

**GEORGE MASON UNIVERSITY**  
**Graduate School of Education**

**Teaching Problem Solving in the Middle Grades**  
**EDCI 609 001 (3 credits)**  
Spring 2005

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Class Meets: Thursdays 4:30-7:10PM  
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### **I. Course Description**

This course focuses on mathematical inquiry: problem solving, reasoning, and communicating.

Prerequisite: Completion of the Elementary Education Licensure Program and EDCI 552 or Permission of the Instructor.

### **II. Student Outcomes**

At the conclusion of this course, students should be able to:

- A. Promote a better understanding of the nature of mathematics and mathematical inquiry
- B. Demonstrate problem-solving strategies in various mathematical content areas and methods for cultivating problems solving, reasoning and communicating skills
- C. Foster an understanding of how children's mathematical thinking develops
- D. Articulate methodologies for teaching mathematics more effectively to children with various abilities in Grades K-6; Plan effective mathematics instruction for students from diverse populations with a variety of learning needs

### **III. Nature of Course Delivery**

The delivery of this course combines methods of lecture, discussion, independent study/research, student presentation, mathematical problem solving, and writing.

### **IV. Texts and Readings**

Book 1:  
Author: George Polya  
title: How to Solve it - A new aspect of mathematical method  
Publisher: Princeton University Press  
Edition: revised edition  
ISBN #: 069111966X  
Required

Book 2:

Author: Stephen Krulik

Title: Assessing Reasoning and Problem Solving: A Sourcebook for Elementary School Teachers

Publisher: Allyn & Bacon

Edition: Paperback Publication Date: 1998-01-15

ISBN #: 0205198546

Required

Book 3:

Author: Edited by Frank K. Lester and Randall I. Charles

Title: Teaching Mathematics through Problem Solving: Prekindergarten- grade 6

Publisher: NCTM (National Council of Teachers of Mathematics) [www.nctm.org](http://www.nctm.org)

ISBN 0-87353-540-5, Stock #12576

## **V. Course Requirements and Assignments**

The assignments across the semester are intended to improve your strategies as a mathematics teacher and to develop your skills in the interpretation, critique and synthesis of mathematics education research. All assignments are to be completed on time so that class members might benefit from the expertise and contributions of their colleagues.

### **A. Problem Centered Unit (40%)**

Plan and teach a problem centered unit with 4-5 authentic learning tasks using the criteria listed for the assignment. Problem-centered teaching opens the mathematics classroom to exploring, conjecturing, reasoning, and communicating. This model will look at instruction in three phases: launching, exploring, and summarizing. Preview this website to get an idea of how your unit can be designed. <http://www.math.msu.edu/cmp/StudentMaterials/ProblemCentered.htm>

### **B. Problem Solving Notebook & Collection (15%)**

Keep a notebook with solutions to problems presented in class. This problem solving notebook will illustrate your problem solving strategies and reflections. It will also archive the problems and solutions shared in class.

### **C. Discussion & Response Record (15%)**

During each class session, students participate in activities that are documented as a record of their individual contributions to the class. Students are evaluated on these contributions. The following activities are included in the Response Record for the class: (1) Students will be randomly selected to provide an overview of key points in the readings during class discussions, (2) Students will be randomly selected to discuss their Research Synopsis Assignments on the dates these assignments are due, (3) Students will share lesson plans, problem solving activities and teaching ideas from their classrooms.

### **D. Problem Solving Research Synopsis (30%)**

In this assignment you will write a synopsis of three mathematics education research articles from different resource journals. The articles you select **must not** be part of the required readings list in the course. ( Each synopsis is 10% of your final grade)

## **VI. Evaluation Schema**

### Determination of the Final Grade:

#### Graduate Grading Scale

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

## **VII. UNIVERSITY POLICIES**

The university has a policy that requests students to turn off pagers and cell phones before class begins.

### **HONOR CODE**

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of George Mason University and with the desire for greater academic and personal achievement, George Mason University has set forth a code of honor that includes policies on cheating and attempted cheating, plagiarism, lying and stealing. Detailed information on these policies is available in the GMU Student Handbook, the University Catalog, and on the GMU website ([www.gmu.edu](http://www.gmu.edu)).

### **INDIVIDUALS WITH DISABILITIES POLICY**

The university is committed to complying with the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 by providing reasonable accommodations for applicants for admission, students, applicants for employment, employees, and visitors who are disabled. Applicants for admission and students requiring specific accommodations for a disability should contact the Disability Resource Center at 703-993-2474, or the University Equity Office at 703-993-8730.

### **ATTENDANCE POLICY**

Students are expected to attend the class periods of the courses for which they register. Although absence alone is not a reason for lowering a grade, students are not relieved of the obligation to fulfill course assignments, including those that can only be fulfilled in class. Students who fail to participate (because of absences) in a course in which participation is a factor in evaluation, or students who miss an exam without an excuse, may be penalized according to the weighted value of the missed work as stated in the course syllabus (GMU University Catalog, pg. 32).

## VIII. Course Schedule

Class meets 4:30 – 7:10 PM, Thursdays

Calendar

| Session                | Topic/Learning Experiences & Assignments  | Readings  |
|------------------------|---|---|
| Thursday,<br>Jan. 27   | Introduction<br><b>Problem Solving, reasoning and communication</b>   | Monograph<br><a href="http://www.nwrel.org/msec/images/mpm/pdf/monograph.pdf">http://www.nwrel.org/msec/images/mpm/pdf/monograph.pdf</a>  |
| Thursday,<br>Feb. 3    | <b>Issues and perspectives- Teaching Problem Solving -</b><br>Problem of the day  | <ul style="list-style-type: none"> <li>NCTM-1. Benefits of Teaching through Problem Solving</li> <li>George Polya- <u>How to Solve it</u></li> </ul>  |
| Thursday,<br>Feb. 10   | <b>Issues and perspectives-Polya's Problem Solving Approach</b><br>Problem of the day   | <ul style="list-style-type: none"> <li>NCTM- 2 Mathematical Habits of Mind for Young Children-</li> <li>George Polya- <u>How to Solve it</u></li> </ul>   |
| Thursday,<br>Feb. 17   | <b>Classroom Practice-Problem Centered Unit</b><br>Problem of the day   | <ul style="list-style-type: none"> <li>NCTM-3 Teaching Mathematics through Problem Solving:</li> <li>George Polya- <u>How to Solve it</u></li> </ul>  |
| Thursday,<br>Feb. 24   | <b>Classroom Practice- Designing Problem Based Tasks</b><br>Problem of the day<br><b>ASSIGNMENT: 1<sup>st</sup> synopsis due</b><br>Discuss issues from synopsis                          | <ul style="list-style-type: none"> <li>NCTM-4 Signposts for Teaching Mathematics through Problem Solving</li> <li>5 Designing and Selecting Problem-Based Tasks</li> </ul>  |
| Thursday,<br>March 3   | <b>Classroom Practice-Differentiation</b><br>Problem of the day   | <ul style="list-style-type: none"> <li>NCTM-6 How to Focus the Mathematics Curriculum on Solving</li> <li>7 Listening to Children: Informing Us and Guiding Our Instruction</li> </ul>                                |
| Thursday,,<br>March 10 | <b>Classroom Practice-Contextualized Problem Solving</b><br>Problem of the day  | <ul style="list-style-type: none"> <li>NCTM-8 Reflecting on Teaching Mathematics through Problem</li> <li>9 Establishing Classroom Social and Sociomathematical.</li> </ul>   |
| Thursday,<br>March 17  | <b>Spring Break – No class</b>  |   |
| Thursday,<br>March 24  | <b>Classroom Practice- Problem Solving Resources</b><br>Problem of the day<br>Problem Solving Resources<br><b>ASSIGNMENT: 2<sup>nd</sup> synopsis due</b><br>Discuss issues from synopsis | <ul style="list-style-type: none"> <li>Krulik-1.Assessment:The State of the Art.<br/>Why Teachers Assess.<br/>How Teachers Assess.<br/>Need for a Change.</li> </ul>  |
| Thursday,<br>March 31  | <b>Classroom Practice- Assessments &amp; Rubrics</b><br>Problem of the day  | <ul style="list-style-type: none"> <li>Krulik-2.Comprehensive Assessment. Ongoing Tasks. Snapshot Tasks.</li> </ul>   |
| Thursday,<br>April 7   | <b>Research Perspective-Differentiating instruction in Problem Solving</b><br>Problem of the day  | <ul style="list-style-type: none"> <li>Krulik-3. Forced-Choice Questions. What's the Question? What Are the Necessary Facts?</li> <li>NCTM-10 Addressing the Needs of Exceptional Students through Problem</li> </ul> |
| Thursday,<br>April 14  | <b>Research Perspectives-</b><br>Japanese modeling problem solving(TIMMS)   | <ul style="list-style-type: none"> <li>Krulik-4.Formulated Response Questions. Performance Tasks.</li> <li>11 Engaging Students in Problem Posing in an Inquiry-Oriented Mathematics Classroom</li> </ul>             |

|                       |   |  |
|-----------------------|---|--|
| Thursday,<br>April 21 | <b>Technology and Problem Solving</b><br><b><u>ASSIGNMENT: 3rd synopsis due</u></b><br>Discuss issues from synopsis | <ul style="list-style-type: none"> <li>NCTM-12 Problem Solving as a Vehicle for Teaching Mathematics: A Japanese Perspective</li> <li>13 Using Technology to Enhance a Problem-Based Approach to Teaching: What Will and What Will Not Work</li> </ul> |
| Thursday,<br>April 28 | Students' Presentations<br><b><u>ASSIGNMENT DUE Problem Centered Unit Due</u></b>                                   | <ul style="list-style-type: none"> <li>NCTM-14 Computer Technologies and Teaching Geometry through Problem Solving . .</li> <li>15 What Research Tells Us about Teaching Mathematics through Problem Solving</li> </ul>                                |
| Thursday,<br>May 5    | Students' Presentations   |  |

## Guide to Meaningful Problem Solving Tasks

|   |  |   |
|---|--|---|
|   |  | Well-crafted tasks meet these strict criteria   |
| 1 |  | <ul style="list-style-type: none"><li>◆ Engage and interest students</li><li>✓ Apply to the real world</li><li>✓ Connect to student interests</li><li>✓ Are equitable in that they appeal to <i>all</i> students</li><li>✓ Promote active involvement</li></ul> |
| 2 |  | <ul style="list-style-type: none"><li>◆ Contain important mathematical content</li><li>✓ Connect to other problems and mathematics concepts</li><li>✓ Align with current mathematics curriculum</li><li>✓ Integrate other subject areas</li></ul>               |
| 3 |  | <ul style="list-style-type: none"><li>◆ Are open-ended and nonroutine</li><li>✓ Allow multiple approaches and solutions</li><li>✓ Are not readily solvable by using a previously taught algorithm</li></ul>   |
| 4 |  | <ul style="list-style-type: none"><li>◆ Are challenging but accessible to students</li><li>✓ Require persistence</li><li>✓ Allow entry to the problem</li></ul>   |
| 5 |  | <ul style="list-style-type: none"><li>◆ Are well-crafted</li><li>✓ Contain clear and unambiguous wording</li><li>✓ Describe expectations</li><li>✓ Elicit responses that can be scored</li></ul>  |

**EDCI 609: TEACHING PROBLEM SOLVING IN THE MIDDLE GRADES**  
**RESEARCH SYNOPSIS ASSIGNMENTS**

**Understanding, Interpreting, and Evaluating Mathematics Education Research FOCUSED on mathematical inquiry: problem solving, reasoning, and communicating**

**SYNOPSIS** – “A brief statement or outline of a subject; similar to an abstract.”

A Synopsis should be 2-3pages in length, 12 pt font, double-spaced, with headings.

In this assignment you will write a synopsis of two mathematics education research articles from two different resource journals. The articles you select **must not** be part of the required readings list in the course. ( Each synopsis is 15% of your final grade)

**Each SYNOPSIS should include the following items in this order:**

1. APA Citation of the Article – At the beginning of the synopsis, include the APA citation (5<sup>th</sup> edition) of the article.
2. Research Question – What research question did the researchers attempt to answer in this study?
3. Participants – Who participated in the research study? Teachers or students? What grade level or other information do you know about the participants?
4. Procedures/Data Collection Methods – What data was collected during the study? How was the data collected (assessment tests, video or audio tapes, interviews, observations, surveys, etc.)?
5. Analysis – How was the data analyzed after it was collected? Did the researchers use qualitative or quantitative methods of analysis?
6. Results – What did the study conclude? What information was presented by the researchers as the outcomes in the study? What recommendations did the researchers make to teachers/educators/researchers?
7. Impact/Connections – How does this study connect to your teaching of problem solving in mathematics? What impact might the results have on your teaching of mathematics? How does the issue impact the teaching and learning of mathematics in your classroom, your school, or your school system? How does the issue impact parents, teachers, and students? How does the issue impact assessing students’ understanding of mathematics? How will the issue impact mathematics classrooms of the future? What role does the issue play in your personal theory about the mathematics teaching and learning process?

## RUBRIC FOR RESEARCH SYNOPSIS ASSIGNMENTS

| Criteria                                  | Meets Requirements (A, A-)  | Needs Improvement (B+, B, C)  |
|---|---|---|
| <b>APA Citation of the Article</b>        | The APA citation appears at the beginning of the synopsis assignment; The citation follows all requirements in the APA manual (5 <sup>th</sup> edition).  | The APA citation does not appear at the beginning of the synopsis assignment OR; The citation is missing one or more requirements in the APA manual (5 <sup>th</sup> edition).  |
| <b>Research Question</b>                  | The synopsis clearly identifies the question or questions investigated in the study.  | The question is not stated clearly; OR there are two or more questions and the synopsis only identifies one; OR the question in the synopsis does not match the question investigated in the study.   |
| <b>Participants</b>                       | The synopsis describes in detail who participated in the research study; It includes complete descriptive information about the participants (such as the grade level, age, gender, race, academic ability level, number of years teaching experience, etc.).   | The synopsis tells who participated in the research study; It does not go into detail about the participants; Additional descriptive information could have been provided about the participants from the descriptions in the study.  |
| <b>Procedures/Data Collection Methods</b> | The synopsis thoroughly describes the data that were collected during the study and how those data were collected; It provides an accurate description with specific examples of the data collection procedures; It is a thorough outline of the data sources (such as assessment tests, video or audio tapes, interviews, observations, surveys, etc.); It is a complete outline of the procedures (2-week workshop, repeated measures design, year-long observations in a math class, etc.).  | The synopsis describes the data that were collected during the study and how those data were collected; It provides some examples of the data collection procedures; The synopsis may be too brief or may not thoroughly detail all of the data collection methods and procedures.  |
| <b>Analysis</b>                           | The synopsis describes in detail how the data was analyzed after it was collected; It identifies if the researchers used qualitative or quantitative methods of collection and analysis; It gives examples such as “coded using a constant comparative method,” or “analyzed using a qualitative software package,” or “descriptive statistics, a t-test, and an analysis of variance were used.”   | The synopsis provides some information about how data were analyzed; The synopsis may be too brief or may not thoroughly detail all of the procedures of analysis used by the researchers.  |
| <b>Results</b>                            | The synopsis provides a clear and concise summary of the results of the study; It gives the reader summative information about what the researchers concluded in the study; It provides specific information about the recommendations the researchers make to teachers, educators, and other researchers.  | The synopsis provides a summary of the results of the study; It gives the reader information about what the researchers concluded in the study, but it may be too brief; It provides information about the recommendations the researchers make to teachers, educators, and other researchers; It may not be concise or it may lack information about specific conclusions made by the researchers. |
| <b>Impact/Connections</b>                 | The synopsis addresses the following information relevant to the study – It shows how this study connects to your teaching of mathematics; It tells what impact the results might have on your teaching of mathematics; It describes how the issue impacts the teaching and learning of mathematics in your classroom, your school, or your school system; It outlines how the issue impacts parents, teachers, and students; It describes how the issue impacts assessing students’ understanding of mathematics; It details how the issue | The synopsis may be too brief or may not thoroughly discuss all of the pertinent issues and connections of the article as they relate to teaching and learning mathematics in classrooms.   |



|                                     |   |   |
|-------------------------------------|---|---|
|                                     | impacts mathematics classrooms of the future; It describes what role the issue plays in your personal theory about the mathematics teaching and learning process. |   |
| <b>Professional Writing Quality</b> | The synopsis follows professional standards of writing and is free of spelling, grammar, and language mechanics errors.   | The synopsis contains spelling, OR grammar, OR language mechanics errors. |