EWU Programmatic SLO Assessment
AY 2015-16 and "Closing the Loop" for AY 2014-15

Introduction:

Assessment of student learning is an important and integrated part of faculty and programs. As part of ongoing program assessment at Eastern Washington University, each department is asked to report on assessment results for *each* program and *each* certificate for *at least one* Student Learning Outcome (SLO) this year. To comply with accreditation standards, the programs must also demonstrate efforts to "close the loop" in improving student learning and/or the learning environment. Thus, this template has been revised into two parts.

Resources:

Check this site for sample reports (created with the previous year's template) by EWU programs and other assessment resources: http://access.ewu.edu/undergraduate-studies/faculty-support/student-learning-assessment/program-slo-assessment.xml

Additional resources and support are available to:

1) Determine whether students can do, know or value program goals upon graduation and to what extent;
2) Determine students' progress through the program, while locating potential bottlenecks, curricular redundancies, and more; and
3) Embed assessments in sequenced and meaningful ways that save time.

Contact Dr. Helen Bergland for assistance with assessment in support of student learning and pedagogical approaches: hbergland@ewu.edu or 359.4305.

Use this template to report on your program assessment. **Reports are due to your Dean and to Dr. Helen Bergland (hbergland@ewu.edu), Office of Academic Planning, by September 15, 2016.**

Degree/Certificate: Bachelor of Arts in Education
Major/Option: Mathematics/Elementary major, Mathematics/Elementary with Middle Level Mathematics Endorsement Option major, and Mathematics/Secondary with Middle Level Endorsement Option major
Submitted by: Mathematics Education Committee
Date: September 15, 2016

Part I – Program SLO Assessment Report for 2015-16

Part I – for the 2015-16 academic year: Because Deans have been asked to create College-Level Synthesis Reports annually, the template has been slightly modified for a) clarity for Chairs and Directors, and b) a closer fit with what the Deans and Associate Deans are being asked to report.

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

   Demonstrate an understanding of and an ability to use the Mathematical Practices [from Standards for Mathematical Practice (SMPs) from the Common Core State Standards for Mathematics (CCSSM)] and specifically a productive disposition as a student and teacher of mathematics.

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;*
   _X___*SLO is met, but with changes forthcoming;*
   _____*SLO is met without change required*

This is the first year for this SLO to be assessed since the updating of the Program SLOs for the BAE Mathematics/Elementary major, Middle Level Mathematics Endorsement Option majors. Data was collected for program review in four classes Winter Quarter 2016: MATH 211, 212, 311, and 411. Math 211 and 212 are courses for generalists in Elementary Education that are required for majors in the three programs being assessed. They provide a baseline for all SLOs in the programs. Math 311 and 411 are courses that are required for all majors in the three programs being assessed. The data collected from the four courses provide a snapshot of the range of types of expectations encompassed by the SLO as well as the range proficiency of the students in meeting the expectations of the SLO.

The focus of this SLO is on students demonstrating a productive disposition for mathematical proficiency. The SMP section of the CCSSM explains that the definition of productive disposition is taken from the National Research Council's report *Adding It Up,* and is defined as a habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence

and one's own efficacy. Because the SLO refers to a productive definition for teaching as well, the SLO includes the expectation that our majors are aware and attend to producing and assessing productive dispositions in their future students.

The following is an explication of the strategies, methods, observations, and findings gathered from data by course. The course-by-course explication represents the strategies and methods and findings for the program assessment of the SLO. Following the course-by-course analysis of findings is a summary analysis of the findings for the program assessment of the SLO for the three programs as a whole.

MATH 211

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

Task

To solve the multiplication problem 22×49, Cindy writes the following:

> *22 is about 20 and 49 is almost 50, and 20×50 is 1000. Because I used 20 instead of 22, I added 49 twice. Then, because I used 50 instead of 49, I took away 20. So for my answer I get $1000 + 49 + 49 - 20 = 1078$.*

Why does this give Cindy the correct answer?

Note: It is NOT enough to just check that $22 \times 49 = 1078$. You must explain why Cindy did each step. However, you do not have to explain why this works for all multiplication problems, just for this one problem.

This task was chosen because it reveals both the students' attention to the underlying structure of multiplication and to their attentiveness to future students' reasoning about multiplication. Teachers of elementary mathematics must understand the underlying structures of the operations of arithmetic in order to assess and to respond to their students' understanding of the operations appropriately. Attending to underlying structures of arithmetic operations is evidence of "making sense" of the operations. Students who meet the SLO on this task show a disposition for sense-making and to attending to their students' disposition for sense-making.

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

Student Response Rubric for Disposition toward Mathematics Teaching and Learning

Mathematical Disposition	
Met	Explains how changes in each factor of a multiplicative number sentence effect the production of the product. Able to use that knowledge to reverse the process appropriately to produce the intended product of the original number sentence. Explanation addresses the two roles of factors in producing the product: number of groups and number of items per group.
Not Met: Partial	Addressed only one role of factors in producing product.

Not Met: Lack With Disposition to students	Did not understand the role of factors in producing products.
Exceeded	Detailed attention to promoting potential elementary students' understanding of multiplicative reasoning
Met	Acknowledgement of elementary student when explaining how changes in each factor of a multiplicative number sentence effects the production of the product. Able to use that knowledge to reverse the process appropriately to produce the product of the original number sentence. Explanation addresses the two roles of factors in producing a product: number of groups and number of items per group.
Not Met	Failure to acknowledge the elementary student in the explanation and/or explanation fails to address one or more of the roles of the factors in producing the intended product or exhibits a lack of understanding of how factors produce a product.

b. Analysis of findings:

	Mathematical Disposition			With disposition to students		
	Not Met					
	Lack	Partial	Met	not met	met	exceeded
All students	9 (14%)	22 (35%)	32 (51%)	36 (57%)	26 (41%)	1 (2%)
Majors	1 (9%)	4 (36%)	6 (55%)	6 (55%)	4 (36%)	1 (9%)

- More than half of all the students including more than half of identified majors demonstrated a mathematical disposition.
- Of those students (majors and non-majors) that did not meet the standard for a mathematical disposition, more than half demonstrated some understanding of the structure of multiplication.
- Most of the students who demonstrated a mathematical disposition also demonstrated a disposition to students
- One student (a major) exceeded expectations

Sample Student Responses

Exceeds Expectations for Disposition

22 is about 20 and 49 is almost 50, and 20 × 50 is 1000. Because I used 20 instead of 22, I added 49 twice. Then, because I used 50 instead of 49, I took away 20. So for my answer I get 1000 + 49 + 49 – 20 = 1078.

1000 + 49 + 49 + 20 = 1078

stands for squares

stands for rows

Why does this give Cindy the correct answer?

Note: It is NOT enough to just check that 22 × 49 = 1078. You must explain why Cindy did each step. However, you do not have to explain why this works for all multiplication problems, just for this one problem.

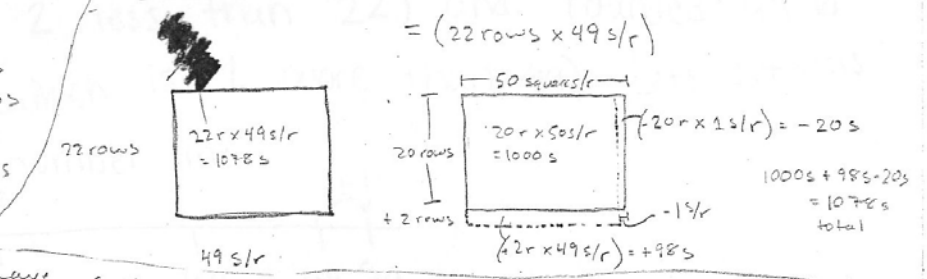
22 rows × 49 squares/row

① [(22 rows × 49 s/r) − (2 rows × 49 s/r)] + (20 rows × 1 s/r) = (20 rows × 50 squares/r)

② [(20 rows × 50 squares/row) − (20 rows × 1 s/r)] + (2 rows × 49 s/r)

= (22 rows × 49 s/r)

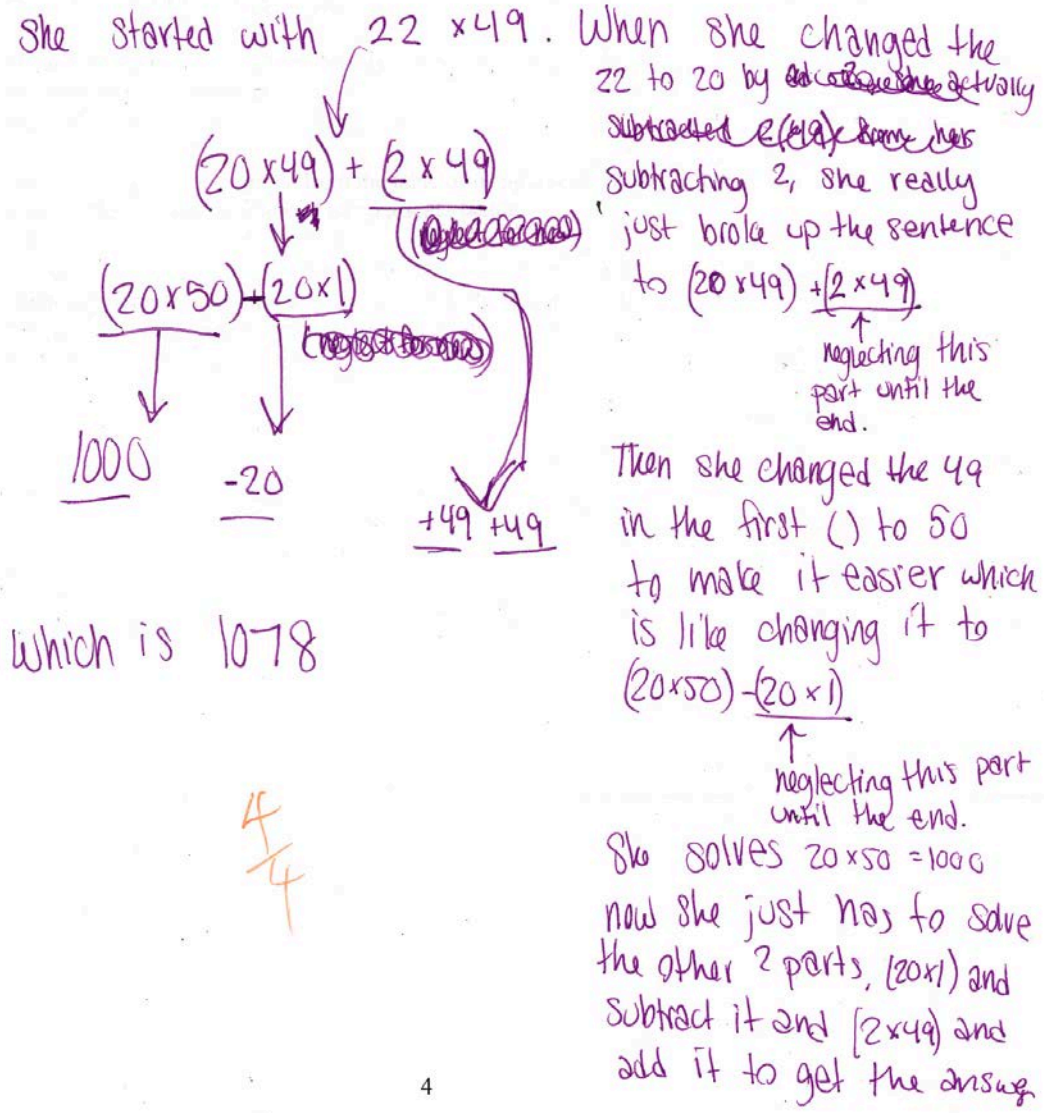
22 rows
× 49 squares/row
18s = 9 s/r × 2 rows
180s = 9 s/r × 20 rows
80s = 40 s/r × 2 rows
800s = 40 s/r × 20 rows
980s
98s
1078s



1000s + 98s − 20s = 1078s total

I have a couple things going on here. First I made number sentences using the distributive property, then I also used arrays a visual. Number sentence ① shows what Cindy started out with, the 22rows × squares/row, then I wrote what she did to that first number sentence to get at she wanted which was (20 rows × 50 squares/row). In number sentence ②, I lained what Cindy was trying to explain. So, she changed 22rows × 49squares/row 20 rows × 50 squares/row which I showed in number sentence ①. So, in number tence ②, Cindy says she multiplied 20 rows × 50 squares/row, but to make up for at she added or took away before, she "added 49 twice" because she "used instead of 22", so to show this in the number sentence I added 2 rows × squares/row, and Cindy did this part correctly because she initially took away ows with 49 squares in each row, and now shes adding them back, to compensate what she did earlier. Then cindy says "because I used 50 instead of 49, I took ay 20" and in number sentence ② I showed this as 20 rows × 1 square/row ng subtracted from 20 rows × 50 squares/row. Again, Cindy is compensating for at she originally did to the number sentence; she originally added 20 rows × /r to 22 rows × 49 s/r which is shown in number sentence ①, and then she es that same amount out, the 20 rows × 1 s/r, from 20 rows × 50 s/r which is wn in number sentence ②. I left the number sentences as equations and not wers to show that after she manipulates the rows and squares/rows, ends up with the same equation as she started with in the begining h is 22r × 49s/r, because whatever she added/subtracted, she remembered to back or subtract from in the end as well, which is why this works for multiplication problem. The arrays are to show a visual of what she did. The shows the original array. So she took away 2 rows with 49 s/r, but then

Met Expectations for Disposition



MATH 212

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

As Exam #1 was reviewed in class (at Week 4 in the Winter Quarter), it was emphasized that students would be turning that Exam back in on the last day of the Quarter, along with any needed corrections. One question on that Exam #1 was discussed in particular (due to it having multiple ways of framing a solution), along with suggested modifications for practice, and a variation of that question appeared on the Final Exam. By analyzing student performance on the question as it appeared in the Final Exam, and cross-referencing that with the performance on similar item in Exam #1, one possible aspect of student disposition emerges.

Namely, the capacity for self-correction, along with the desire to learn from past errors in moving forward, is a positive dispositional trait for students seeking to grow in their own mathematical

comprehension. It was expected that students who did in fact make any necessary self-corrections and/or modified practice and review would do as well or better on the similar item asked on the Final Exam.

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

Of the 53 student responses collected from two Sections of MATH212 in Winter 2016, two were culled because they received no errors on the specific questions under analysis (receiving 100% on the question both on Exam #1 and the Final Exam). Four categories were identified for the remaining 51 students –

[1] NO EVIDENCE OF CORRECTIONS OR MODIFIED PRACTICE : 24/51 ≈ 47.1%
[2] NO EVIDENCE OF MODIFIED PRACTICE : 11/51 ≈ 21.6%
[3] SOME EVIDENCE OF CORRECTIONS OR MODIFIED PRACTICE : 7/51 ≈ 13.7%
[4] GOOD EVIDENCE OF CORRECTIONS OR MODIFIED PRACTICE : 9/51 ≈ 17.6%

    b. Analysis of findings:

There are several plausible reasons why almost 70% of the 51 students (in Categories [1] and [2] above) actually scored worse on the Final Exam version than on the Exam #1 version. First, a duration of at least five weeks passed from Exam #1 and the Final Exam, and while that offered much time for corrections, some may have simply forgotten the material or never got around to making the corrections (such as those in Category [1]). Second, a certain modification to the Exam #1 question was suggested in class, and it seems clear that those in Category [2] did not attempt that modification. Third, and most salient, despite the encouragement in class to make self-corrections and practice on modified problems, these suggestions were not part of a graded assignment. Students focused only on getting through an Exam or Quiz may be more concerned with accruing points credited toward passing the class and less disposed to actually mastering the material.

For the almost 30% of the 51 students (in Categories [3] and [4] above), scores on the Final Exam version were the same or higher than on the Exam #1 version. In Category [3], only marginal improvement was made by students, so that their Final Exam score on the question was still below mastery. One possible explanation is that, while making self-corrections and attempting practice on modified problems, they still hadn't fully comprehended the concepts being addressed. Of the students in Category [4], a vastly improved performance on the Final Version as compared with the Exam #1 version went along with evidence of both self-corrections and practice on the modified problems. This suggested a disposition toward mastering the material.

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

Task

2) $k(x) = 7 - \frac{3}{4} f\left(\frac{1}{2}(x-5)\right)$

A) Describe the order of transformations from f to k.

B) Use any one of parametric reasoning, composition reasoning, or parametric function reasoning to explain why those are the correct transformations.

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

Student responses were scored according to the following rubric:

Not Met: Student makes assumptions not warranted by the problem. Does not take audience into account. Writes a response that is more a record of work than a explanation addressed to another person. Provides an explanation that does not include explanatory text. Work contains major mathematical errors that show a disinclination or inability to make sense of the rules.
Met: Provides a single explanation, with an emphasis on rules and procedure. Only minor mathematical errors.
Exceeded: Provides thorough explanation, using more than one of the assigned methods, including detailed explanatory text. Fully details not only the rules, but also the reason for the rules.

    b. Analysis of findings:

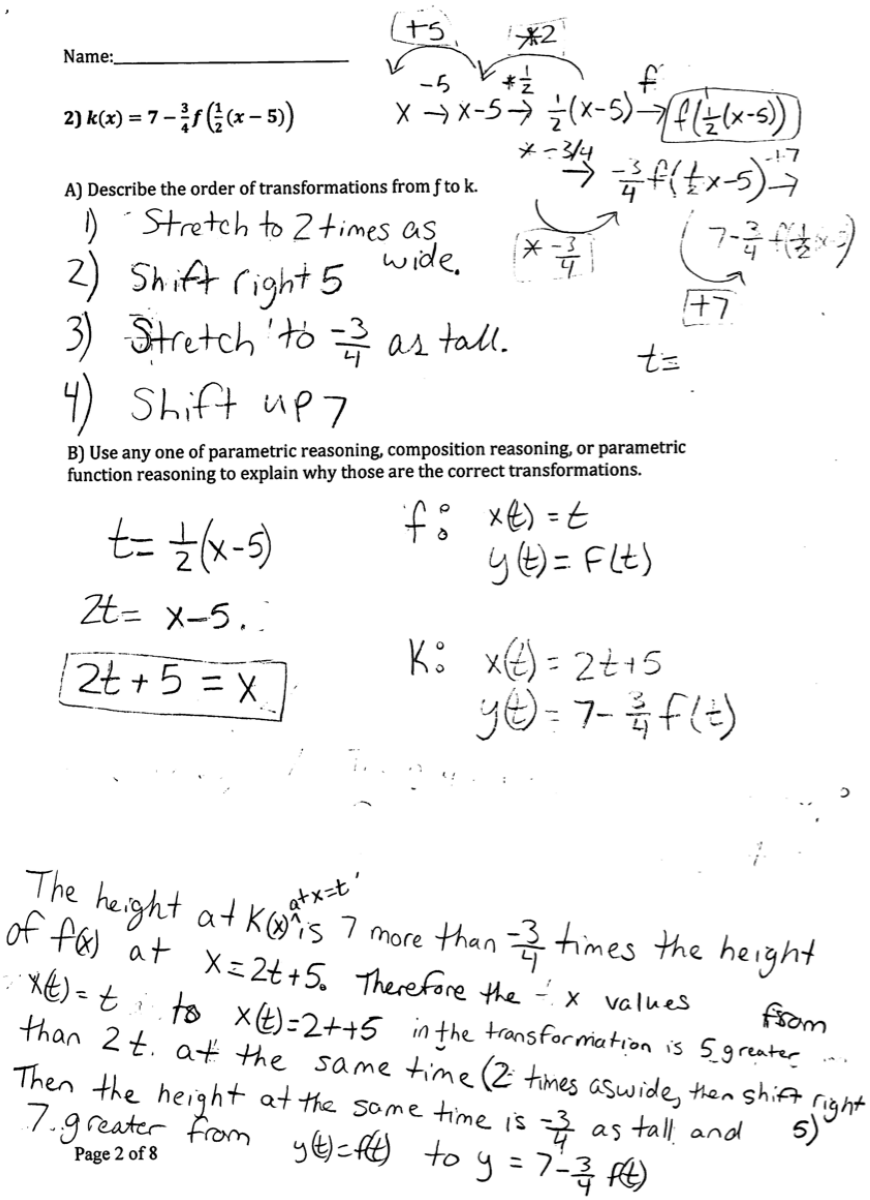
Results

	Not attempted	not met	met	exceeded
Dispositions		1	1	1

Observations:

- Majority of students explained each step they used individually, with both the step, the interpretation, and the result explained.
- Majority of students emphasized following a procedure or a technique, rather than explaining why the procedure or technique was sensible and correct.

Sample Student Response



Name:_____

2) $k(x) = 7 - \frac{3}{4} f\left(\frac{1}{2}(x-5)\right)$

A) Describe the order of transformations from f to k.

1) Stretch to 2 times as wide.
2) Shift right 5
3) Stretch to $\frac{-3}{4}$ as tall.
4) Shift up 7

B) Use any one of parametric reasoning, composition reasoning, or parametric function reasoning to explain why those are the correct transformations.

$t = \frac{1}{2}(x-5)$

$2t = x-5$

$2t+5 = x$

f: $x(t) = t$, $y(t) = f(t)$

K: $x(t) = 2t+5$, $y(t) = 7 - \frac{3}{4} f(t)$

The height at $K(x)$ at $x=t$ is 7 more than $\frac{-3}{4}$ times the height of $f(x)$ at $x = 2t+5$. Therefore the x values from $x(t) = t$ to $x(t) = 2t+5$ in the transformation is 5 greater than 2t. at the same time (2 times as wide, then shift right 5) Then the height at the same time is $\frac{-3}{4}$ as tall and 7 greater from $y(t) = f(t)$ to $y = 7 - \frac{3}{4} f(t)$

Page 2 of 8

Implications:

- Students seem to be more concerned with how to get the result, than why the method is reasonable. As future teachers of mathematics, explanations in their own classrooms should include both. In 311, greater emphasis needs to be placed on the value of sense making and strategizing over memorizing and doing.
- Students need more practice doing sense making with less instructor support. This may be a modification to 311, but it may not be necessary in 311 specifically; a follow on course (such as problem solving) could serve a similar purpose.

MATH 411

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

Students answered the following on a quiz in the 7th week of the quarter: True or false: If a, b, and c are integers and a|b and a|c, then a^2|bc. Use informal reasoning to justify. Prove.

It addresses the SLO by:

- •asking students to demonstrate understanding of divisibility, justify their reasoning, use correct language from K-8 standards, and understand how to write a proof at the level of high school.

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

	Not met	Met	Mastered
Understand and use key terms and notation correctly (e.g. 'factor' vs. 'multiple')	4 (30.8%)	9 (69.2%)	1 (7.7%)
Create an argument with a logical flow	6 (46.2%)	6 (46.2%)	1 (7.7%)
Fully justify each statement with valid mathematical reasoning	5 (38.5%)	6 (46.2%)	2 (15.4%)

   b. Analysis of findings:

- Many students have a poor understanding of informal reasoning.
- One student still misunderstands the 'divides' notation and uses it as an operator.
- Overall, students demonstrated a good understanding of being precise while describing their understanding, but sometimes confused vocabulary important to future teachers (e.g. factor vs. multiple, divides vs. division)
- Overall, students understand the structure of a proof and can use it to demonstrate a proof of the statement.

Analysis of findings across courses:

The tasks and analysis for the SLO across the four courses reveal the different possible interpretations of the SLO, but all suggest two significant aspects: a disposition to make sense of a mathematical topic at more than a procedural level and a sense of self-efficacy alternatively defined as the diligence to improve one's own understanding of a mathematical topic. Across MATH 211, 311, and 411 approximately two thirds of the majors demonstrated a disposition to make sense of a mathematical topic at more than a procedural level. This may suggest little change in our majors' dispositions to make sense of a mathematical topic at more than a procedural level.

The evidence for self-efficacy from MATH 212 is difficult to interpret for our programs since our majors were not identified in the data. If the assumption is made that roughly 16% of the students were our majors based on the data from MATH 211, then all or a majority of our majors may have been in the 30% who demonstrated self-efficacy. In addition the two students who were excluded from the data collection may have been our majors.

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

For MATH 211, proposed changes will begin with focused class discussion on the topic of what constitutes a productive disposition and how it can be promoted in elementary students. Feedback to students on assessments will include attention to evidence of productive dispositions. This will begin Fall 2016 and continue throughout the academic year.

For MATH 212, a two-step process will be phased in to the next academic year. In the first step, a cycle of self-correction, modified practice, and re-assessment (on similar versions of a specific question type) will be implemented as part of a graded assignment. In other words, students will receive points accruing toward a quarter grade simply for acting in accord with the desired disposition. In the second step, again a similar cycle as in the first step will be in place, but the actual work of self-correction and modified practice will be suggested rather than assigned as part of a graded assignment. In this manner, it is hoped students gravitate to the disposition of seeking to grow in mathematical understanding for its own sake (and not just to pass an Exam, Quiz, or Class). The two-step process as described for MATH212 will be phased into the courses taught in Fall Quarter, 2016. Then a review of results will suggest any refinements moving on into Winter and Spring of 2017.

Because of the small numbers in MATH 311, no changes have been proposed as there was insufficient data to suggest the need or direction for change if any.

For Math 411, use of correct language was not emphasized early in the quarter. We will discuss the importance of precise and correct language and notation use early in the quarter and give students opportunities to examine and assess their own use of language and notation. The changes will be incorporated in MATH 411 in winter. The need for more informal reasoning, and focus on language and notation has been discussed in the Mathematics Education Committee so that earlier courses can also emphasize on language and notation. We will develop a rubric to better capture what we expect of students and share the rubric with them for MATH 411.

6. Description of revisions to the assessment process the results suggest are needed and an evaluation of the assessment plan/process itself.

Because productive dispositions have not been assessed in our program prior to this year, this year's assessment provides baseline evidence for what assessment items and types were currently available in our courses to assess this SLO. The Mathematics Education Committee is currently engaged in evaluating and revising our current assessment plan/process based on the experiences of the past five years and the new needs that have arisen at the University level. We have begun the process of identifying, refining and articulating the SLOs for our programs with particular attention to how SLOs are addressed/assessed across courses. We have observed that our course objectives need to be revised to align with our SLOs and that we need to design a process for meeting SLOs that builds across our programs. Based on the data we have collected on this SLO, we will identify sub-goals with related activities and assessment processes across all courses to build productive dispositions in both our majors and in the larger population of elementary mathematics teacher candidates as part of our work on revising our assessment plan/process.

NEW: PART II – CLOSING THE LOOP
FOLLOW-UP FROM THE 2014-15 PROGRAM ASSESSMENT REPORT

In response to the university's accrediting body, the Northwest Commission on Colleges and Universities, this section has been added. This should be viewed as a follow up to the previous year's findings. In other words, begin with findings from 2014-15, and then describe actions taken during 2014-15 to improve student learning along, provide a brief summary of findings, and describe possible next steps.

PLEASE NOTE: The College-Level Synthesis report includes a section asking Deans to summarize which programs/certificates have demonstrated "closing-the-loop" assessments and findings based on the previous year's 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 2014-15

   Possess a deep understanding of how students learn mathematics and of the pedagogical knowledge specific to mathematics teaching and learning.

2. **Strategies implemented** during 2015-16 to improve student learning, based on findings of the 2013-14 assessment activities.

   One proposed change was to provide elementary and elementary / middle level mathematics majors with more field opportunities focused on mathematics. It is believed that opportunities for elementary and elementary / middle level mathematics majors to work with children on mathematics tasks at the elementary / middle school level will reinforce the knowledge for teaching mathematics that they are learning in the courses prior to MTED 490 and make it more accessible to them when they are responsible to teach mathematics lessons. More mathematics-focused field placements will provide elementary and elementary / middle level mathematics majors with more opportunities to develop knowledge of elementary mathematics learners. To that end we negotiated with the Education Department and worked through our advising to promote the scheduling of the MTED 390 course after our majors are in their field placements.

Second, an early field placement course (MTED 293) has been developed and approved for secondary and secondary/ middle level mathematics majors to increase their knowledge of K-8 students and to reinforce their knowledge of elementary / middle level mathematics content for teaching that they have acquired in their prior courses.

Finally, we worked on the proposal to extend the elementary/midlevel mathematics content courses from two courses to three has the potential for deepening students' understanding of the mathematics that they will be teaching. We believe that increasing the number of courses will allow more time to develop models and conceptual underpinnings of important content such as proportional reasoning that have been noted to be weak in prior program assessments. University paperwork for this course sequence was submitted in Fall of 2015 but approval has been delayed until the 2016-2017 academic year to resolve Education Department concerns.

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.

   There has not been enough time to evaluate the efficacy of the changes enumerated in #2.

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

   We are reviewing and updating our course objectives for all three programs.

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 in the assessment planning and process, 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