Professional Development Institute

Flex Course Syllabus

Learner-Centered Math Instruction Using Manipulatives (3-6)

PDI Course Number: 60T02

UCSD Course Number: EDUC41616

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

Do your students seem to flounder in math because they just can't "see it" in their heads? In mathematics, manipulatives provide the perfect segue from the unfamiliar to the familiar. They help students transform their mathematical reasoning so that problems become less confusing and much more clear. This online course is designed for teachers in grades 3-6 who want to learn how to incorporate manipulatives such as linking cubes, color tiles and counters, number lines, Cuisenaire rods, base ten blocks, place value chips, fraction strips, algebra tiles, Algeblocks, pattern blocks, pentominoes, attribute blocks, tangrams, Anglegs, dice, geoboards, and even virtual maniplatives into their everyday teaching in order to guide their students to take ownership of their learning so that they can become critical and logical mathematical thinkers. Information on math standards is shared together with distinct suggestions for how to incorporate specific manipulatives into your math instruction in order to improve the way students approach math problems. By the end of this course, teachers will feel much more confident, and have the tools they need, to use manipulatives to strengthen their students' math skills.

Educational Outcomes

1. Teachers will learn about the various mathematical learning theories which support numerate thinking.
2. Teachers will understand and appreciate the role manipulatives play in the mathematical problem-solving process.
3. Teachers will discover the benefits and advantages of using math manipulatives in the classroom.
4. Teachers will learn specific strategies to incorporate manipulatives into their mathematics instruction in order to challenge their students' problem-solving abilities.
5. Teachers will learn how to use math manipulatives to link concrete ideas with abstract concepts.
6. Teachers will understand the basics of the Common Core State Standards for Mathematics and NCTM Standards.
7. Teachers will learn how to use manipulatives as a teaching tool in order to support a student-centered classroom.
8. Teachers will learn how linking cubes can be used to strengthen students' mathematical problem-solving skills.
9. Teachers will learn how color tiles and counters can be used to strengthen students' mathematical problem-solving skills.
10. Teachers will learn how number lines can be used to strengthen students' mathematical problem-solving skills.
11. Teachers will learn how Cuisenaire rods can be used to strengthen students' mathematical problem-solving skills.
12. Teachers will learn how base ten blocks can be used to strengthen students' mathematical problem-solving skills.
13. Teachers will learn how place value chips can be used to strengthen students' mathematical problem-solving skills.
14. Teachers will learn how algebra tiles and algeblocks can be used to strengthen students' mathematical problem-solving skills.
15. Teachers will learn how pattern blocks and pentominoes can be used to strengthen students' mathematical problem-solving skills.
16. Teachers will learn how attribute blocks can be used to strengthen students' mathematical problem-solving skills.
17. Teachers will learn how geoboards can be used to strengthen students' mathematical problem-solving skills.
18. Teachers will learn how tangrams can be used to strengthen students' mathematical problem-solving skills.
19. Teachers will learn how Anglegs can be used to strengthen students' mathematical problem-solving skills.
20. Teachers will learn how fraction strips, fraction circles, and fraction squares can be used to strengthen students' mathematical problem-solving skills.
21. Teachers will learn how dice and spinners can be used to strengthen students' mathematical problem-solving skills.

22. Teachers will learn how virtual manipulatives can be used to strengthen students' mathematical problem-solving skills.
23. Teachers will learn how to create problems that result in real-world implications in order to make mathematics meaningful for their students.

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: Write Lesson Plans (20% of final grade)
- Culminating Practicum (20% of final grade)

Topical Outline

Unit One

- Learning Theory and Mathematics
- The Role of Math Manipulatives in Problem Solving
- Introduction to the NCTM Standards and the Common Core Standards for Mathematics
- **Assignment #1**
  Write an autobiography including information about yourself, your grade level and what you specifically hope to learn about using manipulatives in the classroom. Your autobiography should be a minimum of three paragraphs.
- **Test #1**

Unit Two

- Linking Cubes
- Color Tiles and Counters
- Number Lines
- **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

- Cuisenaire Rods
- Base Ten Blocks
- Place Value Chips
- **Assignment #3**
  Online Discussion Board Participation/Engagement: Please post a tip, strategy, or idea that specifically relates to effectively using manipulatives and will make a difference to other teachers in their own classrooms. 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

- Algebra Tiles and Algeblocks
- Pattern Blocks and Pentominoes
- Attribute Blocks
- **Test #4**

Unit Five

- Geoboards
- Tangrams
- Anglegs
- **Test #5**

Unit Six

- Working with Fractions
- Probability with Spinners and Dice
- Virtual Manipulatives
- **Assignment #4**
  Develop three complete lessons that you would like to now teach using the manipulatives that were introduced throughout the course. Each lesson must focus on a different manipulative, and the manipulatives you choose should be used to showcase mathematical concepts that were not presented within the course (e.g., using base ten blocks to model the distributive property of multiplication). Be sure to note which manipulative you are illustrating, the grade level it is most appropriate for, and how the manipulative can be used to help students illustrate the concept. The lesson should be described in enough detail so that someone else can teach it. 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.

Burns, Marilyn (2007). *About Teaching Mathematics: A K-8 Resource*. 3rd ed. Sausalito, CA: Math Solutions.

Burris, Anita (2010). *Understanding the Math You Teach: Content and Methods for Prekindergarten Through Grade 4.* Boston, MA: Pearson Allyn Bacon Prentice Hall.

California Department of Education (1989). "Characteristics of Middle Grade Students." *Caught in the Middle,* 144-148. Sacramento, CA. Print.

Centers for Disease Control and Prevention (2012). "Teen Drinking and Driving: A Dangerous Mix." *CDC VitalSigns.* Retrieved from http://www.cdc.gov/vitalsigns/teendrinkinganddriving/.

Common Core State Standards for Mathematics
http://www.corestandards.org/assets/CCSSI_Math%20Standards.pdf

Encyclopedia Britannica
http://www.britannica.com/biography/al-Khwarizmi

Gersten, R. and D. Chard (2001). "Number Sense: Rethinking Arithmetic Instruction for Students with Mathematical Disabilities." *The Journal of Special Education, 33.1*, 18-28. Print.

Gupta, Lila Das (2006). "Turning the Tide on Times Tables." *The Daily Telegraph, 11.* Retrieved from http://www.telegraph.co.uk/education/3352968/Turning-the-tide-on-times-tables.html.

Hands-On Standards: Photo-Illustrated Lessons for Teaching with Math Manipulatives, Grades 3-4. Vernon Hills, IL: Learning Resources, Inc.

Hands-On Standards: Photo-Illustrated Lessons for Teaching with Math Manipulatives, Grades 5-6. Vernon Hills, IL: Learning Resources, Inc.

"Learning Theories Knowledgebase." Retrieved from http://www.learning-theories.com/

Leitze, A.R, and N. Kitt. (2000). "Using Homemade Algebra Tiles to Develop Algebra and Prealgebra Concepts." *Mathematics Teacher.* Sept. 462-66.

Mason, M. (2002). "The van Hiele Levels of Geometric Understanding." Retrieved from http://jwilson.coe.uga.edu/EMAT8990/GEOMETRY/mason,%20marguerite.%20the%20van%20hiele%20levels%20of%20geometric%20understanding.%202002.pdf

Moore, Sara. (2013). "Teaching with Manipulatives: Strategies for Effective Instruction." *Colorado Mathematics Teacher*. Fall Issue.

Moyer, P.S., J.J. Bolyard & MA. Spikell (2002). "What are Virtual Manipulatives?" Retrieved from http://courses.edtechleaders.org/documents/elemmath/manipulatives.pdf
National Council of Teachers of Mathematics, *An Agenda for Action*. (1980). Retrieved from http://www.nctm.org/flipbooks/standards/agendaforaction/index.html.

Moyer-Packenham, Patricia S. (2010). *Teaching Mathematics with Virtual Manipulatives.* Rowley, MA: Didax, Inc.

National Council of Supervisors of Mathematics (2013). "Improving Student Achievement in Mathematics by Using Manipulatives with Classroom Instruction." *The*

National Council of Supervisors of Mathematics Improving Student Achievement Series, 11. Spring Issue.

National Council of Teachers of Mathematics (1995). *Assessment Standards for Teaching Mathematics.*

National Council of Teachers of Mathematics (1989). *Curriculum and Evaluation Standards for School Mathematics.*

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics.*

National Council of Teachers of Mathematics (1991). *Professional Standards for Teaching Mathematics.*

Picciotto, Henri. (2013). *Working with Pentominoes*. Rowley, MA: Didax Educational Resources.

"Social-Cognitive Learning Theory: Definition and Examples." Retrieved from http://study.com/academy/lesson/social-cognitive-learning-theory-definition-and-examples.html

Soltis, Jonas (2004). *Perspectives on Learning* (4th ed.). New York: Teachers College Press.

Smithsonian's National Museum of Natural History: Geoboards. Retrieved from http://americanhistory.si.edu/collections/search/object/nmah_904510

Spicer, J. (2000). "Virtual Manipulatives: A New Tool for Hands-On Math." *ENC Focus* 7 (4), 14-15. Print.

"Theories of Mathematical Learning and Understanding." Retrieved from http://ponce.inter.edu/cai/tesis/lmrivera/cap2.htm

Tompert, Ann (1990). *Grandfather Tang's Story*. New York, NY: Crown Publishers, Inc.
Wentworth, G.A. (1901). *First Steps in Geometry.* London, England: Forgotten Books.

Wallis, David A. (2005). "History of Angle Measurement." Retrieved from https://www.fig.net/resources/proceedings/fig_proceedings/cairo/papers/wshs_01/wshs01_02_wallis.pdf

Wentworth, G.A. & G.A. Hill (1901). "First Steps in Geometry." Retrieved from http://www.cut-the-knot.org/triangle/Triangles.shtml