

Assurance of Student Learning Reflection 2024-2025	
Ogden College of Science and Engineering	Mathematics
049 Master of Arts in Mathematics	
Nick Fortune, Program Coordinator	
<i>Is this an online program?</i> ☒ Yes ☐ No	Please make sure the Program Learning Outcomes listed match those in CourseLeaf. Indicate verification here ☒ Yes, they match! (If they don't match, explain on this page under Evaluation)

Instructions: For the 2024-25 assessment, we are asking you to reflect on the last three-year cycle rather than collect data. It's important to take time to look over the results from the last assessment cycle and really focus on a data-informed direction going forward. In collaboration with your assessment team and program faculty, review each submitted template from 2021-2024 and consider the following for each Program Learning Outcome, add your narrative to the template, and submit the draft to your **ASL Rep** by **May 15, 2025**.

Overall Comment: The Master of Arts in Mathematics underwent a program revision at the beginning of this three-year reflection period. Therefore, we provide this overall comment here before the details of each Program Student Learning Outcome to contextualize the reflection.

The old program included 18 hours of mathematics and 16 hours of Teacher Leader courses and therefore housed in two departments. The new 30-hour program is housed completely in the Mathematics Department. The three new math courses were MATH 515, 585, and 595. These were first offered in 2023 Spring, Summer, and Fall respectively.

This means that the curriculum map changed during this period, we added two program learning outcomes, and we changed which classes pulled data for which learning outcomes. We also cleaned up the rubrics so that they corresponded to a learning outcome and not a course. This meant that the same rubric was used multiple courses providing data for a learning outcome. These changes were done incrementally and described in detail below.

Although not required, we collected data in 2024-2025. We describe some of that data below.

Program Student Learning Outcome 1	
Program Student Learning Outcome	Students will be able to communicate mathematics in a written form at a level commensurate with that of students completing a master's degree.
Evaluation	This program learning outcome is very relevant. The MA in Mathematics is specifically designed for those who are already teachers and want to pursue career advancement. Their ability to communicate mathematically (to their current/future students) is of the utmost relevance and importance. This SLO remained the same for each of the three years in the reflection period. However, each year we made minor adjustments to the instruments (see below).
Measurement Instruments	Measurement Instrument: Discussion boards, regularly assigned quizzes, and assessments from _____. A score of 8 or higher on a 10-point multipart rubric (see Rubric 1 below) will demonstrate students' ability to communicate mathematically. We expect at least 75% of students to meet this learning outcome. During each year, we pulled data from MATH 501, when we revised the program we first included data from MATH 515 here but chose to have MATH 515 provide data from SLO 3 so we pulled data from MATH 511 here. Even though not required, we collected data in 2024-2025 and used the same instruments as 2023-2024 (and met the success target). 2021-2022: MATH 501 (Introduction to Probability and Statistics) 2022-2023: MATH 501 (Introduction to Probability and Statistics) and 515 (Introduction to Number Theory) 2023-2024: MATH 501 (Introduction to Probability and Statistics) and 511 (Algebra from an Advanced Perspective) 2024-2025: MATH 501 (Introduction to Probability and Statistics) and 511 (Algebra from an Advanced Perspective) While everyone in our program is aware of how AI is going to change our jobs, an important thing we will continue to do is have proctored paper exams in testing centers. Given the modifications we made after the program revision, we are satisfied with how this learning outcome is being assessed.
Criteria & Targets	For all years of review our success target was "A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome." Each year we met the success target. 2021-2022 and 2022-2023 each had 100% of students meeting the target. Switching to collecting data from MATH 511 was good here as we had 85.7% of students meet this target in 2023-2024 and 90.91% in 2024-2025. We believe this is good as there is always room for improvement.
Results & Conclusion	Results: These results are as expected. Communicating mathematically is an extremely important skill and one we will continue to assess. The minor instrument changes were provided us a with evidence of program success in regards to this learning outcome. Conclusions: MATH 501 was taught relevately consistently during this time frame. MATH was taught for the first time in Spring 2023 and MATH 511 returned to a previously used textbook (prior to this window we attempted a different text that did not end up working well for students).

<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	As this learning outcome (along with all in our program) went through a long modification process during this three-year review period, we do not plan to make changes. Rather, we plan to continue to collect data in 25-26, 26-27, and 27-28 that matches what we collected in 23-24 and 24-25. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.
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Program Student Learning Outcome 2	
Program Student Learning Outcome	Students will be able to write proofs of theorems in mathematics.
Evaluation	This program learning outcome is very relevant. Proof writing is a cornerstone of mathematics, especially graduate mathematics. This SLO remained the same for each of the three years in the reflection period. However, each year we made minor adjustments to the instruments (see below).
Measurement Instruments	Measurement Instrument: Assessments from _____. A score of 8 or higher on a 10-point multipart rubric (see Rubric 2 below) for problems given on assessments will indicate that students are able to use multiple strategies in problem solving situations. We expect at least 75% of students to meet this learning outcome. During each year, we pulled data from MATH 503. MATH 515 was assessed in 2022-2023 and 2023-2024. Even though not required, we collected data in 2024-2025 and used the same instruments as 2023-2024 (and met the success target). 2021-2022: MATH 503 (Introduction to Analysis) 2022-2023: MATH 503 (Introduction to Analysis) and 515 (Introduction to Number Theory) 2023-2024: MATH 503 (Introduction to Analysis) and 515 (Introduction to Number Theory) 2024-2025: MATH 503 (Introduction to Analysis) and 515 (Introduction to Number Theory) While everyone in our program is aware of how AI is going to change our jobs, an important thing we will continue to do is have proctored paper exams in testing centers. Given the modifications we made after the program revision, we are satisfied with how this learning outcome is being assessed.
Criteria & Targets	For all years of review our success target was “A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome.” Each year we met the success target. 2021-2022: 83.3% (503) 2022-2023: 81.8% (503) and 100% (515) 2023-2024: 90% (503) and 100% (515) 2024-2025: 80% (503) and 100% (515) We believe that these numbers are reasonable. Proof writing is one of the hardest things in mathematics and it makes sense that students sometimes struggle but it is good that we are always meeting this target. We do see though that we are having more success in 515 compared

	to 503 and we believe that is based on the difficulty of real analysis content.
Results & Conclusion	Results: These results are as expected. Proof writing is an extremely important skill and one we will continue to assess. The minor instrument changes were provided us a with evidence of program success in regards to this learning outcome. Conclusions: MATH 503 was notoriously one of our hardest classes. We hired a new instructor that taught the course with a new perspective in 2023-2024 and 2024-2025 that the students really appreciated. He used new textbooks, supported students with videos, and provided numerous proof writing resources. MATH 515 was a new course in the program and assessed in the years that we taught it. Next cycle there will be a new instructor for both MATH 503 and MATH 515 (at some point during the cycle).
<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	As this learning outcome (along with all in our program) went through a long modification process during this three-year review period, we do not plan to make changes. Rather, we plan to continue to collect data in 25-26, 26-27, and 27-28 that matches what we collected in 23-24 and 24-25. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.

Program Student Learning Outcome 3	
Program Student Learning Outcome	Students will demonstrate their capacity to use multiple strategies and appropriate technology to apply mathematics in problem solving situations and will justify their solutions with sound logic.
Evaluation	This program learning outcome is very relevant. Using technology as a mathematics teacher is extremely timely and relevant (e.g., Desmos, GeoGebra). Furthermore, as a teacher, they need to be able to solve problems in multiple ways as their students will not all solve problems in the same way. This SLO remained the same for each of the three years in the reflection period and each year we used MATH 512 (Geometry from an Advanced Perspective) to gather data as geometry lends itself nicely to using dynamic geometry software (e.g., Desmos Geometry).
Measurement Instruments	Measurement Instrument: Assessments from MATH 512, Geometry from an Advanced Perspective. A score of 8 or higher on a 10-point multipart rubric (see Rubric 3 below) will demonstrate students' ability to choose appropriate strategies, including the use of technology, to solve problems and justify their solutions. We expect at least 75% of students to meet this learning outcome. While everyone in our program is aware of how AI is going to change our jobs, to gather data for this we use both proctored and unproctored assessment items. We have exams that have both proctored components and take home components so students use of technology and multiple strategies can be assessed. Given the modifications we made after the program revision, we are satisfied with how this learning outcome is being assessed.
Criteria & Targets	For all years of review our success target was "A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome." Each year we met the success target. 2021-2022: 100% 2022-2023: 80% 2023-2024: 80%

	2024-2025: 92.86% We believe that these numbers are reasonable as there is sometimes variation in how comfortable students are using technology based on their background coming into the program.
Results & Conclusion	Results: These results are as expected. There is sometimes variation in how comfortable students are using technology based on their background coming into the program. Conclusions: MATH 512 was taught by two different faculty during this review period. Both emphasized using multiple strategies to solve geometry problems as well as how to effectively and appropriate use technology. While this is the one learning outcome that stayed constant during this three-year review period, we believe this learning outcome is assessing what we want it to.
<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	We plan to continue to collect data in 25-26, 26-27, and 27-28 in the same way that we did for this last review period. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.

Program Student Learning Outcome 4	
Program Student Learning Outcome	Students will demonstrate their capacity for collaboration in the mathematics classroom as a learner and as a teacher.
Evaluation	This program learning outcome is very relevant. Collaboration is a pedagogical tool used by mathematics educators in our program. Even though we teach asynchronous online classes, it is paramount that students work together on problems. This mirrors how we would want them teaching their own mathematics classes in their job. Mathematics is a human activity and thus, collaboration is key to the success. This SLO remained the same for each of the three years in the reflection period. However, each year we made minor adjustments to the instruments (see below).
Measurement Instruments	Measurement Instrument: Discussion boards from _____. A score of 8 or higher on a 10-point multipart rubric (see Rubric 4 below) will demonstrate students' ability to collaborate when working towards solutions to problems. We expect at least 75% of students to meet this learning outcome. During 2021-2023 we used MATH 511 to gather data here. However, in 2023 we switched to MATH 503 and 512 as we found that those classes used the discussion boards the most as the problems tended to be the most difficult. This gave us more data to have for a student to then use the rubric to score them. We met the success target each year. 2021-2022: MATH 511 (Algebra from an Advanced Perspective) 2022-2023: MATH 511 (Algebra from an Advanced Perspective) 2023-2024: MATH 503 (Introduction to Analysis) and 512 (Geometry from an Advanced Perspective) 2024-2025: MATH 503 (Introduction to Analysis) and 512 (Geometry from an Advanced Perspective) Given the modifications we made after the program revision, we are satisfied with how this learning outcome is being assessed.

Criteria & Targets	For all years of review our success target was “A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome.” Each year we met the success target. 2021-2022: 88.9% (511) 2022-2023: 100% (511) 2023-2024: 80% (503) and 80% (512) 2024-2025: 80% (503) and 78.57% (512) These numbers are on the lower side in recent years (but still meeting our success target). We attribute this, in part, to the switch to Blackboard Ultra. We have communicated with relevant staff at WKU how the new setup for Discussion Boards hinders students’ ability to have back and forth discussion mirroring in-person discussion. This has been communicated to Blackboard and we hope that there is improvement. Of course, we have tried new ways to figure out how to encourage student discussion even in Blackboard Ultra.
Results & Conclusion	<u>Results:</u> These results are as expected, albeit slightly low. <u>Conclusions:</u> These numbers are on the lower side in recent years (but still meeting our success target). We attribute this, in part, to the switch to Blackboard Ultra. We have communicated with relevant staff at WKU how the new setup for Discussion Boards hinders students’ ability to have back and forth discussion mirroring in-person discussion. This has been communicated to Blackboard and we hope that there is improvement. Of course, we have tried new ways to figure out how to encourage student discussion even in Blackboard Ultra. Despite this, we believe this learning outcome is assessing what we want it to.
<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	As this learning outcome (along with all in our program) went through a long modification process during this three-year review period, we do not plan to make changes. Rather, we plan to continue to collect data in 25-26, 26-27, and 27-28 that matches what we collected in 23-24 and 24-25. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.

Program Student Learning Outcome 5	
Program Student Learning Outcome	Students will be able to communicate about research in mathematics education in a written form at a level commensurate with that of students completing a master’s degree.
Evaluation	This program learning outcome has only officially been assessed once (2023-2024) and twice if you include the data we collected this year (2024-2025). This program learning outcome was new when we did the program revision discussion on the first page of this document. While the program learning outcome was on the 2022-2023 document, we had not yet gotten a chance to teach MATH 585 and MATH 595 until Summer 2023 therefore, the first year it was assessed was 2023-2024. Therefore, as this program learning outcome is new, it is still relevant.
Measurement Instruments	Measurement Instrument: Discussion boards and written assignments from MATH 585, Advanced Mathematical Thinking I. A score of 8 or higher on a 10-point multipart rubric (see Rubric 5 below) will demonstrate students’ ability to read, interpret, and analyze research in mathematics education. We expect at least 75% of students to meet this learning outcome. 2023-2024: MATH 585 (Advanced Mathematical Thinking I) 2024-2025: MATH 585 (Advanced Mathematical Thinking I)

	We are satisfied with how this learning outcome is being assessed.
Criteria & Targets	For all years of review our success target was “A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome.” Each year we met the success target. 2023-2024: 100% 2024-2025: 83%
Results & Conclusion	<u>Results:</u> This was the second time that this learning outcome was assessed. These results are expected. <u>Conclusions:</u> The students in this class produced high quality discussions and assignments demonstrating an ability to read, interpret, and analyze research in mathematics education. MATH 585 was taught we implemented the course in a similar way except that some content was reordered to better support progression through the content.
<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	As this learning outcome is relatively new, we do not plan to make changes. Rather, we plan to continue to collect data in 25-26, 26-27, and 27-28 that matches what we collected in 23-24 and 24-25. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.

Program Student Learning Outcome 6	
Program Student Learning Outcome	Students will be able to conduct research regarding secondary students’ mathematical thinking.
Evaluation	This program learning outcome has only officially been assessed once (2023-2024) and twice if you include the data we collected this year (2024-2025). This program learning outcome was new when we did the program revision discussion on the first page of this document. While the program learning outcome was on the 2022-2023 document, we had not yet gotten a chance to teach MATH 585 and MATH 595 until Summer 2023 therefore, the first year it was assessed was 2023-2024. Therefore, as this program learning outcome is new, it is still relevant.
Measurement Instruments	Measurement Instrument: Capstone research projects from MATH 595, Advanced Mathematical Thinking II. A score of 8 or higher on a 10-point multipart rubric (see Rubric 6 below) will demonstrate students’ ability to design and conduct research in mathematics education. We expect at least 75% of students to meet this learning outcome. 2023-2024: MATH 595 (Advanced Mathematical Thinking II) 2024-2025: MATH 595 (Advanced Mathematical Thinking II) We are satisfied with how this learning outcome is being assessed.
Criteria & Targets	For all years of review our success target was “A score of 8 or higher on a 10-point multipart rubric. We expect at least 75% of students to meet this learning outcome.” Each year we met the success target. 2023-2024: 87.5% 2024-2025: 83%

Results & Conclusion	<u>Results:</u> This was the second time that this learning outcome was assessed. These results are expected. <u>Conclusions:</u> The students in this class demonstrated an ability to design and conduct research in mathematics education. They all created a research proposal, interviewed high school students (with appropriate IRB approval), analyzed results, and wrote a final paper. The goal of this course is for them to see how designing and conducting research can enhance how they would approach teaching the mathematics that they are interviewing students on. MATH 595 we implemented the course in a similar way except we changed the order of some assignments in the first 4 weeks of the semester.
<u>**IMPORTANT - Plans for Next Assessment Cycle:</u>	As this learning outcome is relatively new, we do not plan to make changes. Rather, we plan to continue to collect data in 25-26, 26-27, and 27-28 that matches what we collected in 23-24 and 24-25. We will be going through Academic Program Review during the next three-year assessment cycle, therefore, stability and generating data over a full review cycle will be helpful.

CURRICULUM MAP 049

Program name:	Master of Arts in Mathematics						
Department:	Mathematics						
College:	Ogden College of Science & Engineering						
Contact person:	Nick Fortune						
Email:	nicholas.fortune@wku.edu						
		Learning Outcomes					
		LO1	LO2	LO3	LO4	LO5	LO6
Key: I = Introduced R = Reinforced / Developed M = Mastered A = Assessed		Students will be able to communicate mathematics in a written form at a level commensurate with that of students completing a master's degree.	Students will be able to write proofs of theorems in mathematics.	Students will demonstrate their capacity to use multiple strategies and appropriate technology to apply mathematics in problem solving situations and will justify their solutions with sound logic.	Students will demonstrate their capacity for collaboration in the mathematics classroom as a learner and as a teacher.	Students will be able to communicate about research in mathematics education in a written form at a level commensurate with that of students completing a master's degree.	Students will be able to conduct research regarding secondary students' mathematical thinking.
Course	Course Title						
MATH 501	Introduction to Probability and Statistics I	R/M/A		I/R	I/R		
MATH 503	Introduction to Analysis	I/R	R/M/A		R/M/A		
MATH 511	Algebra from an Advanced Perspective	I/R/M/A	I/R	I/R	I/R		
MATH 512	Geometry from an Advanced Perspective	I/R	I/R	R/M/A	R/M/A		
MATH 515	Number Theory	R/M	R/M/A	R/M	R/M		
MATH 585	Advanced Mathematical Thinking I					I/R/M/A	I/R
MATH 595	Advanced Mathematical Thinking II						R/M/A

Learning Outcome 1 Rubric

For this learning outcome, it is expected that you will engage substantially in discussion boards during this class and demonstrate evidence of conceptual understanding of the content on the midterm, final exam, and paper/project. As part of the MA in Mathematics program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master's level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Explanations show mastery of content and deeper analysis/understanding of the content. Uses specific references to add to explanation. Makes connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Explanations show some analysis. Explanations show mastery and understanding of content. Minor or no connection to teaching of mathematics/statistics is made.	Explanations show some understanding of essential content, facts, but is lacking in greater analysis and evidence.	Explanations do not show understanding of basic content. Explanations are incomplete or inaccurate. Answers show that mastery of the general content is missing.	Product does not address the assignment, is off topic, or was not submitted.

More explanation:

1. A "0" means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.
2. A "2" means that a student provided explanations, but there was not enough evidence of understanding. This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.
3. A "5" means that a student has shown basic understanding of content and material. The base material is present and correct. A student who earns a "5" has an understanding of the concepts presented in class. To improve from "5" a student should include analysis or evaluation of the content. Elaborate beyond "How do you get this answer" toward "Why does this work?"
4. An "8" means that a student has mastered the content and is analyzing the content rather than just stating answers. An "8" typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching of mathematics/statistics.
5. A "10" means that a student's explanation is clear, directed, and evidence driven. Students who earn 10's are writing with the content as their guide to create analytical responses. Students who earn a "10" show understanding of content and relate this understanding to the teaching of this content in their current or future mathematics/statistics classrooms (e.g., considers their future students' thinking, including conceptions and misconceptions).

Learning Outcome 2 Rubric

For this learning outcome, it is expected that students demonstrate evidence of conceptual understanding of the content on assignments, midterm, and final exam. As part of the MA in Mathematics program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master's level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Demonstrates complete understanding. A correct and complete proof is given. Some irrelevant information may be included but does not affect the intended proof.	Demonstrates complete understanding. A correct approach to proving the theorem is attempted. Some statements may be unjustified or improperly justified, but errors are minor and could be fixed given time to polish the proof.	Demonstrates understanding of theorem to be proved, but proof is incomplete or does not prove the intended result. Statements linked into a reasonable (though perhaps misguided) attempt to prove the theorem. The proof may be left incomplete or may depend upon a major unjustified leap.	Attempts the proof but demonstrates little or no understanding.	Product does not address the assignment, is off topic, or was not submitted.

More explanation:

1. A "0" means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.
2. A "2" means that a student provided explanations, but there was not enough evidence of understanding. This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.
3. A "5" means that a student has shown basic understanding of content and material. The base material is present and correct. A student who earns a "5" has an understanding of the concepts presented in class. To improve from "5" a student should include analysis or evaluation of the content. Elaborate beyond "How do you get this answer" toward "Why does this work?"
4. An "8" means that a student has mastered the content and is analyzing the content rather than just stating answers. An "8" typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching.
5. A "10" means that a student's explanation is clear, directed, and evidence driven. Students who earn 10's are writing with the content as their guide to create analytical responses. Students who earn a "10" show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms (e.g., considers their future students' thinking, including conceptions and misconceptions).

Learning Outcome 3 Rubric

For this learning outcome, it is expected that students demonstrate evidence of conceptual understanding of the content on assignments, midterm, and final exam. As part of the MA in Mathematics program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master's level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.

Table 1: Rubric for non-proof problems.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Demonstrates complete understanding and gives correct solution that is identified and includes work/explains thinking.	Demonstrates understanding, shows work/explains thinking, and has a correct solution that is not identified, or “units” are not included or demonstrates understanding, shows work/explains thinking, but gets a slightly wrong answer.	Demonstrates some understanding and gives incorrect solution but shows work and provides explanations/justify thoughts.	Attempts the problem but demonstrates little or no understanding or gives correct solution but shows no work and/or provides no answer to back up correct solution.	Product does not address the assignment, is off topic, or was not submitted.

Table 2: Rubric for problems with proofs.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Demonstrates complete understanding. A correct and complete proof is given. Some irrelevant information may be included but does not affect the intended proof.	Demonstrates complete understanding. A correct approach to proving the theorem is attempted. Some statements may be unjustified or improperly justified, but errors are minor and could be fixed given time to polish the proof.	Demonstrates understanding of theorem to be proved, but proof is incomplete or does not prove the intended result. Statements linked into a reasonable (though perhaps misguided) attempt to prove the theorem. The proof may be left incomplete or may depend upon a major unjustified leap.	Attempts the proof but demonstrates little or no understanding.	Product does not address the assignment, is off topic, or was not submitted.

More explanation:

1. A “0” means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.
2. A “2” means that a student provided explanations, but there was not enough evidence of understanding. This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.
3. A “5” means that a student has shown basic understanding of content and material. The base material is present and correct. A student who earns a “5” has an understanding of the concepts presented in class. To improve from “5” a student should include analysis or evaluation of the content. Elaborate beyond “How do you get this answer” toward “Why does this work?”
4. An “8” means that a student has mastered the content and is analyzing the content rather than just stating answers. An “8” typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching.
5. A “10” means that a student’s explanation is clear, directed, and evidence driven. Students who earn 10’s are writing with the content as their guide to create analytical responses. Students who earn a “10” show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms (e.g., considers their future students’ thinking, including conceptions and misconceptions).

Learning Outcome 4 Rubric

For this learning outcome, it is expected that you will engage substantially in discussion boards related to the mathematics content. These discussion boards will demonstrate your capacity for collaboration as a learner and a teacher. As part of the MA in Mathematics program, it is expected that you will develop the ability to communicate mathematics in the written form as is expected for a master's level student. As such, your written work (as compared to numerical answers) on these assessments will be analyzed according to the following rubric.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Explanations show mastery of content and deeper analysis/understanding of the content. Uses specific references to add to explanation. Makes connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Explanations show some analysis. Explanations show mastery and understanding of content. Minor or no connection to teaching of mathematics/statistics is made.	Explanations show some understanding of essential content, facts, but is lacking in greater analysis and evidence.	Explanations do not show understanding of basic content. Explanations are incomplete or inaccurate. Answers show that mastery of the general content is missing.	Product does not address the assignment, is off topic, or was not submitted.

More explanation:

1. A "0" means that the student either turned in an explanation that did not address the question/content or did not turn in an assignment at all.
2. A "2" means that a student provided explanations, but there was not enough evidence of understanding. This typically means that a student did not elaborate well enough or had some factual/procedural errors or major conceptual errors, which did not provide enough evidence or comprehension of the material.
3. A "5" means that a student has shown basic understanding of content and material. The base material is present and correct. A student who earns a "5" has an understanding of the concepts presented in class. To improve from "5" a student should include analysis or evaluation of the content. Elaborate beyond "How do you get this answer" toward "Why does this work?"
4. An "8" means that a student has mastered the content and is analyzing the content rather than just stating answers. An "8" typically means that a student is venturing into more abstract ideas and concepts and is attempting to relate them to their teaching.
5. A "10" means that a student's explanation is clear, directed, and evidence driven. Students who earn 10's are writing with the content as their guide to create analytical responses. Students who earn a "10" show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms (e.g., considers their future students' thinking, including conceptions and misconceptions).

Learning Outcome 5 Rubric

For this learning outcome, it is expected that you will engage substantially in discussion boards during this class and demonstrate evidence of understanding of the content on the midterm, final exam, and paper/project. As part of the MA in Mathematics program, it is expected that you will develop the ability to read, interpret, and analyze research in mathematics education as is expected for a master's level student. As such, your written work on these assessments will be analyzed according to the following rubric.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Discussions and assignments show mastery of the ability to read, interpret, and analyze research in mathematics education. Makes connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Discussions and assignments show the ability to read, interpret, and analyze research in mathematics education. Makes some connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Discussions and assignments show some ability to read, interpret, and analyze research in mathematics education. Makes no connection to teaching.	Discussions and assignments do not show ability to read, interpret, and analyze research in mathematics education. Makes no connection to teaching.	Did not show ability to read, interpret, or analyze research in mathematics education. Makes no connection to teaching.

More explanation:

1. A “0” means that the student either turned in assignments that did not address the objective or did not turn in an assignment at all.
2. A “2” means that a student provided assignments, but there was not enough demonstration of the ability to read, interpret, and analyze research in mathematics education. This typically means that a student did not elaborate well enough or had some major misunderstandings.
3. A “5” means that a student has shown basic ability to read, interpret, and analyze research in mathematics education. A student who earns a “5” has an understanding what mathematics education research is but could improve by including analysis or evaluation of the content. Elaborate beyond “How did this research happen” toward “What does this mean?”
4. An “8” means that a student has demonstrated the ability to read, interpret, and analyze research in mathematics education. An “8” typically means that a student is venturing into more theoretically grounded ideas and concepts and is attempting to relate them to their teaching.
5. A “10” means that a student has demonstrated the exemplary ability to read, interpret, and analyze mathematics education research. Students who earn a “10” demonstrate a strong understanding of literature in mathematics education. Students who earn a “10” show understanding of content and relate this understanding to the teaching of this content in their current or future math classrooms (e.g., considers their future students’ thinking, including conceptions and misconceptions).

Learning Outcome 6 Rubric

For this learning outcome, it is expected that you will demonstrate evidence of understanding on assignments and a final project. As part of the MA in Mathematics program, it is expected that you will develop the ability to design and conduct research on mathematics education as is expected for a master's level student. As such, your written work on these assessments will be analyzed according to the following rubric.

10	8	5	2	0
Surpasses Standard (Mastery plus Connections)	Meets Standard (Mastery)	Approaching Standard	Not Yet Approaching Standard	No Attempt
Capstone project demonstrates the exemplary ability to design and conduct mathematics education research. Makes connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Capstone project demonstrates the ability to design and conduct mathematics education research. Makes some connection to teaching of mathematics/statistics in a thoughtful way, considering student thinking and understanding.	Capstone project demonstrates some ability to design and conduct mathematics education research. Makes no connection to teaching.	Capstone project does not demonstrate ability to design and conduct mathematics education research. Makes no connection to teaching.	Capstone project does not address the assignment, is off topic, or was not submitted.

More explanation:

1. A "0" means that the student either turned in a project that did not address the objective or did not turn in an assignment at all.
2. A "2" means that a student provided a project, but there was not enough demonstrate of the ability to design and conduct mathematics education research. This typically means that a student did not elaborate well enough or had some major misunderstandings.
3. A "5" means that a student has shown basic ability to design and conduct mathematics education research. A student who earns a "5" has an understanding of what mathematics education research is but could improve by including more analysis or evaluation.
4. An "8" means that a student has demonstrated the ability to design and conduct mathematics education research. An "8" typically means that a student is venturing into more theoretically grounded ideas and concepts and is attempting to relate them to their teaching.
5. A "10" means that a student has demonstrated the exemplary ability to design and conduct mathematics education research. Students who earn a "10" demonstrate a strong understanding of literature in mathematics education and the ability to design their own study that builds on that research. Students who earn a "10" relate this understanding to the teaching of this content in their current or future math classrooms (e.g., considers their future students' thinking, including conceptions and misconceptions).