Theme: Preparing Inquiring Educators: Knowledge, Understanding, Application

1. **Course Title and Credits:** ELCL 614 Multiple Representations of Mathematics Across the Curriculum; 3 graduate credits

2. **Course Description:** This course presents an in-depth analysis of multiple forms of representation of concepts and procedures in major strands of K-8 mathematics curriculum. Emphasis is on making connections between symbolic and concrete representations, adapting similar forms of representation to a variety of topics, and developing forms of assessment that are consistent with the representational models of instruction. The theoretical underpinnings of manipulative materials are explored through readings and hands-on experiences. Students are expected to develop projects that can be piloted and evaluated during the semester. This course is offered as a core course for the elementary and middle school mathematics teachers. It provides an essential component for understanding contemporary mathematics education consistent with professional and state curriculum standards in the field.

3. **Pre- or Co- Requisites:** None – This course is open to non-degree students.

4. **Course Objectives:**
   A. Overview of distinctions and connections among enactive, iconic, and symbolic forms of representation in mathematics across the curriculum.
   B. Consideration of the state curriculum and professional standards describing the theory and importance of multiple forms of representing mathematical ideas.
   C. Uses of the most versatile and widely used manipulatives for concrete modeling of mathematical concepts.
   D. Uses of the currently most versatile and widely used technology to facilitate student-representations of mathematical concepts.
   E. Comparing uses of concrete and technological representations to different mathematical concepts and procedures.
   F. Applications of a variety of materials and tools to the same mathematical concept.
   G. Examination of the relevance of connections among concrete, symbolic, and iconic representations of the same concepts and/or procedures in mathematics.
   H. Analyze the relationships among concrete, symbolic, and iconic approaches to the same topic.
   I. Consider assessment procedures for evaluating the understanding of concepts and procedures taught with manipulative and/or technological materials/equipment.
   J. Compare the appropriateness and efficacy of different form of assessment using varied forms of representation.
K. Consider the progression of uses of the same form of representation for related concepts across the curriculum.
L. Consider comprehensive plans for utilizing several forms of representation across several strands of the mathematics curriculum.

5. **Student Learning Outcomes:**

As a result of participating in this course, students will be able to:
A. Distinguish among and make connections between enactive, iconic, and symbolic forms of representation in mathematics across the curriculum.
B. Describe the theory and importance of multiple forms of representing mathematical ideas based on national and state curriculum standards.
C. Be able to use versatile manipulatives for concrete modeling of mathematical concepts.
D. Be able to use versatile and widely used technology to facilitate student-representations of mathematical concepts.
E. Be able to select and apply appropriate concrete and technological representations to mathematical concepts and procedures.
F. Be able to apply a variety of materials and tools to the same mathematical concept.
G. Be able to describe and demonstrate the relevance of connections among concrete, symbolic, and iconic representations of the same concepts and/or procedures in mathematics.
H. Be able to develop a coherent plan for analyzing the relationships among concrete, symbolic, and iconic approaches to the same topic.
I. Be able to prepare an assessment for evaluating the understanding of concepts and procedures taught with manipulative and/or technological materials/equipment.
J. Be able to distinguish between appropriateness and efficacy of one form of assessment as opposed to another using different forms of representation.
K. Be able to illustrate and plan lessons reflecting the progression of uses of the same form of representation for related concepts across the curriculum.
L. Be able to prepare a comprehensive plan for utilizing several forms of representation across several strands of the mathematics curriculum.

6. **Course Content:**

A. Overview of national standards and NJ Core Curriculum Content Standards for mathematics involving increased use of multiple representational approaches and assessments consistent with these approaches.
   1) the teaching principle
   2) the learning principle
   3) the assessment principle
   4) the technology principle
   5) communicating in mathematics
   6) making connections
B. Representations of Number and Operations
   1) relationships among numbers and number systems
   2) number operations and their relationships
3) computational fluency
4) estimation
C. Representations of Algebra
   1) patterns, relations, functions
   2) mathematical situations and structures
D. Representations of Geometry
   1) properties of two-and three-dimensional shapes
   2) spatial relations
   3) coordinate geometry
   4) symmetry and transformations
   5) visual problem solving
E. Representations of Measurement
   1) units and systems of measurement
   2) tools for measurement and estimating measurement
F. Representations of Data Collection and Analysis
G. Representations of Probability
H. Problem Solving
   1) building new knowledge
   2) problems that exist in contexts
   3) choosing strategies

7. Teaching/Learning Methods:
   A. Cooperative group problem solving and experiments
   B. Analysis of videotapes
   C. Computer and other technological experiences
   D. Discussion of assigned readings

8. Evaluation Methods:
   A. Contributions to class discussions and activities
   B. Contributions to Blackboard discussions
   C. Small group lesson planning based on NJCCCS posted online
   D. Online feedback to small group lesson plans
   E. Small group in-class demonstrations and online critiques of lesson plans
   F. Individual reflective written report on classroom implementation of group lesson plans

9. Recommended Texts/Readings:


10. **Preparers’ Names and Date:** Peter Appelbaum, Rochelle G. Kaplan, Fall 1996

11. **Department Approval Date:** 1996

12. **Reviser’s Name and Date:** Peter Appelbaum, Fall 1999; Rochelle G. Kaplan, Fall 2003.

13. **Department Revision Approval Date:** Fall 1999; Fall 2003

14. **Bibliography:**


