Degree/Certificate: Bachelor of Arts in Education

Major/Option: Mathematics/Elementary and Middle Level Mathematics Endorsement Option
Submitted by: Mathematics Education Committee
Date: November 1, 2013

Part I – Program SLO Assessment Report for 2012-13

1. **Student Learning Outcome:** The student performance or learning objective as published either in the catalog or elsewhere in your department literature.

Use spatial visualization and geometric modeling to explore and analyze geometric figures and apply and use measurement concepts and tools.

2. **Overall evaluation of progress on outcome:** Indicate whether or not the SLO has been met, and if met, to what level.
   - _____ SLO is met after changes resulting from ongoing assessments, referencing assessment results from the previous year to highlight revisions;
   - _____ SLO is met, but with changes forthcoming;
   - X SLO met without change required

   ⚫ Please note that we are continuing to make adjustments to our program to improve our students' meeting of this SLO.

3. **Strategies and methods:** Description of assessment method and choices, why they were used and how they were implemented.

Math 312 is a mathematics content course designed to provide prospective elementary mathematics majors with a solid foundation in geometric concepts and an introduction to deductive proofs. The topics include inductive and deductive reasoning; tools of geometry; properties of triangle, polygons, and circles; transformations; and similarity. In the fall of 2012, 10 middle level math majors took Math 312. The work of learning for this class consists of active class participation, homework, three tests, and one final exam. The following two items were chosen from the final exam as the assessment of the SLO of 2012-13.
The first item was to check students’ understanding of a rotational transformation and the second item to check students’ understanding of a point of concurrency of a triangle. Both items require students to use spatial reasoning at a more advanced level than the previous courses such as Math 212 and Math 412. For example, the second item asks students to examine the provided figure from two opposite perspectives. One perspective is to look at the triangle as a given object to produce the inscribed circle, and the other perspective is to look at the triangle as a figure consisting of tangent line segments of a circle. Both of the items also require students to use measurement concepts and tools. They were graded on a scale of 1-10 points.

4. **Observations gathered from data**: Include findings and analyses based on the strategies and methods identified in item #3.
   a. **Findings**:

   **Item 1**
   
<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percents of students</td>
<td>10%</td>
<td>60%</td>
<td>0%</td>
<td>30%</td>
</tr>
</tbody>
</table>

   **Item 2**
   
<table>
<thead>
<tr>
<th>Score</th>
<th>0</th>
<th>4 or 5</th>
<th>8 or 9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percents of students</td>
<td>10%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
</tr>
</tbody>
</table>

   b. **Analysis of findings**:
On the first item, 90% of the students gained a point above 7 and successfully constructed the center of the rotational symmetry. But variations were noticed with respect to the level of justification about their construction. 60% of the students justified their constructions by stating the steps of constructions and none of the students by using the property of perpendicular bisectors. 30% of the students gained a perfect score by examining and specifying the amount of the rotation as they used geometric reasoning employed in their constructions.

On the second item, 60% of the students gained a point above 7 and successfully analyzed the provided figure with an understanding of incenter and the property of tangent line segments of a circle. 30% of the students gained a 4 or a 5 and showed some confusion among the points of concurrency of a triangle. However, the students with a 4 or 5 succeeded in finding the perimeter of the triangle and justifying their answer as they used the property of incenter.

5. **What program changes will be made based on the assessment results?**

   a) Describe plans to improve student learning based on assessment findings (e.g., course content, course sequencing, curriculum revision, learning environment or student advising).

Though in general students were successful in using spatial reasoning to relate and analyze geometric figures, we noticed that students should increase the depth of their knowledge so that they can go beyond merely stating the steps of what they did when asked to justify their answers.

Using tools including technology may play a crucial role in deepening geometric understanding. The depth in geometry increases when students explore their ideas and observations, make conjectures based on the discerned observations, justify the conjectures with logical necessity, and confirm the justified knowledge through investigation. Therefore, instructors should continue to encourage students to use dynamic features of technology and reflect on and communicate discerned observation and reasoning behind them.

   b) Provide a broad timeline of how and when identified changes will be addressed in the upcoming year.

Mathematics education faculty will discuss ways to increase math elementary majors’ attention to reasoning and justification in their mathematical activities. In particular, faculty will discuss the use of technology in students’ coursework for the purpose of increasing reasoning and justification.

6. **Description of revisions to the assessment process the results suggest are needed and an evaluation of the assessment plan/process itself (e.g., what changed, what worked, what did not work, and why?).**

The evaluation process was effective; no revisions are necessary.
PART II – CLOSING THE LOOP
FOLLOW-UP FROM THE 2011-12 PROGRAM ASSESSMENT REPORT

Working definition for closing the loop: Using assessment results to improve student learning as well as pedagogical practices. This is an essential step in the continuous cycle of assessing student learning. It is the collaborative process through which programs use evidence of student learning to gauge the efficacy of collective educational practices, and to identify and implement strategies for improving student learning.” Adapted 8.21.13 from http://www.hamline.edu/learning-outcomes/closing-loop.html.

1. Student Learning Outcome(s) assessed for 2011-12
Demonstrate computational proficiency using various strategies, including a conceptual understanding of numbers, relationships among number and number systems and meanings of operations with all real numbers.

2. Strategies implemented during 2012-13 to improve student learning, based on findings of the 2011-12 assessment activities.

The assessment report created from the 2011-12 data revealed students’ weaknesses in number concepts, especially foundational concepts taught in Math 211 and Math 212. During weekly meetings, math education faculty discussed the difficulties that the group of students who failed either or both courses more than once would have encountered. We also tried to identify the source of their failures. For example, we examined data to find whether transfer students have higher failure rate than non-transfer students. We found that the number of students who failed more than once decreased during 2012-13 and our dedication to help students develop good study habits affected downzizing the group of students with the sequence of failures. To continue to improve student learning, we started thinking about re-sequencing and restructuring Math 211 and Math 212 during 2012-2013, and it is still in progress. We also hired two tenure-track math education faculty so that we can provide more consistent instruction in the identified weaknesses.

We also reflected on the findings and recommendations about Math 211 and Math 212 in relation to this year’s report using the data from Math 312. One of the important concepts to develop and deepen in Math 312 is a measurement concept, and measurement contexts provide great opportunities for students to examine numbers and operations. Students in Math 312 were provided various tools, including technology with dynamic features, as frequently as possible to help develop numbers as conceptual entities to relate geometric objects and represent the relationships between objects. From the perspective that students continue to develop and refine math concepts, students had ample opportunities to improve their learning in the identified weaknesses.

3. Summary of results (may include comparative data or narrative; description of changes made to curriculum, pedagogy, mode of delivery, etc.): Describe the effect of the changes towards improving student learning and/or the learning environment.
Taking the recommendation that all instructors who teach Math 211 and 212 should come plan together to address the issues found, math education faculty ended up teaching those courses only by tenure-track or tenured mathematics education faculty this year. We are also in the process of restructuring Math 211 and Math 212 along with the following method course. From the new sequenced courses and restructured curriculum, we expect students to have better chance to develop pedagogical content knowledge, which is the knowledge that teachers should be empowered to understand students’ ways of thinking and their progression of important mathematical concepts.

4. What further changes to curriculum, pedagogy, mode of delivery, etc. are projected based on closing-the-loop data, findings and analysis?

See discussion for section 3 above.
Definitions:

1. **Student Learning Outcome**: The student performance or learning objective as published either in the catalog or elsewhere in your department literature.

2. **Overall evaluation of progress on outcome**: This checklist informs the reader whether or not the SLO has been met, and if met, to what level.

3. **Strategies and methods used to gather student performance data**, including assessment instruments used, and a description of how and when the assessments were conducted. Examples of strategies/methods: embedded test questions in a course or courses, portfolios, in-class activities, standardized test scores, case studies, analysis of written projects, etc. Additional information could describe the use of rubrics, etc. as part of the assessment process.

4. **Observations gathered from data**: This section includes findings and analyses based on the above strategies and methods, and provides data to substantiate the distinction made in #2. For that reason this section has been divided into parts (a) and (b) to provide space for both the findings and the analysis of findings.

5. **Program changes based on the assessment results**: This section is where the program lists plans to improve student learning, based on assessment findings, and provides a broad timeline of how and when identified changes will be addressed in the upcoming year. Programs often find assessment is part of an ongoing process of continual improvement.

6. **Description of revisions to the assessment process the results suggest are needed**. Evaluation of the assessment plan and process itself: what worked, what did not, and why.

Some elements of this document have been drawn or adapted from the University of Massachusetts’ assessment handbook, “Program-Based Review and Assessment: Tools and Techniques for Program Improvement” (2001). Retrieved from [http://www.umass.edu/oapa/oapa/publications/online_handbooks/program_based.pdf](http://www.umass.edu/oapa/oapa/publications/online_handbooks/program_based.pdf)