

**George Mason University**  
**College of Education and Human Development**  
**Graduate School of Education**  
**Mathematics Education Leadership**

MATH 614 6M2 & 6M3 – Rational Numbers for K-8 Teachers  
3 Credits, Spring 2023  
Thursdays 7:20 pm-10:00 pm Synchronous Online

**Faculty**

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**COVID 19 Procedures: Spring 2023**

**Students, please be aware of and follow all policies and procedures for Mason’s Safe Return to Campus: <https://www2.gmu.edu/Safe-Return-Campus>**

**Prerequisites/Corequisites**

Admission to the Mathematics Education Leadership Master’s Degree Program or instructor permission.

**University Catalog Course Description**

This course will cover the basic number strands in fractions and rational numbers, decimals and percents, and ratios and proportions in the school curriculum. Instruction will cover interpretations, computations, and estimation with a coordinated program of activities that develop both rational number concepts and skills and proportional reasoning. Offered by [Mathematics](#). May not be repeated for credit.

**Course Overview**

This course, for future K-8 mathematics teacher specialists, examines concepts contained in the rational number strands of the Virginia Standards of Learning (SOL), Common Core State Standards (CCSS), and/or referenced in the National Council of Teachers of Mathematics (NCTM) Principles and Standards. Through a coordinated program of activities, participants will learn to explore the structure of rational number systems, properties of numbers and develop number sense, computation and estimation concepts and skills.

## Course Delivery Method

This course will be delivered online using a synchronous format via Zoom through Blackboard Learning Management system (LMS) housed in the MyMason portal. You will log in to the Blackboard (Bb) course site using your Mason email name (everything before @masonlive.gmu.edu) and email password.

**Under no circumstances, may candidates/students participate in online class sessions (either by phone or Internet) while operating motor vehicles. Further, as expected in a face-to-face class meeting, such online participation requires undivided attention to course content and communication.**

### *Technical Requirements*

To participate in this course, students will need to satisfy the following technical requirements:

- High-speed Internet access with standard up-to-date browsers. To get a list of Blackboard's supported browsers see:

[https://help.blackboard.com/Learn/Student/Getting\\_Started/Browser\\_Support#supported-browsers](https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#supported-browsers)

To get a list of supported operation systems on different devices see:

[https://help.blackboard.com/Learn/Student/Getting\\_Started/Browser\\_Support#tested-devices-and-operating-systems](https://help.blackboard.com/Learn/Student/Getting_Started/Browser_Support#tested-devices-and-operating-systems)

- Students must maintain consistent and reliable access to their GMU email and Blackboard, as these are the official methods of communication for this course.
- Students will need a headset microphone for use with the Blackboard Collaborate web conferencing tool.
- Students may be asked to create logins and passwords on supplemental websites and/or to download trial software to their computer or tablet as part of course requirements.
- The following software plug-ins for PCs and Macs, respectively, are available for free download:
  - Adobe Acrobat Reader: <https://get.adobe.com/reader/>
  - Windows Media Player:  
<https://support.microsoft.com/en-us/help/14209/get-windows-media-player>
  - Apple Quick Time Player: [www.apple.com/quicktime/download/](http://www.apple.com/quicktime/download/)

### *Expectations*

- Course Week:  
Our course week will begin on the day that our synchronous meetings take place as indicated on the Schedule of Classes.

- Log-in Frequency:  
Students must actively check the course Blackboard site and their GMU email for communications from the instructor, class discussions, and/or access to course materials at least 3 times per week. In addition, students must log-in for all scheduled online synchronous meetings.
- Participation:  
Students are expected to actively engage in all course activities throughout the semester, which includes viewing all course materials, completing course activities and assignments, and participating in course discussions and group interactions.
- Technical Competence:  
Students are expected to demonstrate competence in the use of all course technology. Students who are struggling with technical components of the course are expected to seek assistance from the instructor and/or College or University technical services.
- Technical Issues:  
Students should anticipate some technical difficulties during the semester and should, therefore, budget their time accordingly. Late work will not be accepted based on individual technical issues.
- Workload:  
Please be aware that this course is **not** self-paced. Students are expected to meet *specific deadlines* and *due dates* listed in the **Class Schedule** section of this syllabus. It is the student's responsibility to keep track of the weekly course schedule of topics, readings, activities and assignments due.
- Instructor Support:  
Students may schedule a one-on-one meeting to discuss course requirements, content or other course-related issues. Those unable to come to a Mason campus can meet with the instructor via telephone or web conference. Students should email the instructor to schedule a one-on-one session, including their preferred meeting method and suggested dates/times.
- Netiquette:  
The course environment is a collaborative space. Experience shows that even an innocent remark typed in the online environment can be misconstrued. Students must always re-read their responses carefully before posting them, so as others do not consider them as personal offenses. *Be positive in your approach with others and diplomatic in selecting your words.* Remember that you are not competing with classmates, but sharing information and learning from others. All faculty are similarly expected to be respectful in all communications.
- Accommodations:  
Online learners who require effective accommodations to insure accessibility must be registered with George Mason University Disability Services.

## Learner Outcomes or Objectives

This course is designed to enable students to do the following:

1. Use numerous representations and conceptual models
2. Develop flexibility in problem solving
3. Explain number concepts and interpret student work in many ways

**Professional Standards (National Council of Teachers of Mathematics (NCTM) NCATE Mathematics Content for Elementary Mathematics Specialist (NCATE) *Addendum to the NCTM NCATE Standards 2012*)**

Upon completion of this course, students will have met the following professional standards:

**Standard 1: Content Standards**

To be prepared to support the development of student mathematical proficiency, all elementary mathematics specialists should know the following topics related to number and operations with their content understanding and mathematical practices supported by appropriate technology and varied representational tools, including concrete models:

C.1.1 Counting and cardinality, comparing and ordering, understanding the structure of the base ten number system with particular attention to place value, order of magnitude, one-to-one correspondence, properties, and relationships in numbers and number systems – whole numbers, integers, **rationals, irrationals and reals.**

C.1.2 Arithmetic operations (addition, subtraction, multiplication, and division) including mental mathematics and standard and non-standard algorithms, interpretations, and representations of numbers – fractions, decimals, rationals, irrationals and reals.

C.1.4 Quantitative reasoning and relationships that include ratio, rate, proportion, and the use of units in problem situations

**Standard 2: Mathematical Practices (NCTM NCATE Mathematics Content for Elementary Mathematics Specialist *Addendum to the NCTM NCATE Standards 2012*)**

Effective elementary mathematics specialists solve problems, represent mathematical ideas, reason, prove, use mathematical models, attend to precision, identify elements of structure, generalize, engage in mathematical communication, and make connections as essential mathematical practices. They understand that these practices intersect with mathematical content and that understanding relies on the ability to demonstrate these practices within and among mathematical domains and in their teaching and mathematics leadership.

In their role as teacher, lead teacher, and/or coach/mentor, elementary mathematics specialist candidates:

2a) Use problem solving to develop conceptual understanding, make sense of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies in solving problems confronted within the field of mathematics and other contexts, and formulate and test conjectures in order to frame generalizations.

2b) Reason abstractly, reflectively, and quantitatively with attention to units, constructing viable arguments and proofs, and critiquing the reasoning of others; represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; use multiple representations to model and describe mathematics; and utilize appropriate mathematical vocabulary and symbols to communicate mathematical ideas to others.

2c) Formulate, represent, analyze, and interpret mathematical models derived from real-world contexts or mathematical problems.

2f) Model how the development of mathematical understanding within and among mathematical domains intersects with the mathematical practices of problem solving, reasoning, communicating, connecting, and representing.

### **Required Texts**

Lamon, S.J. (2012). *Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers* (3rd edition). Routledge.

National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. NCTM.

### **Suggested Texts**

Van de Walle, J., Karp, K., & Bay-Williams, J. (2018). *Elementary and middle school mathematics: Teaching developmentally* (10<sup>th</sup> edition). Pearson Education.

American Psychological Association (2020). *Publication Manual of the American Psychological Association* (7<sup>th</sup> edition). American Psychological Association.

### **Course Performance Evaluation**

Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, Via, hard copy).

- **Assignments and/or Examinations**

1. **PARTICIPATION (20%)**

A commitment to participation in class discussions and course activities depends heavily and primarily on the regular attendance and participation of all involved. Participation will include taking part in discussions informed by critical reading and thinking, leading discussions about selected mathematics problems, and sharing with the class the products of various writing, reflection, lesson planning, and field experience assignments. The expectations, demands and workload of this course are professional and high. This requires students to consider number systems and number theory using different strategies and a variety of manipulatives and resources. During math work time, students should be developing strategies and non-traditional algorithms for the entire work time or discussing and sharing algorithms with each other. During math-talk and discussion times, students should be actively engaged by voicing their thoughts and connecting to topics presented during the discussion.

Participation in this course requires a commitment to reading reflectively and critically the assigned readings. The readings will be used to provide a framework and coherent theme to the course content. They have been selected to introduce themes in professional development as well as research and critical commentary on current issues in mathematics education.

Additional information regarding participation, tardies and absences can be found on Blackboard.

2. **RATIONAL NUMBERS REFLECTIONS - 3 (30%)**

(*NCTM NCATE* 1.1, 2a, 2b, 2c, 2f)

This is a Course Performance Based Assessment. The purpose of this Course Performance Based Assessment is for the candidate to demonstrate preparedness to support the development of student mathematical proficiency. All elementary mathematics specialists should know the identified content topics and the mathematical practices that can be used to develop those understandings.

These **three** assignments require a written reflection connected to the candidate's current mathematical understanding and how it has changed. The final products will be submitted on Blackboard in Via. For a complete project description, rubric and grading criteria please see assignment descriptions at the end of the syllabus and/or on Blackboard.

3. **LEARNING THROUGH LEADING (30%)**

As a mathematics teacher leader, you will support teachers in their understanding of both content and pedagogy. In this assignment, you will lead a small group of teachers in an activity that includes learning rigorous mathematics content using pedagogically sound resources. You will prepare a mathematical task, along with several anticipated solutions and misconceptions, before the presentation. During the presentation, you are to guide the small group of teachers to these various representations and you discuss how students learn this concept along with the learning progressions of this concept.

4. **RATIONAL NUMBER ROUTINE (20%)**

As a mathematics teacher leader, you will model a mathematics routine relevant for learning rational numbers. You will describe the routine, model the routine, and reflect on the routine.

● **Other Requirements**

It is your responsibility to attend all class sessions. Please report your reasons for any absences to the instructor in writing.

Tardiness: It is your responsibility to be on time for each class session. Please report your reasons for any tardiness to the instructor in writing.

Class materials will be posted for each class session on Blackboard. Students are responsible for reviewing these materials and submitting required artifacts (where appropriate) to online class discussion boards.

All assignments are to be turned in to your instructor on time. **Late work will not be accepted for full credit.** Assignments turned in late will receive a 10% deduction from the grade per late day or any fraction thereof (including weekends and holidays).

● **Grading**

Participation – 20%  
Rational Numbers Reflections – 30% (3 total at 10% each)  
Learning Through Leading – 30%  
Rational Numbers Routine – 20%

A 93%-100%	B+ 87%-89%	C 70%-79%
A- 90%-92%	B 80%-86%	F Below 70%

### **Via/Performance-Based Assessment(s) Submission Requirement:**

Every student registered for any Mathematics Education Leadership course with a required Via performance-based assessment (designated as such in the syllabus) must submit these assessments to Via through ‘*Assessments*’ in Blackboard. Failure to submit the assessment(s) to Via (through Blackboard) will result in the course instructor reporting the course grade as Incomplete (IN). Unless this grade is changed upon completion of the required Via submission, the IN will convert to an F nine weeks into the following semester.

### **For Master’s Degrees:**

Candidates must have a minimum GPA of 3.00 in coursework presented on the degree application, which may include no more than 6 credits of C. (Grades of C+, C-, or D do not apply to graduate courses. The GPA calculation excludes all transfer courses and Mason non-degree studies credits not formally approved for the degree).

### **For Endorsement Requirements**

Candidates must have a grade of B or higher for all licensure coursework (endorsement coursework).

### **Professional Dispositions**

Students are expected to exhibit professional behaviors and dispositions at all times. Education professionals are held to high standards, both inside and outside of the classroom. Educators are evaluated on their behaviors and interactions with students, parents, other professionals, and the community at large. At the College of Education and Human Development, dispositions may play a part in the discussions and assignments of any/all courses in a student’s program (and thus, as part or all of the grade for those assignments). For additional information visit:

<https://cehd.gmu.edu/students/policies-procedures/>

This course will require students to audiotape, videotape, or use the audio/video conferencing feature. Students should dress professionally, speak professionally, and aware of their recording surroundings and backgrounds. Background noise (such as television, music, conversations, etc.) and inappropriate background video are distracting, unprofessional, and not allowed in this course.

## Class Schedule

### Key for readings:

- **Lamon** - Lamon, S.J. (2012). *Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers* (3rd edition). Routledge.
- **PTA** - National Council of Teachers of Mathematics. (2014). *Principles to actions: Ensuring mathematical success for all*. NCTM.

Date	Topic(s)	Readings	Due
<b>Week 1</b> 1/26/23	Syllabus Overview  <i>Principles to Actions</i> (NCTM, 2014): The Mathematics Teaching Practices  Proportional Reasoning: An overview  Pre-Assessment		Complete Rational Number Routine & Learning through Leading Survey: <a href="https://forms.gle/kHVpBMEpj31BDCf46">https://forms.gle/kHVpBMEpj31BDCf46</a>
<b>Week 2</b> 2/2/23	Proportional Reasoning: An overview  Access and Equity  Task - Create Your Own	Lamon: Chapter 1 PTA: p. 59-69	
<b>Week 3</b> 2/9/23	Fractions and Rational Numbers  Implement tasks that promote reasoning and problem solving  Task - Apple Cider	Lamon: Chapter 2 PTA: p. 17-24	
<b>Week 4</b> 2/16/23	Relative Thinking  Pose purposeful questions  Task - Who's One	Lamon: Chapter 3 PTA: p. 35 - 42	Rational Number Routine: Group 1 <b>Reflection 1 Due &amp; Uploaded to Via</b>
<b>Week 5</b> 2/23/23	Relative Thinking  Establish mathematics goals to focus learning  Task - p.88 #14	Lamon: Chapter 4 PTA: p. 12-17	Rational Number Routine: Group 2 Learning through leading: Group A
<b>Week 6</b> 3/2/23	Fractions  Curriculum  Task - p. 129 # 29	Lamon: Chapter 5 PTA: p. 70-78	Rational Number Routine: Group 3 Learning through leading: Group B
<b>Week 7</b> 3/9/23	Reasoning with Fractions  Facilitate meaningful mathematical discourse  Task - Pi day pies	Lamon: Chapter 6 PTA: p. 29-35	Rational Number Routine: Group 4
<b>Week 8</b> 3/16/23	GMU SPRING BREAK		



<b>Week 9</b> 3/23/23	Reasoning with Fractions Elicit and use evidence of student thinking Task - p.168 #23	Lamon: Chapter 7 PTA: p. 53-58	Rational Number Routine: Group 5 Learning through leading: Group C <b>Reflection 2 Due &amp; Uploaded to Via</b>
<b>Week 10</b> 3/30/23	Fractions as Part-Whole Comparisons Use and connect mathematical representations Task - Sandwiches	Lamon: Chapter 8 PTA: p. 24-29	Rational Number Routine: Group 6 Learning through leading: Group D
<b>Week 11</b> 4/6//23	Fractions as Quotients Build procedural fluency from conceptual understanding Support productive struggle in learning mathematics Task - p189 #14	Lamon: Chapter 9 PTA: p. 42-53	Rational Number Routine: Group 7 Learning through leading: Group E
<b>Week 12</b> 4/13//23	Asynchronous Week - See weekly slides in Blackboard for details. Asynchronous assignment will be posted by 4/06/23.		
<b>Week 13</b> 4/20/23	Fractions as Operators & Measures Tools and technology Task - Tupperware	Lamon: Chapter 9 (second half) PTA: p. 78-89	Rational Number Routine: Group 8
<b>Week 14</b> 4/27/23	Ratios and Rates Professionalism Assessment	Lamon: Chapter 10 PTA: p. 89-99	Rational Number Routine: Group 9 <b>Reflection 3 Due &amp; Uploaded to Via</b>
<b>Week 15</b> 5/4/23	Changing Instruction Taking Action	Lamon: Chapter 11 PTA: p. 99-118	Rational Number Routine Group: 10

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

### Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/>.

### GMU Policies and Resources for Students

#### *Policies*

- Students must adhere to the guidelines of the Mason Honor Code (see <https://catalog.gmu.edu/policies/honor-code-system/> ).
- Students must follow the university policy for Responsible Use of Computing (see <https://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>).
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.
- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see <https://ds.gmu.edu/>).
- Students must silence all sound emitting devices during class unless otherwise authorized by the instructor.

### *Campus Resources*

- Support for submission of assignments to Via should be directed to [viahelp@gmu.edu](mailto:viahelp@gmu.edu). Questions or concerns regarding use of Blackboard should be directed to <https://its.gmu.edu/knowledge-base/blackboard-instructional-technology-support-for-students/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus>

### **Notice of mandatory reporting of sexual assault, interpersonal violence, and stalking:**

As a faculty member, I am designated as a “Responsible Employee,” and must report all disclosures of sexual assault, interpersonal violence, and stalking to Mason’s Title IX Coordinator per University Policy 1202. If you wish to speak with someone confidentially, please contact one of Mason’s confidential resources, such as Student Support and Advocacy Center (SSAC) at 703-380-1434 or Counseling and Psychological Services (CAPS) at 703-993-2380. You may also seek assistance from Mason’s Title IX Coordinator by calling 703-993-8730, or emailing [titleix@gmu.edu](mailto:titleix@gmu.edu).

**For additional information on the College of Education and Human Development, please visit our website <https://cehd.gmu.edu/students/> .**

## MATH 614 Rational Numbers Participation Rubric

Rational Numbers Participation Rubric				
Level/Criteria	4	3	2	1
	<b>Exceeds Expectations</b>	<b>Meets Expectations</b>	<b>Developing</b>	<b>Does Not Meet Expectations</b>
<p>A commitment to participation in class discussions and course activities depends heavily and primarily on the regular attendance and participation of all involved. Participation will include taking part in discussions informed by critical reading and thinking, leading discussions about selected mathematics problems, and sharing with the class the products of various writing, reflection, lesson planning, and field experience assignments. The expectations, demands and workload of this course are professional and high. This requires students to consider number systems and number theory using different strategies and a variety of manipulatives and resources. During math work time, students should be developing strategies and non-traditional algorithms for the <u>entire</u> work time or discussing and sharing algorithms with each other. During math-talk and discussion times, students should be actively engaged by voicing their thoughts and connecting to topics presented during the discussion.</p> <p>Participation in this course requires a commitment to reading reflectively and critically the assigned readings. The readings will be used to provide a framework and coherent theme to the course content. They have been selected to introduce themes in professional development as well as research and critical commentary on current issues in mathematics education.</p>	<p>Student attends all 14 classes.</p> <p>Student arrives on time to all 14 classes.</p> <p>Student engages in discussion through multiple modalities in all 14 classes.</p> <p>Student engages in small group work in all 14 classes.</p>	<p>Student attends 13 classes.</p> <p>Student arrives on time to 13 classes.</p> <p>Student engages in discussion through multiple modalities in 13 classes.</p> <p>Student engages in small group work in 13 classes.</p>	<p>Student attends 12 classes.</p> <p>Student arrives on time to 12 classes.</p> <p>Student engages in discussion through multiple modalities in 12 classes.</p> <p>Student engages in small group work in 12 classes.</p>	<p>Student attends 11 or less classes.</p> <p>Student arrives on time to 11 or less classes.</p> <p>Student engages in discussion through multiple modalities in 11 or less classes.</p> <p>Student engages in small group work in 11 or less classes.</p>

## MATH 614 Rational Numbers Learning through Leading Rubric

As a mathematics teacher leader, you will support teachers in their understanding of both content and pedagogy. In this assignment, you will lead a small group of teachers in an activity that includes learning rigorous mathematics content using pedagogically sound resources. You will prepare a mathematical task, along with several anticipated solutions and misconceptions, before the presentation. During the presentation, you are to guide the small group of teachers to these various representations and you discuss how students learn this concept along with the learning progressions of this concept.

- 1) Meet with group and review assigned problem.
- 2) Anticipate 5 types of student responses. Include representations that are abstract, concrete, pictorial, use technology, and misconceptions.
- 3) Submit planning document at least 7 days before presentation.
- 4) Present your task on the assigned day.

<b>Rational Numbers Learning through Leading Rubric</b>				
<b>Level/Criteria</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
	<b>Exceeds Expectations</b>	<b>Meets Expectations</b>	<b>Developing</b>	<b>Does Not Meet Expectations</b>
Planning	<p>Group anticipated 5 or more strategies for the assigned task</p> <p>Group submitted planning document at least 7 days before presenting.</p>	<p>Group anticipated 4 or more strategies for the assigned task</p> <p>Group submitted planning document at least 6 days before presenting.</p>	<p>Group anticipated 3 or more strategies for the assigned task</p> <p>Group submitted planning document at least 5 days before presenting.</p>	<p>Group anticipated 2 or more strategies for the assigned task</p> <p>Group submitted planning document at least 4 days before presenting.</p>
Presentation	<p>Task is student-centered and elicits student contributions.</p> <p>The group allows each student a role in the presentation.</p> <p>The group presented student-strategies by selecting and sequencing in order to find connections.</p> <p>The presentation is 15-30 min long</p>	<p>Task is student-centered.</p> <p>The group allows most student a role in the presentation.</p> <p>The group presented student-strategies by selecting and sequencing.</p> <p>The presentation is 5 or more minutes beyond the target time.</p>	<p>Task elicits student contributions.</p> <p>The group allows some student a role in the presentation.</p> <p>The group presented student-strategies by selecting.</p> <p>The presentation is 10 or more minutes beyond the target time.</p>	<p>Task is not student-centered and does not elicit student contributions.</p> <p>The group does not show equitable group presentation.</p> <p>The group did not present student-strategies by selecting and sequencing in order to find connections.</p> <p>The presentation is 15 or more minutes beyond the target time.</p>

## MATH 614 Rational Number Routine Rubric

As a mathematics teacher leader, you will model a mathematics routine relevant for learning rational numbers. You will describe the routine, model the routine, and reflect on the routine.

- 1) In groups, plan a math routine. Include research on specific protocol and anticipate several student strategies.
- 2) In groups, plan the presentation. Ensure the target time limit of 9-10 minutes. Ensure that the presentation is student-centered and elicits student contributions. Plan how each group member will support the group during the presentation.
- 3) Present your number routine on the assigned day.
- 4) Reflect on the number routine implementation. Include both a reflection of the protocol and the overall implementation. Reflection may be done in groups. 1.5-2 pages

Rational Numbers Learning through Leading Rubric				
Level/Criteria	4	3	2	1
	Exceeds Expectations	Meets Expectations	Developing	Does Not Meet Expectations
Presentation	<p>Number Routine has been researched and includes specific protocol.</p> <p>Number Routine is student-centered and elicits student contributions.</p> <p>The group planned the presentation to allow each student a role in the presentation.</p> <p>The group planned by anticipating student strategies before implementing the number routine.</p> <p>The presentation is 9-10 min long</p>	<p>Number Routine has a specific protocol.</p> <p>Number Routine is student-centered.</p> <p>The group shows some evidence of planning equitably for the presentation.</p> <p>The group planned by anticipating a few student strategies before implementing the number routine.</p> <p>The presentation is 2 or more minutes beyond the target time.</p>	<p>Number Routine does not have specific protocol.</p> <p>Number Routine elicits student contributions.</p> <p>Little evidence of planning for equitable presentation.</p> <p>The group planned by anticipating a student strategy before implementing the number routine.</p> <p>The presentation is 3 or more minutes beyond the target time.</p>	<p>Number Routine does not have specific protocol.</p> <p>Number Routine is not student-centered and does not elicit student contributions.</p> <p>No evidence of planning for equitable presentation.</p> <p>The group did not plan by anticipating student strategies before implementing the number routine.</p> <p>The presentation is 4 or more minutes beyond the target time.</p>
Reflection	<p>The student reflected on the specific protocol of the number routine.</p> <p>The student reflected on the implementation of student-centered routines.</p>	<p>The student identified the specific protocol of the number routine.</p> <p>The student reflected on the implementation of student-centered routines.</p>	<p>The student identified the specific protocol of the number routine.</p> <p>The student briefly reflected on the implementation of student-centered routines.</p>	<p>The student did not identify the specific protocol of the number routine.</p> <p>The student did not reflect on the implementation of student-centered routines.</p>

## MATH 614 Rational Numbers Written Reflection Rubric

<b>Rational Numbers Written Reflection (Course Performance-Based Assessment)</b>				
<b>Level/Criteria</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1</b>
	<b>Exceeds Expectations</b>	<b>Meets Expectations</b>	<b>Developing</b>	<b>Does Not Meet Expectations</b>
<p><b>BUILDING CONCEPTUAL AND PROCEDURAL UNDERSTANDING</b></p> <p>NCTM Element 1a</p> <p>Demonstrate and apply knowledge of major mathematics concepts, algorithms, procedures, applications in varied contexts and connections within and among mathematical domains</p>	<p>The written reflection includes all of the following elements:</p> <ul style="list-style-type: none"> <li>· Applies conceptual and procedural knowledge in identifying solutions in the problem</li> <li>· Explains connections between conceptual and procedural knowledge</li> <li>· Discusses new knowledge in relation to past knowledge and experiences</li> </ul>	<p>The written reflection includes two of the following elements:</p> <ul style="list-style-type: none"> <li>· Applies conceptual and procedural knowledge in identifying solutions in the problem</li> <li>· Explains connections between conceptual and procedural knowledge</li> <li>· Discusses new knowledge in relation to past knowledge and experiences</li> </ul>	<p>The written reflection includes one of the following elements:</p> <ul style="list-style-type: none"> <li>· Applies conceptual and procedural knowledge in identifying solutions in the problem</li> <li>· Explains connections between conceptual and procedural knowledge</li> <li>· Discusses new knowledge in relation to past knowledge and experiences</li> </ul>	<p>The written reflection:</p> <ul style="list-style-type: none"> <li>· Does not apply conceptual and procedural knowledge in identifying solutions in the problem</li> <li>· Does not explain connections between conceptual and procedural knowledge</li> <li>· Does not discuss new knowledge in relation to past knowledge and experiences</li> </ul>

<p><b>PROBLEM SOLVING</b> NCTM Element 2a</p> <p>Use problem solving to develop conceptual understanding, make a sense of a wide variety of problems and persevere in solving them, apply and adapt a variety of strategies in solving problems confronted within the field of mathematics and other contexts, and formulate and test conjectures in order to frame generalizations.</p>	<p>The written reflection includes all of the following elements:</p> <ul style="list-style-type: none"> <li>· Uses problem solving within the assigned problem to formulate generalizations</li> <li>· Makes sense of the problems within the assigned problem</li> <li>· Applies a variety of strategies and representations within the assigned problem</li> </ul>	<p>The written reflection includes two of the following elements:</p> <ul style="list-style-type: none"> <li>· Uses problem solving within the assigned problem to formulate generalizations</li> <li>· Makes sense of the problems within the assigned problem</li> <li>· Applies a variety of strategies and representations within the assigned problem to the assigned problem</li> </ul>	<p>The written reflection includes one of the following elements:</p> <ul style="list-style-type: none"> <li>· Uses problem solving within the assigned problem to formulate generalizations</li> <li>· Makes sense of the problems within the assigned problem</li> <li>· Applies a variety of strategies and representations within the assigned problem to the assigned problem</li> </ul>	<p>The written reflection:</p> <ul style="list-style-type: none"> <li>· Does not use problem solving within the assigned problem to formulate generalizations</li> <li>· Does not make sense of the problems within the assigned problem</li> <li>· Does not apply a variety of strategies and representations within the assigned problem</li> </ul>
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<p>REPRESENTATIONS NCTM Element 2b</p> <p>Represent and model generalizations using mathematics; recognize structure and express regularity in patterns of mathematical reasoning; use multiple representations to model and describe mathematics; and utilize appropriate mathematical vocabulary and symbols to communicate mathematical ideas to others.</p>	<p>The written reflection includes all of the following elements:</p> <ul style="list-style-type: none"> <li>· Describes how multiple representations were used to model the problem</li> <li>· Discusses how the representations support the creation of generalizations</li> <li>· Uses appropriate mathematical vocabulary and symbols</li> </ul>	<p>The written reflection includes two of the following elements:</p> <ul style="list-style-type: none"> <li>· Describes how multiple representations were used to model the problem</li> <li>· Discusses how the representations support the creation of generalizations</li> <li>· Uses appropriate mathematical vocabulary and symbols</li> </ul>	<p>The written reflection includes one of the following elements:</p> <ul style="list-style-type: none"> <li>· Describes how multiple representations were used to model the problem</li> <li>· Discusses how the representations support the creation of generalizations</li> <li>· Uses appropriate mathematical vocabulary and symbols</li> </ul>	<p>The written reflection:</p> <ul style="list-style-type: none"> <li>· Does not describe how multiple representations were used to model the problem</li> <li>· Does not discuss how the representations support the creation of generalizations</li> <li>· Does not use appropriate mathematical vocabulary and symbols</li> </ul>
<p>CONTEXT NCTM Element 2c</p> <p>Formulate, represent, analyze, and interpret mathematical models derived from real-world contexts of mathematical problems.</p>	<p>The reflection includes all of the following elements:</p> <ul style="list-style-type: none"> <li>· An example of a similar problem with a different context.</li> <li>· An analysis of a similar problem (compare and contrast)</li> <li>· An interpretation of the solution</li> </ul>	<p>The reflection includes two of the following elements:</p> <ul style="list-style-type: none"> <li>· An example of a similar problem with a different context.</li> <li>· An analysis of a similar problem (compare and contrast)</li> <li>· An interpretation of the solution</li> </ul>	<p>The reflection includes one of the following elements:</p> <ul style="list-style-type: none"> <li>· An example of a similar problem with a different context.</li> <li>· An analysis of a similar problem (compare and contrast)</li> <li>· An interpretation of the solution</li> </ul>	<p>The reflection does not include the following elements:</p> <ul style="list-style-type: none"> <li>· An example of a similar problem with a different context.</li> <li>· An analysis of a similar problem (compare and contrast)</li> <li>· An interpretation of the solution</li> </ul>



<p>NCTM PROCESS STANDARDS</p> <p>NCTM Element 2f</p> <p>Model how the development of mathematical understanding within and among mathematical domains intersects with the mathematical practices of problem solving, reasoning, communicating, connecting, and representing.</p>	<p>The reflection includes a description of how each of the five NCTM Process Standards impact the mathematical understanding. Process Standards are:</p> <ul style="list-style-type: none"> <li>· problem solving</li> <li>· reasoning</li> <li>· communicating</li> <li>· connecting</li> <li>· representing</li> </ul>	<p>The reflection includes a description of how four of the five NCTM Process Standards impact the mathematical understanding. Process Standards are:</p> <ul style="list-style-type: none"> <li>· problem solving</li> <li>· reasoning</li> <li>· communicating</li> <li>· connecting</li> <li>· representing</li> </ul>	<p>The reflection includes a description of how three of the five NCTM Process Standards impact the mathematical understanding. Process Standards are:</p> <ul style="list-style-type: none"> <li>· problem solving</li> <li>· reasoning</li> <li>· communicating</li> <li>· connecting</li> <li>· representing</li> </ul>	<p>The reflection includes a description of how two or less of the five NCTM Process Standards impact the mathematical understanding. Process Standards are:</p> <ul style="list-style-type: none"> <li>· problem solving</li> <li>· reasoning</li> <li>· communicating</li> <li>· connecting</li> <li>· representing</li> </ul>
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