we feel that our rubric might not adequately measure what we are trying to measure. Our plans for modifying the rubric which had been on hold are discussed at the end of the document.

Action - Decision or Recommendation: The failure to meet the goal in MATH4950, our capstone course is concerning. We will be expanding that course to a two-semester sequence as part of the current QEP next year. This should help to address the issue. Both students who did not successfully complete the course struggled with choosing a project. The first semester of our new sequence will now be devoted to that aspect of a

AY 2017 – 2018 Assessment

research project which will hopefully help students. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

Measure 4.3. (Direct – Student Artifact)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. A rating of Satisfactory or better on the Conventions and Clarity portions of the paper rubric displays the ability to integrate equations, mathematical symbols, graphs, and other illustrations into text. Our target is 75% of mathematics majors will score Satisfactory or better on the Conventions and Clarity portion of the paper rubric.

Finding: Target not met

Fall 2017 - There were 3 mathematics majors enrolled in the course. Of these, 2 scored Excellent on Clarity, and 2 scored Excellent on Conventions (the remaining student did not turn in a final paper). Spring 2017 – There was 1 mathematics major enrolled in the course. This student did not turn in a final paper. For the academic year, 2 of 4 met the goal for Clarity (50% success rate) and 2 of 4 met the goal for Conventions (50% success rate)

Analysis: The results from AY16-17 were **target was met:**

For the academic year 1617, 5 of 6 met the goal for Clarity (83% success rate) and 6 of 6 met the goal for Conventions (100% success rate)

In AY17-18 we had the worst outcome on this measure we have ever had. There were extenuating circumstances with both the students in question, but it still is a disheartening set back. We had been meeting this goal regularly, so we had not made any changes to this course.

Action - Decision or Recommendation: The failure to meet the goal in MATH4950, our capstone course is concerning. We will be expanding that course to a two-semester sequence as part of the current QEP next year. This should help to address the issue. Both students who did not successfully complete the course struggled with choosing a project. The first semester of our new sequence will now be devoted to that aspect of a research project which will hopefully help students. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

AY 2017 – 2018 Assessment

SLO 5. Students will develop the ability to think in an analytical fashion.

Course Map: Tied to course syllabus below.

MATH2080: Fundamentals of Proof

MATH4950: Mathematics – A Capstone Course

Measure 5.1. (Direct - Skill)

MATH2080 is the first course in the mathematics major where students are expected to write at length about mathematics. Responses to questions on the final exam in this course will be evaluated with regard to whether or not the student can write about mathematics in a clear and logically rigorous manner. Our target is for 75% or higher of mathematics majors to show proficiency on this measure.

Finding: Target met

This course is only taught in the fall semesters. This fall, we had 2 mathematics majors enrolled in the class. Of these, 2 demonstrated appropriate levels of skill in critical thinking and analysis on their Final Exam for a success rate of 100%.

Analysis: The results from AY16-17 were **target was met:**

In fall 2016, there were 2 mathematics majors enrolled in the course. Of these 2 demonstrated appropriate levels of skill in critical thinking and analysis on their Final Exam for a success rate of 100%.

We have met our target at 100% for the second year in a row after narrowly missing it two years ago. We have increased the frequency of discussions with this class the importance of being able to write clearly about mathematics. This is having a positive effect.

We had been meeting this goal regularly, but we feel that our rubric might not adequately measure what we are trying to measure. Our plans for modifying the rubric which had been on hold are discussed at the end of the document.

Action - Decision or Recommendation: Given our success with this approach of discussing the importance of being able to write about mathematics, it will now be our standard approach. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document. We have concerns that our assessment of their progress at this level is not comparable to measures of the same sorts of skills in subsequent classes. Long-term plans for revising our rubrics for measuring success in this outcome are discussed at the end of this document

AY 2017 – 2018 Assessment

Measure 5.2. (Direct - Knowledge)

All mathematics majors take MATH4950 either the last or next to last semester before graduation. This class involves an independent research project which culminates in a paper and a public presentation. A rating of Satisfactory or better on the Organization and Depth portions of the paper rubric displays the think analytically. Our target is 75% of mathematics majors will score Satisfactory or better on the Organization and Depth portion of the paper rubric.

Finding: Target not met

Fall 2017 - There were 3 mathematics majors enrolled in the course. Of these, 2 scored Excellent on both Depth and Organization (the remaining student did not turn in a final paper). Spring 2017 – There was 1 mathematics major enrolled in the course. This student did not turn in a final paper. For the academic year, 2 of 4 met the goal for Depth (50% success rate) and 2 of 4 met the goal for Organization (50% success rate)

Analysis: The results from AY16-17 were **target was met:**

In AY17-18 we had the worst outcome on this measure we have ever had. There were extenuating circumstances with both the students in question, but it still is a disheartening set back. We had been meeting this goal regularly, but we feel that our rubric might not adequately measure what we are trying to measure. Our plans for modifying the rubric which had been on hold are discussed at the end of the document.

Action - Decision or Recommendation: The failure to meet the goal in MATH4950, our capstone course is concerning. We will be expanding that course to a two-semester sequence as part of the current QEP next year. This should help to address the issue. Both students who did not successfully complete the course struggled with choosing a project. The first semester of our new sequence will now be devoted to that aspect of a research project which will hopefully help students. We have some long-term plans for revising our rubrics for measuring success in this outcome which are discussed at the end of this document.

Comprehensive summary of key evidence of improvements based on analysis of results.

We met our targets on only 6 of our 12 measures. Let us examine what seems to have worked and what has not.

We have initiated or continued the following approaches in the past year:

- Discussing the importance of speaking about mathematics in MATH1010 and 2080
- Stressing the importance of applications and the use of technology in MATH2110
- Stressed the importance of writing about mathematics in MATH2080 and 3100.
- Modification of the assignments in MATH3100.

AY 2017 – 2018 Assessment

Our adjustments in the MATH3100 course seem to have worked for us as is reflected by our improvements in Measures 1.1 and 3.1. Our work in the previous year in MATH1010 and MATH2080 continues to show good results. Our new innovations in MATH2110 seem to be promising as well as is reflected in our success with Measure 4.1.

The 6 measures where we failed to meet the target are all taken from our Capstone course, MATH4950. This has historically been a strong area for us, and we were caught a little flatfooted. This year 2 of 4 math majors simply failed to complete this course. Although there were outside reasons that contributed to these 2 students' performance, their struggles with the course began with a common problem: choosing a topic for their research project. We have had students struggle with this in the past, but the 2 students in question here had remarkable difficulties with this aspect. I think we had underestimated how much of an obstacle this could be.

Fortunately for AY18-19, we have undertaken a redesign of our Capstone course as part of the current QEP. We will be expanding to a two-course sequence MATH4940-4950. The first course will cover the process of choosing a topic culminating in a presentation of the problem the student plans to explore in the next semester. The second course will now begin with students presenting their work so far which has in the past did not begin until about 30% of the way through the course. We expect these changes to improve Measures 1.1, 2.3, 3.2, 4.2, 4.3, and 5.2. for AY18-19.

This year we have made no changes to our assessment plan as was requested by our assessment team. Here are the changes we would like to implement if possible in the next year:

- We would like to add as Measure 1.3, the ETS Major Field Exam in Mathematics. This will give us some objective measure of how our students are doing relative to mathematics majors across the country.
- We are measuring students' progress in writing and speaking about mathematics throughout our curriculum. We have some concerns that our measures may not be consistent enough in different courses. Our plan is to begin by developing new rubrics for evaluating presentations and papers in MATH4950. Then we would use simplified versions of these rubrics to assess the use of technology in MATH2110, speaking about mathematics in MATH1010 and 2080, and writing about mathematics in MATH2080 and 3100. We believe this would give us a clearer longitudinal view of our students' progress.