Degree/Certificate: Bachelor of Arts in Education

Major/Option: Mathematics / Elementary
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;
   
   ____ 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, 15 elementary 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 within which to produce the inscribed circle, and the other perspective is to look at the triangle as a figure consisting of tangent line segments to the 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>Percent of students</td>
<td>7%</td>
<td>53%</td>
<td>13%</td>
<td>27%</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>Percent of students</td>
<td>7%</td>
<td>20%</td>
<td>20%</td>
<td>53%</td>
</tr>
</tbody>
</table>
b. Analysis of findings:

On the first item, 93% of the students earned points above 7 out of 10 and successfully constructed the center of the rotational symmetry. But variations were noticed with respect to the level of justification about their constructions. 53% of the students justified their constructions by stating the steps used to create their constructions, and 13% of the students by using the property of perpendicular bisectors. 27% of the students earned 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, 73% of the students earned points above 7 out of 10 and successfully analyzed the provided figure with an understanding of the incenter and the properties of tangent line segments to a circle. 20% of the students earned a 4 or a 5 and showed some confusion among the points of concurrency of a triangle. However, many of 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 the 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 appropriate 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](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 helping students develop good study habits affected downsizing the group of students with the sequence of failures. To continue to improve student learning especially in the courses for general elementary majors, we started thinking about resequencing 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. Rather than having non-math-education faculty teach the Math 211 and 212 courses, we will now be able to have only math-education faculty teach these courses.

   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 to geometric objects and to 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 plan together to address the issues found, only tenure-track or tenured mathematics education faculty math ended up teaching those courses this year [2013-2014]. We are also in the process of restructuring Math 211 and Math 212 along with the following math methods course. From the new sequenced courses and restructured curriculum, we expect students to have a better chance of developing pedagogical content knowledge, which is the knowledge with which teachers should be empowered to understand students’ ways of thinking about math and their progression of understanding about 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 section 3 discussion.