



## **Professional Development Institute**

### **Flex Course Syllabus**

## **Middle School Math Problem Solving (6-8)**

**PDI Course Number: 96T02**

**UCSD Course Number: EDUC40104**

If you would like information about receiving post-baccalaureate (graduate) credit for completing this course, [please click here](#).

### **Course Timeline**

Participants have one year to complete the course. Participants must spend a minimum of three weeks in this course.

### **Course Description**

Have you ever wondered why some of your students excel in math but seem to falter when it comes to solving problems? This online course is designed for teachers in grades 6-8 who want to help their students become critical and logical mathematical thinkers. Information on the problem-solving process is shared together with distinct suggestions for incorporating specific problem-solving strategies into math instruction. The course begins by building problem-solving foundations such as how to break down a word problem, how to approach math vocabulary, and how to visualize and perform the problem. Then, specific strategies are shared such as thinking logically, predicting and estimating, using a model or diagram, creating a table to find a pattern, and using an algorithm or formula. Teachers will gain valuable classroom ideas including using manipulatives, developing real-world problems, and checking and explaining solutions. Teachers will gain strategies for differentiating their math instruction so that all students can find success in problem solving. Teachers will also learn how to appropriately assess students in the problem-solving process. Finally, ideas for connecting the math problem-solving process to other content areas will be shared. By the end of this course, teachers will have the tools they need to effectively teach their students the problem-solving process.

## **Educational Outcomes**

1. Teachers will understand the Common Core State Standards for Mathematics for grades 6-8.
2. Teachers will understand the Common Core State Standards for Mathematical Practice.
3. Teachers will learn the four steps to the problem-solving process and specific strategies to plan the same.
4. Teachers will learn how to set up a problem-solving environment within their own classrooms.
5. Teachers will understand the concept of growth mindset and learn specific strategies for fostering the same in the classroom.
6. Teachers will learn strategies for approaching and dissecting word problems so that they are more transparent to students.
7. Teachers will learn how to use activities and strategies provided to teach and reinforce important vocabulary in relation to mathematical problem solving.
8. Teachers will learn strategies to visualize and act out word problems in order to help students determine what information is relevant (or irrelevant) to the problem at hand.
9. Teachers will learn specific strategies for strengthening problem-solving skills when using logic to solve problems.
10. Teachers will learn specific strategies for strengthening problem-solving skills when predicting and estimating.
11. Teachers will learn specific strategies for strengthening problem-solving skills when using a model or diagram.
12. Teachers will learn specific strategies for strengthening problem-solving skills when creating a table to find a pattern.
13. Teachers will learn specific strategies for strengthening problem-solving skills when using an algorithm or formula.
14. Teachers will learn specific metacognition strategies for immediate use in the classroom.
15. Teachers will be introduced to the types of differentiation and will learn specific instructional strategies for incorporating the same into their daily math lessons.
16. Teachers will learn how to use math manipulatives to link concrete ideas with abstract concepts.
17. Teachers will learn how to use virtual math manipulatives to link concrete ideas with abstract concepts.
18. Teachers will learn how to create problems that result in real-world implications in order to make mathematics meaningful for their students.
19. Teachers will be able to properly use formative assessment to help guide instruction.
20. Teachers will discover ways to assess their students' problem-solving process.
21. Teachers will gain an understanding of specific strategies to integrate mathematical problem solving with other content areas.

## **Instructional Media**

- Online Discussions
- Online Engagement
- Online Collaboration

- Instructor Feedback
- Instructor Interaction
- Online Resources and Websites
- Supplemental Instructional Materials
- Printable Classroom Resources

## Evaluation

- Test #1 (5% of final grade)
- Test #2 (5% of final grade)
- Test #3 (5% of final grade)
- Test #4 (5% of final grade)
- Test #5 (5% of final grade)
- Autobiography and Goals for the Course (10% of final grade)
- Article/Video Reflection (15% of final grade)
- Course Collaboration/Share Ideas with the Class (10% of final grade)
- Cumulative Assignment/Project: Create Real-World Math Problems (20% of final grade)
- Culminating Practicum (20% of final grade)

## Topical Outline

### Unit One

- Introduction to the Common Core State Standards for Math (Grades 6-8)
- Introduction to the Common Core State Standards for Mathematical Practices
- The Problem Solving Process
- **Assignment #1**  
*Write an autobiography including information about yourself, your grade level and what you specifically hope to learn about implementing math problem-solving skills in the middle school classroom. Your autobiography should be a minimum of three paragraphs.*
- **Test #1**

### Unit Two

- Setting Up a Problem-Solving Environment
- Breaking Down a Word Problem
- Approaching Mathematical Vocabulary
- Visualizing and Performing the Problem
- **Assignment #2**  
*As an educator, it is important to be aware of the research, studies, and professional work done in the field. In the course, you will find an article and video that are relevant to the specific course content. Read the article and then write an essay with your thoughts.*

- **Test #2**

### Unit Three

- Applying the Key Shifts in CCSS Math to Problem Solving
- Teaching Logical Reasoning
- Prediction and Estimation
- **Assignment #3**

*Online Discussion Board Participation/Engagement: Please post a tip, strategy, or idea that specifically relates to effectively implementing math problem-solving skills in the middle school classroom. Your assignment should be a minimum of three paragraphs and detailed enough for another teacher to easily follow. This is a great opportunity to share and collaborate with other teachers at your grade level around the country. Take time to review and respond to other postings that are relevant to your classroom population in order to gain effective ideas to use immediately in your classroom*

- **Test #3**

### Unit Four

- Using a Model or Diagram
- Creating a Table and Finding a Pattern
- Using an Algorithm or Formula
- Metacognition in Math
- **Test #4**

### Unit Five

- Checking and Explaining Solutions
- Differentiation in the Math Classroom
- Using Manipulatives and Other Resources
- **Test #5**

### Unit Six

- Making it Meaningful - Real-Life Problem Solving
- Assessing Problem Solving
- Connecting Mathematical Problem Solving to Other Content Areas
- **Assignment #4**

*Create two real-world math problems for each of the five problem-solving strategies that have been discussed in the course (logical reasoning, prediction/estimation, using a model or diagram, creating a table to find a pattern, and using an algorithm or formula). Be sure to note which problem-solving strategy you are illustrating and that all the problems are appropriate to middle school. Using the format presented in the assignment, create the problem and include the solution. When you are finished with this assignment, you will have created a total of ten real-world math problems, two for each*

of the five problem-solving strategies. Keep in mind that this assignment is a cumulative project and therefore, you are expected to demonstrate the knowledge you gained from the course and your ability to apply what you have learned in a practical setting.

- **Assignment #5**

The culminating practicum is a three-step process. (1) In the first assignment, you were asked what goals you had and what you hoped to learn from the course. Think back to your original goals for this course. Write a minimum two-paragraph reflection specifically describing how what you learned can be used to help you reach those goal(s). (2) Next, write a minimum three-paragraph plan that specifically describes the ways in which you intend to implement a particular strategy you learned in this course into your own teaching situation. (3) Last, write a minimum two-paragraph reflection describing a student you have or have had in the past. Then, discuss how the strategies you learned in this course will specifically benefit that student as you put your plan into action.

## Bibliography

The Professional Development Institute wishes to thank the NGA Center for Best Practices and the Council of Chief State School Offices for their generous public license of the Common Core State Standards.

“Al-Khwarizmi” (n.d.). Retrieved from <https://www.britannica.com/search?query=Al-Khwarizmi>

Bahr, Damon L., and Lisa Ann De. Garcia (2010). *Elementary Mathematics Is Anything but Elementary: Content and Methods from a Developmental Perspective*. Australia: Wadsworth Cengage Learning. Print.

Bowman, Tim (2016). “Teaching Kids to Struggle.” Retrieved from <http://blog.classcreator.io/teaching-kids-to-struggle-growthmindset/>

Chard, David (n.d.). “Vocabulary Strategies for the Mathematics Classroom.” Retrieved from [https://www.eduplace.com/state/pdf/author/chard\\_hmm05.pdf](https://www.eduplace.com/state/pdf/author/chard_hmm05.pdf)

Chick, Nancy (n.d.). “Metacognition.” Retrieved from <https://cft.vanderbilt.edu/guides-sub-pages/metacognition/>

Common Core State Standards Initiative (2010). “Key Shifts in Mathematics.” Retrieved from <http://www.corestandards.org/other-resources/key-shifts-in-mathematics/>

Dweck, Carol (2015). “Carol Dweck Revisits the ‘Growth Mindset.’” Retrieved from <http://www.edweek.org/ew/articles/2015/09/23/carol-dweck-revisits-the-growth-mindset.html>

Fisher, Douglas and Nancy Frey (2014). *Better Learning Through Structured Teaching: A Framework for the Gradual Release of Responsibility*. (2<sup>nd</sup> ed.). Alexandria, VA: ACSD.

Fisher, Douglas, Nancy Frey, & John Hattie (2016). *Visible Learning for Literacy, Grades K-12: Implementing the Practices That Work Best to Accelerate Student Learning*. Thousand Oaks, CA: Corwin. Print.

Glenberg, A., J. Willford et. al. (2011). "Improving Reading to Improve Math." Retrieved from <http://www.edweek.org/media/improvingreading-36read.pdf>

Gojak, Linda M (2012). "Reasoning and Making Sense in Mathematics: It's a K–12 Focus." Retrieved from [http://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/Linda-M\\_Gojak/Reasoning-and-Making-Sense-in-Mathematics\\_-It\\_s-a-K%E2%80%9312-Focus/](http://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/Linda-M_Gojak/Reasoning-and-Making-Sense-in-Mathematics_-It_s-a-K%E2%80%9312-Focus/)

Great Schools Partnership (2015). "Assessment Definition." Retrieved from <http://edglossary.org/assessment/>

Haspell, Elliot (2011). "Acting Out Word Problems." VIDEO. Retrieved from <https://www.youtube.com/watch?v=5NfY4WOW6SU>

Hauk, Olaf, Ingrid Johnsrude, & Friedemann Pulvermüller (2004). "Somatotopic Representation of Action Words in Human Motor and Premotor Cortex." Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/14741110>

Hirsch, E.D. (2013). "Knowing More Words Makes You Smarter (and Richer)." Retrieved from <https://www.vocabulary.com/articles/under-the-hood/knowing-more-words-makes-you-smarter-and-richer/>

Hoffman, Brad (2015). "Why Teaching Both Estimation and Accuracy is Important." Retrieved from <http://mylearningspringboard.com/why-teaching-both-estimation-and-accuracy-is-important-in-math-instruction/>

Hood River County School District (n.d.). "Fluency Expectations with Common Core Standards for Math" (n.d.). DOC. Retrieved from <http://webcache.googleusercontent.com/search?q=cache:0QQfk-MAzJgJ:www.hoodriver.k12.or.us/cms/lib06/OR01000849/Centricity/Domain/860/Fluency%20Expectations%20with%20Common%20Core%20Standards%20for%20Math.docx+&cd=5&hl=en&ct=clnk&gl=us>

Huitt, W., and J. Hummel (2003). "Piaget's Theory of Cognitive Development." PDF. Retrieved from [http://www.newriver.edu/images/stories/library/Stennett\\_Psychology\\_Articles/Piagets%20Theory%20of%20Cognitive%20Development.pdf](http://www.newriver.edu/images/stories/library/Stennett_Psychology_Articles/Piagets%20Theory%20of%20Cognitive%20Development.pdf)

Johnson, Ben (2011). "How to Creatively Integrate Science and Math." Retrieved from <http://www.edutopia.org/blog/integrating-math-science-creatively-ben-johnson>

Metsisto, Diana (2005). "Reading in the Mathematics Classroom." Retrieved from <http://www.ascd.org/publications/books/105137/chapters/Reading-in-the-Mathematics-Classroom.aspx>

Moss, C., S. Brookhart, & B. Long (2011). "Knowing Your Learning Target." Retrieved from <http://www.ascd.org/publications/educational-leadership/mar11/vol68/num06/Knowing-Your-Learning-Target.aspx>

Pólya, George (1945). *How to Solve It*. Princeton, NJ: Princeton University Press.

Price-Mitchell, Marilyn (2015). "Metacognition: Nurturing Self-Awareness in the Classroom." Retrieved from <http://www.edutopia.org/blog/8-pathways-metacognition-in-classroom-marilyn-price-mitchell>

Rasmussen, Karen (1998). "Setting a Positive Tone." Retrieved from <http://www.ascd.org/publications/newsletters/education-update/sept98/vol40/num06/Setting-a-Positive-Tone.aspx>

Ruttle, Martha (2016). "Predictions & Estimates." Retrieved from <http://www.mathlearningcenter.org/blog/predictions-estimates>

Schoen, Harold L., and Marilyn J. Zweng (1986). "Estimation and Mental Computation: 1986 Yearbook." Retrieved from [http://tian.terc.edu/empower\\_readings/Reys\\_Teaching\\_Computational\\_Estimation.pdf](http://tian.terc.edu/empower_readings/Reys_Teaching_Computational_Estimation.pdf)

Shaughnessy, J. Michael (2011). "Reasoning and Sense Making — Expanding Our NCTM Initiative." Retrieved from [http://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/J\\_-Michael-Shaughnessy/Reasoning-and-Sense-Making%E2%80%94Expanding-Our-NCTM-Initiative/](http://www.nctm.org/News-and-Calendar/Messages-from-the-President/Archive/J_-Michael-Shaughnessy/Reasoning-and-Sense-Making%E2%80%94Expanding-Our-NCTM-Initiative/)

Sparks, Sarah D. (2011). "Studies Find Students Learn More by 'Acting Out' Text." Retrieved from <http://www.edweek.org/ew/articles/2011/07/13/36read.h30.html>

Tomlinson, Carol (2009). "What is Differentiated Instruction?" Retrieved from <http://www.readingrockets.org/article/what-differentiated-instruction>

Visible-learning.org (2015). "Hattie Ranking: 195 Influences and Effect Sizes Related to Student Achievement." Retrieved from <http://visible-learning.org/hattie-ranking-influences-effect-sizes-learning-achievement/>

Wilcox, Brad, and Eula Monroe Ewing (2011). "Integrating Writing and Mathematics." Retrieved from <http://www.readingrockets.org/article/integrating-writing-and-mathematics>

Wright, Jim (n.d.). "Combining Cognitive & Metacognitive Strategies to Assist Students with Mathematical Problem Solving." PDF. Retrieved from

[http://www.interventioncentral.org/sites/default/files/pdfs/pdfs\\_workshops/pei/math\\_cognitive\\_metacognitive\\_strategy.pdf](http://www.interventioncentral.org/sites/default/files/pdfs/pdfs_workshops/pei/math_cognitive_metacognitive_strategy.pdf)