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 Science in Mathematics

Major/Option:

Submitted by: Math Curriculum Committee
Date:

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.

   SLO # 1: Create and understand mathematical arguments and proofs
   SLO #2: Demonstrate the ability to communicate mathematical concepts both technically and non-technically;
   SLO # 3: Perform analysis with numerical and symbolic mathematical technology/software;
   SLO # 4: Discuss mathematical applications in industry and the sciences.

   SLOs Assessed AY 2014-15: 1,2,3

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*

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

The Math Curriculum Committee (MCC) has developed the program assessment method through a collaborative effort. Furthermore, in order to align with the University Core Skills assessment that took place during the 2015/16 academic year, a universal spreadsheet was developed that serves as a tool for collecting assessment data for both program and University core skills assessment purposes. In the spreadsheet, which will eventually be used for each course taught as part of the program, specific course learning objectives are mapped to both University Core Skills and Program SLOs.

An example of such mappings is shown below:

Course:	MATH 385	Section :	1
Term:	Fall 2014		
Course SLO Assessed:	3,4,5		
Core Skill Assessed:	3		
Program SLO Assessed:	1,2		

		University Core Skill				Program Student Learning Outcome (BS, Mathematics)			
	Course Student Learning Outcome	1. Read Critically	2. Write Critically	3. Analyze Quantitatively	4. Perform or Present Publically	1. Demonstrate the ability to create and understand mathematical arguments and proofs;	2. Demonstrate the ability to communicate mathematical concepts both technically and non-technically;	3. Demonstrate the ability to use numerical and symbolic mathematical technology/software;	4. Demonstrate knowledge of mathematical applications in industry and the sciences.
1	Prove and apply counting techniques, including those involving combinations, permutations, partitions and the basic multiplication rule.			x		x	x		
2	When presented with a word problem, decide what counting techniques apply and use these to calculate probabilities of events when the sample space	x		x			x		
3	**Prove simple probability rules based on stated axioms and results well-known from set theory.**			x		x	x		
4	**Solve word problems by applying either the law of total probability and Bayes' rule or tree diagrams combined with the definition of conditional probability.**	x		x			x		
5	**Solve word problems which require the ability to recognize and use probabilities implicitly stated as unions, intersections or conditional probabilities.**	x		x			x		
6	Determine whether a given function is a valid probability function, probability density function or cumulative distribution function.	x		x			x		
7	Calculate the mean and variance of discrete and continuous random variables, including instances when such calculations require the use of infinite series, improper integrals and/or integration rules.			x			x		
8	Recognize situations when a standard discrete or continuous probability distribution, including the binomial, geometric, hypergeometric, Poisson, uniform, normal or exponential distribution, can be applied and identify the parameter(s) of the stated distribution.	x					x		
9	Use formulae, tables or technology when applicable to find probabilities or a mean and variance when a standard distribution applies.			x			x	x	
10	State and apply the Central Limit Theorem.			x			x		
11	Given that X has a normal distribution with mean mu and variance sigma^2, derive the distribution of (X-mu)/sigma. Use this result along with normal probability tables to calculate probabilities associated with X			x			x		
	Set-up the appropriate null and alternative hypotheses from word problems								

For the 2015/16 program assessment report, a variety of courses ranging from freshman to senior level were chosen:

Math 161: Calculus I
Math 162: Calculus II
Math 163: Calculus III
Math 241: Calculus IV
Math 225: Foundations of Mathematics
Math 231: Linear Algebra
Math 301: Discrete Mathematics
Math 370: Survey of Geometries
Math 385: Probability and an Introduction to Statistics
Math 432: Rings and Polynomials
Math 447: Differential Equations
Math 460: Continuous Functions
Math 494: Senior Seminar

In each course, the instructor has chosen two or more questions/assignments that ideally each relate to a unique course learning objective (or possibly more than one). The spreadsheet referenced above identifies which program SLO(s) the question(s) can be used to assess. The student answers or performances are scored for assessment purposes using a scale from 0-5. The following rubric is used to determine whether the SLO is met or not:

0-2: Not meeting goal (student is lacking the skill)
3-4: Minimally meeting goal (student is developing the skill)

5: Fully meeting goal (student has mastered the skill)

For University Core Skills assessment, the same rubric is used. When tabulating the data, it may be useful to compare the percentage of students who have met the goal across the different grades assigned in the course. An example of such results is shown below (color coded for additional emphasis):

Student	Score on Question 3	Total Score on Final Exam (out of 200 points)	Course Grade	Assessment Score 3
1	5	174	3.0	Fully Meeting Goal
2	2	156	3.0	Not Meeting Goal
3	2	176	3.2	Not Meeting Goal
4	3	149	2.6	Minimally Meeting Goal
5	2	107	1.1	Not Meeting Goal
6	2	159	2.9	Not Meeting Goal
7	5	140	2.7	Fully Meeting Goal
8	5	156	2.9	Fully Meeting Goal
9	5	178	3.3	Fully Meeting Goal
10	1	141	2.5	Not Meeting Goal
11	5	191	3.7	Fully Meeting Goal
12	5	200	4.0	Fully Meeting Goal
13	5	176	2.9	Fully Meeting Goal
14	3	153	2.2	Minimally Meeting Goal
15	3	97	0.0	Minimally Meeting Goal
16	3	154	2.4	Minimally Meeting Goal
17	2	110	2.0	Not Meeting Goal
18	5	172	3.0	Fully Meeting Goal
19	3	167	2.9	Minimally Meeting Goal
20	5	178	3.3	Fully Meeting Goal
21	5	139	2.0	Fully Meeting Goal
22	2	110	1.3	Not Meeting Goal
23	5	196	3.9	Fully Meeting Goal
24	1	115	2.3	Not Meeting Goal
25	3	116	2.2	Minimally Meeting Goal
26	3	145	2.0	Minimally Meeting Goal
27	2	144	2.0	Not Meeting Goal
28	3	175	3.0	Minimally Meeting Goal
29	2	144	2.2	Not Meeting Goal
30	2	166	2.8	Not Meeting Goal

Students fully meeting goal (5):	36.67%
Students minimally meeting goal (3-4):	26.67%
Students not meeting goal (0-2):	36.67%

	3.5-4.0	3.0-3.4	2.5-2.9	2.0-2.4	<2.0
Students fully or minimally meeting goal (by course grade)	100.00%	71.43%	62.50%	55.56%	33.33%

Following the analysis of the data for a particular course, each course assessment is summarized, the results in two brief paragraphs identifying

1) Overview of the assessment
2) Remarks, including possible Intervention: changes proposed or implemented

Based on the collective data as well as individual summaries identified at the course level the MCC meets and decides for each SLO assessed if the goal has been met or not.

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

The detailed findings and analysis of findings of the 2015/16 data are reported in the attached documentation provided course by course. A summary of each course assessment is given below:

Course	Overview	Remarks	Faculty Contact
Math 161	• Three problems were given in the assessment. Each dealt with the relation between the geometrical concept of the slope of the tangent line with that of the derivative. • University Core Skills 1 and 3 were addressed. • The overall goal was to have the students comprehend the concept behind taking the derivative of a generic smooth function. This required more that just having them be able to compute derivatives of specific functions. • As a result of not just asking for computations the results were overall poor. • The first problem involved an understanding of the basic meaning of derivative as the slope of the tangent line. Roughly 40% did not meet, 40% minimally	• Currently students entering Math 161, Calculus I, do not believe they are responsible (in the sense of being questioned) for understanding the concepts underlying basic mathematical computations. In this case the resulting computation being 'taking the derivative' • Since they have not had experience with conceptual type problems then the overall poor results were not surprising. • Despite this fact, since the conceptual understanding of the derivative is of fundamental importance then the students entering the calculus sequence should be assessed on their comprehension of this topic. • One course improvement for me	Dr. Toneva

	met and 20% fully met the goal. • For the second problem, the students needed to relate the slope of secant lines with that of the tangent line. Over 80% did not meet, about 8% minimally met and 8% fully met the goal. • For the third problem the students needed to make the connection between the concept of the limit of the slopes of the secant lines and the derivative. Roughly 40% did not meet, 40% met minimally and 20% fully met the goal. ---	would be to provide more explicit diagrams on the board and exhibiting animations illustrating how the secant lines are being used to approximate the tangent line. ---	---------------------------------
Math 460	• For this assessment two problems were analyzed. • The first problem: prove that the product of two convergent sequences is also convergent. • The second problem: prove that the composition of two continuous functions is continuous. • Results: Problem 1: about 20% fully met, 50% minimally met and 30% did not meet the goal. Problem 2: 20% fully met, 40% minimally met	• It would be beneficial to introduce calculus and linear algebra 'proof' type problems to the students in Math 225. • Students in calculus and linear algebra have problems requiring written explanations. • The common denominator is dealing with written explanations • If students in calculus and linear algebra have had experience in explaining mathematical concepts	Dr. Toneva

	and 40% did not meet the goal. • These are poor results. The first problem was about convergent sequences, this is the major topic in Math 163, Calculus III. The second problem involved continuous functions, a fundamental topic first introduced in Math 161, Calculus I. Both problems required the students to give a proof. 'Proof techniques' is the major theme of Math 225, Foundations of Mathematics. These two problems involved connecting Math 225 with the calculus courses. While it is common that calculus students generally do poorly when asked to explain generic mathematical results, it is very disappointing that those few who went on to be math secondary students or math majors, were still uncomfortable and struggling with basic 'proof' problems.	then the transition to providing mathematical proofs and in general explaining higher level mathematics to others would be smoother for them. • Another alternative would be to change the current content of Math 460. Ease up on the concentration of rigorous proofs of the foundations of real analysis and put more emphasis on computations and applications.	
Math 225	Previously the students had	The initial introduction of limits	Dr. Gentle

	been introduced to the epsilon-delta definition of limits in Calculus I and had exercises involving establishing continuity of simple functions (such as linear functions). The topic of limits is important throughout mathematics and is the major concept in Math 460. For Math 225, the concept of quantification (universal and existential) is an important topic. It made sense for the students to study limits at an intermediate level and engage in exercises involving proving some basic facts about limits. The students were given a homework assignment with 5 multi-part problems involving limits. Results : about 25% fully met, 40% minimally met and 35% did not meet the goal. Overall the results were poor but it was a rigorous experience involving 'proofs' which helped convey to the students the transition from elementary computational math to conceptual mathematics.	from Calculus I did not seem to help at all. For better results more time would be needed to be spent in Math 225, on a thorough re-introduction to 'epsilon-delta'. This re-opens the general discussion of whether 'epsilon-delta' type exercises should even be introduced in Calculus I since student success with such exercises does not seem to weigh in on their subsequent comprehension of the concept of limits. If limits becomes a standard topic for Math 225, then it would be best to first give the students an overview the importance of limits in all areas of mathematics.	
Math 432	Previously math secondary students were required to take Math 431: Group Theory, the first of a three course sequence in Modern Algebra. However teachers of high school mathematics should have greater knowledge of polynomials and modular arithmetic. Unfortunately these were subtopics of the second	It will be necessary to introduce the general concept of 'algebraic structures' in order for the students to comprehend the theory of polynomials and modular arithmetic. This introduction should not be an isolated portion of the course. It should accompany the presentation of the basic results about	Dr. Gentle

	course in the sequence: Math 432, Ring Theory. This year was the first year that Math 432 was taught without Math 431 as a pre-requisite. It will take a few years to realign the study of modern algebra at EWU to serve both math majors and secondary math students. A major topic in the study of polynomials is factorization of a given polynomial into irreducibles. This year the main difficulty students had with this topic was the lack of understanding of the importance of the underlying context. Irreducibilty depends upon the nature of the coefficients used. Switching about from rational numbers , real numbers, complex numbers and modular numbers is necessary but caused great confusion for the students. While group theory is not needed in studying this topic the experience of having various groups as contexts for problems made it easier for a student to study polynomials in Math 432 after taking Math 431. There were several other situations where a previous study of group theory would have aided the students in understanding the abstract concept of ring theory. Many of the applications of Ring Theory involve basic understanding (at a comfort level) of mod 2. It would be a good idea to have mod 2 computational results introduced earlier to the students. This could be done in both Math 231: Linear Algebra	polynomials and modular arithmetic in order to motivate why such abstraction is required. If the students have never done problems involving mod 2 computations then it will be worthwhile to spend some time in convincing them that such computations are 'natural' and easy.	

	and Math 225: Foundations of Mathematics. Because of their lack of comfort working mod 2 the students had difficulty understanding and solving problems about Digital Communication. The students were given (on homeworks, tests and the final) about 25 problems involving factorization into irreducible polynomials. Five of these were used for the assessment. Results: about 30% fully met, 30% minimally met and 40% did not meet the goal.		
Math 447	• The assessment consisted of three problems. • Problem 1: involved solving systems of first-order differential equations by matrix exponentiation. • Problem 2: involved converting of high-ordered non-linear, scalar differential equations by converting them to a first-order system, and then using linearization to characterize the behavior of solutions to the original equation by equilibrium points. • Problem 3: involved comprehension and application of the Hartman-Grobman Theorem.	• In class discussion of weaknesses in homework as soon as possible after submission is of great benefit. • By later assigning similar problems gives the students a second chance to fully meet the goals • Meeting with students individually has great benefit. • The difficulty that the students had with eigenvalues brings up two issues which the math curriculum committee will discuss. First: how much emphasis should be placed on the topic of eigenvalues for Math 231, Linear Algebra?	Dr. Lynch

	• Results, for Problem 1: 60% fully met and 40% minimally met the goal, for Problem 2: 100% fully met the goal and for Problem 3: 80% fully met and 20% did not meet the goal. • The struggles for Problem 1 involved dealing with eigenvalues. In particular having either non-real eigenvalues or repeated eigenvalues led to errors in finding the real solutions of the system.	Second: generally students are weak when complex numbers are involved. How should students be introduced to complex numbers? This is important in order for the students to be comfortable in a complex number context in advanced courses.	
Math 385	• The assessment involved a problem with two parts taken from an exam. Both parts dealt computations related to simple probability rules based on stated axioms and results from set theory. The first part dealt with basic computations based on the rules and the second involved some preliminary reasoning prior to computation. • For part (a): 70% fully met, 20% minimally met and 10% did not meet the goal, for part(b): 30% fully met, 40% minimally met and 40% did not meet the goal. ---	This question appears to show surprisingly little correlation with final course grade. Part of the assessment process should involve analysis of such correlation. This particular assessment may be an exception to the expected positive correlation between student final grades and their scores on assessments. Overall the students showed strength in handling basic statistical computation but were a bit weak in dealing with statistical reasoning needed for subsequent computations. --	Dr. Hansen --------------------------------

Math 494	• This assessment involved a Project Assignment • Each student picked a mathematical topic of their own choice. • Both a presentation and a submitted paper of the topic were required. • Results: 2/3 fully met and 1/3 minimally met the goal.	• Meeting with each individual student (possibly several times) prior to their presentation helps a great deal. • Encouragement to give warm-up presentations to other students and friends is also beneficial.	Dr. Hansen

Math 231	• Three problems were used for assessment. • The first involved comprehension of linear systems. The students were required to not only provide the set of solutions to the system but also to relate the solution set to the concepts of subspace and basis. They also required to connect the solution set with the Rank and Nullity Theorem. • The second question involved three dimensional geometry. In particular the computation of the distance from a point to a subspace. Also they were asked to include a labeled conceptual diagram. • The third problem involved the concept of orthogonality in n-dimensional space. The students were asked to provide a proof that an orthogonal set of vectors was also a linearly independent set. • For the first problem roughly ¾ of the students fully met the goal and 1/8 did not meet the goal. For the second problem about one half fully met, and one third did not meet the goal. These students had difficulty in understanding the concepts involved. Meanwhile the main issue for those who minimally met the goal was due to errors in computation. For the third problem the	• It was encouraging that a majority of students were comfortable dealing with systems of equations because this topic is of fundamental importance for future STEM related applications. in all STEM related situations. • Overall the students did a good job in addressing the course SLO's. • However they did poorly on the departmental SLO #1 –constructing mathematical proofs. That being said , the manner in which the course was taught was done in order to introduce students to both linear algebra accompanied with 'proofs' that show where the resulting mathematical computations come from. Formulas were not given without explanations and proofs of the underlying concepts of linear algebra. • The results of the assessment indicate that the majority learned the underlying concepts, however many students did not learn how to perform mathematically rigorous proofs which is desired for students exiting	Dr. Oster

	results were almost the reverse of problem two, about one half did not meet while one third fully met the goal. Most of the students were unable to effectively engage in a 'proof' type problem.	this course. • This brings up the issue of what weight, and what methods of evaluation, 'proof' type problems should have in this course. This issue will be discussed by the math curriculum committee. • From a standpoint of addressing the University Core Skill of quantitative reasoning, the class utilized a great deal of quantitative reasoning throughout the class.	
Math 162 And Math 241	• The assessment involved 5 problems: #1 dealt with the Power and Sum Rules for differentiation of a polynomial, #2 with integrating even and odd power functions, #3 with the Chain Rule for differentiation involving trig functions, #4 with interpreting integration of a positive function as finding area under the	Give weekly quizzes which include retention of material from reading assignments. Students will gradually improve their handling for all types of problems, not just those involving basic computation.	Dr. Nievergelt

	curve and #5 with the Fundamental Theorem of Calculus. • Overall the results for both Math 162 and Math 241: the first three problems were good , most of the students fully met the goal. This was probably because the first three problems involved computations with elementary functions. These problems were at the level of Math 161, Calculus I. • For both Math 162 and 241 Problem 4, about 40% did not meet, 60% met minimally and 0% fully met the goal. The difficulty here was mostly likely 'not seeing the forest because of the trees'. Here the tree involved the indefinite integration of a non-elementary function but if the student had interpreted the definite integral as finding the area then no computation was necessary. • Problem 5, for Math 162:about 88% did not meet, 12% met minimally and 0% fully met the goal. For Math 241: about 70% did not meet, 30% minimally met and 0% fully met the goal. The poor results here were due to the students not recalling the Fundamental Theorem of Calculus. • It is certainly interesting that there was no obvious improvement from Math 162, Calculus II and Math 241, Calculus IV.		

Math 347	• This assessment involved 3 problems. Problem 1 dealt with the Product and Chain rules for differentiation involving trig and exponential functions. Problem 2 involved both a conceptual understanding of Taylor Series and the Fundamental Theorem of Calculus. Problem 3 with the Fundamental Theorem of Calculus. • Results: Problem 1, about 50% either did not meet or minimally met and 0% fully met the goal. Problem 2, 100% of the students did not meet the goal, Problem 3, about 75% did not meet, 25 % minimally met and 0% fully met the goal. • These problems were review type problems (from the Calculus sequence) for the students of Math 347, Differential Equations. The results reflect how difficult it is to enter into the topic of differential equations when the students arrive with poor retention of calculus results.	By giving weekly quizzes on retention of material from reading assignments, students will gradually improve their handling for all types of problems, not just those involving basic computation. As the course progresses students should then be able to review those results needed from the calculus sequence for the study of differential equations.	Dr. Nievergelt
Math 370	Understanding Euclidean Plane Geometry involves the comprehension of geometrical proof techniques based upon axiom systems and then the ability to prove basic geometric	Possibly spend a bit more time on the concept of axiom systems (and reduce amount of time on another topic in order to do so) but not to the extent of deleting fundamental	Dr. Gentle

	results. One of the main purposes of Math 225 is to cover proof techniques. Almost every student who struggled with Math 225 will suffer in topics involving 'proofs' in Math 370 (and in all upper division courses). Time is a two-fold problem. First how much time should be spent in Math 225 on the general concept of 'proofs' and then how much time should be spent in Math 370 on axiomatic geometrical proof techniques? Math 370 should introduce the students to many geometrical topics and not just emphasize the importance of geometrical proofs of Euclidean Geometry. Finding the right balance will be difficult (and will always depend upon the make-up of each individual class). This year the students did poorly presenting proofs utilizing the given axioms but overall did well with comprehension of other topics (such as geometrical constructions, Platonic and Archimedian Solids, Inversions, geometry and complex numbers, Euler's (Graph) Formula, Geometrical Transformations, Finite Geometries). The students were given about 20 problems during the course involving axiomatic type proofs of Euclidean and Non-Euclidean Geometric facts. Four of these	geometric topics that math secondary students should be introduced to.	

	were used for the assessment. Results: roughly 20% fully met, 30% minimally met and 50% did not meet the goal.		
Math 231	Solving linear systems is a major topic. At some point the students are allowed to use calculators (to get the reduced row echelon form). However there is always the difficulty of presenting the resulting 'parametric solution'. Finding non-trivial but manageable (and not too time consuming) applications is always a problem. This year I spent some time introducing the students to Markov Chains and Shift Registers. The students had difficulties dealing with exercises on these topics. One main difficulty was their unwillingness to provide a presentation of their results. Many continue to think that 'the answer' to a math question is to be presented as a number or function put inside a small box (and all other work involved in getting there becomes irrelevant once the box is filled). The assessment consisted of three parts: first part: 2 problems involving comprehension of the parametric solution of a system of equations, second part : 2 shift register problems, third part: 2 problems involving Markov Chains.	Once the very basic outline of solving a system of equations is given then will 'work backwards'. Start by giving them many RREFs and getting them to write down the corresponding solution (with a lot of parametric examples). In order to have them do problems involving Shift Registers (digital communication) will spend time introducing mod 2 arithmetic (without spending time on the underlying abstract algebra theory). Throughout the course (not just for shift registers) will assign various problems in the mod 2 context. Introduce Markov chains early in the course and then return to this topic after eigenvalues and eigenvectors are brought into the mix.	Dr. Gentle

	Results: for part one, roughly 50% fully met, 30% minimally met and 20% did not meet the goal; part two, 40% fully met, 30% minimally met and 30% did not meet the goal; part three 35% fully met, 40% minimally met and 25% did not meet the goal.		
Math 301	Comprehension and familiarity of modular arithmetic is extremely important for computer science. Taught Math 301 twice this year (fall and spring) and saw an improvement in student comfort with modular arithmetic this spring. The key seems to be in connecting modular arithmetic with applications such as digital communication and encryption. For the fall course I spent too much time on theoretical aspects prior to dealing with application topics. When asked to compute with large numbers the students had great difficulty because their calculators could not deal with the resulting extremely large numbers and they often just gave up not realizing modular techniques were required. The students were given numerous problems involving modular arithmetic. The assessment was based upon 5 specific problems (given to	I plan to continue giving the computer science students lots of computational problems involving modular arithmetic. They may struggle at first but soon get used to it and then towards the end of the course manage to comprehend the underlying theory better.	Dr. Gentle

	both classes). Overall for the fall course, roughly 35% fully met, 40% minimally met and 25% did not meet the goals, for the spring course 45% fully met, 40% minimally met and 15% did not meet the goals.		
Math 163	Calculus III has a grey cloud over it. Many of the students arrive with a negative view. Mostly due to the topic of 'infinite series', which they have been told is very difficult. Also at this point in their math education students should realize that a solution to a problem requires a presentation, unfortunately this does not seem to be the case presently at EWU. The result is a two-fold dilemma: the students think that the concepts involved in Math 163 are above the heads of almost all students in the class and the belief that to answer a math problem just requires a final numerical or functional result put inside a box with no explanation given. The assessment was based upon 4 problems involving properties of infinite series. Results; roughly 15% fully met, 50% minimally met and 355 did not meet the goals.	Hopefully 'Common Core' mathematics or something similar will eventually have an impact on easing the transition from high school to university level mathematics. The main thread of the common core is about the explanations and presentations of mathematical concepts involved in computations. Until then it is necessary to get students to buy into the fact that mathematics is not just about computation. I intend to continue emphasizing that the presentation of their homework problems will be a major component of their final grade and will continue to assign problems that require explanations. The topic of 'infinite series' follows that of 'infinite sequences'. The students get confused (even after giving them warnings) between sequence and series. It would help if the basic concept and various examples of sequences were introduced earlier (in Pre-calculus, and Calculus I and II).	Dr. Gentle

		Also the concept of mathematical induction would be useful when providing examples and problems. Easy type induction problems could be given in Pre-Calculus and Calculus I and II. Then induction would be a useful tool one could use for infinite sequences and series. This would also help Math 225 and Math 301 students for whom induction (not just computational in nature) is a major topic.	

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).

      Last year was the first year of the BS in Mathematics program (previously a BA program). Many changes are currently happening and the assessment process will evolve with and effect these changes. It is too early to specify which improvements have occurred due to previous assessments. Currently the main change due to assessments is that they prompt the faculty to have discussions and spark self-reflections. The results of assessments of the previous two years will play a major role in this coming year MCC discussions of course content, curriculum revision and student advising.

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

Assessment results will be used by the MCC (and the entire math department) throughout the year to help determine changes in the Math BS program, content for individual courses and overall methods of evaluation of students' mathematical understanding.

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

   Copies of the program and course change proposals submitted to UAC are on file in the Mathematics Department and available on request. Individual course assessments are available on the departments share drive.
   Assessment has always been a main theme of teaching mathematics: homework, quizzes, tests, final exam, projects and presentations. Students are continually assessed throughout the course because in order to learn math one must solve problems. Student work is then assessed, in the sense that students are provided with not only a numerical evaluation but with comments from the instructor indicating reasons underlying why their errors were made (although lately due to class size, sometimes evaluations of student work is done by computers).
   Concentrating on individual assessments consisting of a few problems has the danger of derailing the power of continual personal mathematical assessment. There are many assessment issues that should be dealt with which are not tied to such individual assessments. For example: alignment of grading procedures both within the department and as part of STEM. Are all courses with multiple sections assessed and graded consistently (because of the great number of lecturers and adjuncts this could greatly affect student grades)? Are overall math grades really lower than the other STEM departments (and if so does this affect recruitment of math majors)? In particular what does a 4.0 or a 0.7 in a math course mean? How much emphasis should be placed on having students provide written mathematical presentations? Should the math department continue the trend of using computer programs (like Web –Assign) to assess students? How to improve assessment while class size increases dramatically? What are the best ways to assess student understanding of technology use in math courses and how much weight should this carry? In general how will assessment procedures affect the mathematical standards at EWU? The mathematics taught at EWU should be at a level which allows for smooth transition to mathematics used in any STEM graduate program. Overall the goal should be that assessment procedures both support and aid us in doing so. Another major task will be to develop an assessment of the overall assessment process.

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 2015-16 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

   SLO # 1: Demonstrate the ability to create and understand mathematical arguments and proofs
   SLO # 2: Demonstrate the ability to communicate mathematical concepts both technically and non-technically

2. **Strategies implemented** during 2015-16 to improve student learning, based on findings of the 2014-15 assessment activities.

   Program and course changes due to the transition from BA to BS in mathematics along with the previous year's assessments affected attempts by faculty to improve student learning. At this point individual self-reflection of one's own previous assessments affected how courses were delivered in 2015-16. There was no detailed strategy taken in 2015-16, other than collecting more data .

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.

   As the assessment process evolves then the assessment results of others will impact how each faculty teaches a course.

The effects of program and course changes have not yet been thoroughly analyzed since these were just implemented in 2015/16.

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

   The strategy will be to encourage discussions about assessments and this will then lead to overall improvement of student learning. It will also stimulate further discussion and future planning of the overall assessment process for the mathematics department.

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