Course Syllabus
Southeast Missouri State University

Department of Mathematics   **Course No. MA622**
Title of Course: Rational Numbers and Proportional Thinking   **New: Fall 2013**

I.   Catalog Description and Credit Hours of Course:

The course is designed to develop an understanding of the learning and teaching of rational
numbers and ratio and proportional relationships. Emphasis will be given to how children
think about and learn these concepts and how they fit into the elementary school
curriculum. (3)

II.   Co-requisite: MA612 Internship in Rational Numbers and Proportional Thinking

III. Purposes and Objectives of the Course:

This course will focus on the content and complexities of teaching and assessing number
and operations in a K-5 setting and will include topics from grades 6-8 to develop an
understanding of how the mathematical ideas in the elementary grades build to those in the
middle grades. Students will develop an expertise related to rational numbers and ratio and
proportional relationships that will support fellow teachers and enhance student learning.
Students will also examine the learning trajectories children exhibit as they develop
concepts and skills in these areas. Course content will include the teaching and learning of
numbers and operations in base 10, rational numbers, ratio and proportional relationships,
and the number system.

The learner will:
• Describe how the base-ten system extends to decimals and represent decimals on
    number lines.
• Explain the rationale for decimal computation.
• Examine hypothetical or actual student calculation methods and decide if the methods
    are valid or not.
• Describe fractions as numbers which can be represented with lengths and on number
    lines define fractions A/B as A parts, each of size 1/B.
• Explain how addition, subtraction, multiplication, and divisions concepts and problem
    types extend to rational numbers.
• Explain the connection between fractions and division.
• Use reasoning and drawings to solve problems and explain solutions.
• Explain how multiplication with numbers less than 1 result in products smaller than the
    factors and division can result in quotients larger than the dividend.
• Reason about and explain how quantities vary together in a proportional relationship.
• Describe how proportional relationships differ from other relationships such as additive
    relationships and inversely proportional relationships.
• Explain how unit rates may be used to solve problems.
• Describe how ratios connect to fractions.

- Explain that the concept of proportional relationship is a precursor and key example of a linear relationship.
- Compare and contrast different ways to find values in proportional relationships and in inversely proportional relationships.
- Determine if student-invented algorithms are valid.
- Use the Common Core State Standards for Mathematics and the Learning Progressions to guide the planning, implementation, and assessment of the teaching of rational numbers and ratio and proportional relationships.
- Develop in themselves the mathematical practices described in the Standards for Mathematical Practice from the Common Core State Standards for Mathematics in the context of rational numbers and proportional thinking.

IV. Student Learning Outcomes:

A. Students will be able to explain how whole number addition, subtraction, multiplication, and division concepts and problem types extend to rational numbers.
B. Students will be able to describe how proportional relationships differ from other relationships such as additive relationships and inversely proportional relationships.
C. Students will be able to determine if student-invented algorithms are valid.

V. Expectations of Students:

A. Participate in all class activities.
B. Read all assigned material.
C. Complete all class assignments.
D. Adequate mastery of course content on examinations.

VI. Course Outline:
Topics   Class Hours

A. Overview of Number and Operations – Base 10, Number and Operation – Fractions, Ratio and Proportional Relationships, and The Number System domains of Common Core State Standards for Mathematics.   **7**

B. Common Core Learning Progressions for Number and Operations – Base 10, Number and Operation – Fractions, Ratio and Proportional Relationships, and The Number System domains of Common Core State Standards for Mathematics.   **10**

C. Fractions   **14**
   1. Meaning of fractions.
      a. Specifying the whole
      b. Explaining what is meant by "equal parts"
      c. Definition of A/B as A parts, each of size 1/B
   2. Number line and number line diagrams with fractions
   3. Equivalent fractions
      a. Models

b. Applications
c. Numerical process
4. Comparing fractions
a. Models
b. Importance of same whole
5. Addition and subtraction of fractions
a. Decomposing and composing fractions
b. Representations and models – fraction strips, number lines, fraction circles
c. Application problems
6. Multiplication and division
a. Models and representations – area model, fraction strips, number line
b. Alternate algorithms
c. Using fractions to multiply decimals
d. Using relationship between multiplication and division to work with fraction division problems
e. Multiplication as scaling
f. Application problems
g. Multiplication and division of decimals
7. Common student errors
8. Analyzing student work

D. Ratio, Proportional Relationships, and Percents **14**
1. Definitions and essential characteristics of ratios, rates, and proportional relationships
2. Representing ratios and equivalent ratios
3. Connecting ratio to fractions
4. Ratio tables
5. Double number line diagrams
6. Percents as ratios
7. Relating percents to fractions and decimals
8. Solving problems with percents
9. Proportional relationships
a. Recognizing proportional relationships
b. Equations for proportional relationships
c. Correspondences among tables, graphs and equations of proportional relationships
10. Analysis of student work and development of appropriate remediation and enrichment

Total **45**

VII. Textbook:

Required textbook and resources:
- Common Core Progressions Documents

- Adding it Up Jeremy Kilpatrick, Jane Swafford, Bradford Findell, *Editors*; Mathematics Learning Study Committee; National Research Council
- Lobato, J. Ellis, . & Zbiek, R. M., (2010). *Developing Essential Understanding of Rational Numbers for Teaching Mathematics in Grades 3-5* . Reston, VA: NCTM.
- Karp, K., Caldwell, J., Bay-Williams, J., & Zbiek, M. (2011). *Developing Essential Understanding of Ratios, Proportions, and Proportional Reasoning for Teaching Mathematics in Grades 6 - 8.* Reston, VA: NCTM.

VIII. Basis of Student Evaluation:

- **Homework Assignments**   **20%**
  Students will be asked to complete a variety of assignments related to the teaching and learning of rational numbers and proportions in the elementary grades.
- **Midterm Exam**   **30%**
- **Final Exam**   **30%**
- **Journal article reviews and reflections**   **10%**
  Students are to read three articles on rational numbers or proportional reasoning from *Teaching Children Mathematics* or *Teaching Mathematics in the Middle School.* For each, write a 3-4 page reflection that:
    - Provides bibliographic information.
    - Provides a brief summary of the article.
    - Describes the strengths of the article.
    - Describes any weaknesses or questions raised by the article.
    - Describes how the students would use information from the article in his/her classroom.
    - Describes how the student would share the information from the article with others in his/her school.
- **Discussion board posts and replies**   **10%**
  Questions will be posted on the Discussion Board. Students are expected to post a response to each and reply to two students for each original post.

IX. Grading Scale
90% - 100% = A
80% - 89% = B
70% - 79% = C
0% - 69% = F

The weight of the evaluation criteria may vary according to each instructor and will be communicated at the beginning of the course.

X. Academic Policy Statement:
Students will be expected to abide by the University Policy for Academic Honesty regarding plagiarism and academic honesty. Refer to:
http://www6.semo.edu/judaffairs/code.html

XI.   Student with Disabilities Statement:
If a student has a special need addressed by the Americans with Disabilities Act (ADA) and requires materials in an alternative format, please notify the instructor at the beginning of the course. Reasonable efforts will be made to accommodate special needs.