

Fresno Pacific University
Center for Professional Development

Course Syllabus

MAT 924 Virtual Manipulatives (K-12)

Number of Units: 3 semester units

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Course Description

This online course will explore the use of web-based virtual manipulatives to engage K-12 students with important mathematics concepts. Teachers will investigate the nature of virtual manipulatives, compare and contrast them to traditional manipulatives, and discover ways of integrating them into their mathematics instruction. Specific resources and activities provided will encourage the development and use of appropriate standards-based lessons and activities using the manipulatives.

Teachers will become familiar with current research on the use of computer-based virtual manipulatives in the classroom. Based on this research and information gathered from online sources, teachers will design several lessons and activities that engage students in the use of virtual manipulatives. Teachers will relate these activities to their current standards-based math instruction and determine to what extent the lessons and activities have contributed to increased student achievement in mathematics. Teachers will collaborate and share their findings with their online community. This course can be completed with or without students.

Course Materials

Moyer, P. S., Bolyard, J. J., & Spikell, M. A. (2002). What Are Virtual Manipulatives?
Teaching Children Mathematics, v8(n6), p372.

Moyer, P.S., ed. Using Virtual Manipulatives to Investigate Patterns and
Generate Rules in Algebra, *Teaching Children Mathematics*, April 2005.

Beck, Shari A., Huse, Vanessa E. A "Virtual Spin" on the Teaching of Probability.
Teaching Children Mathematics, v13 n9 p482-486, May 2007.

Additional materials will include a variety online resources and articles.

Course Requirements

To complete this course satisfactorily, students must:

- 1) Discuss their use of manipulatives in math instruction.
- 2) Post an insight into using virtual manipulatives in the classroom.
- 3) Discuss current research on the use of virtual manipulatives.
- 4) Analyze three standards that can be supported through manipulative-based instruction.
- 5) Design and evaluate three lessons/activities using virtual manipulatives.
- 6) Collaborate with colleagues through sharing and posting of lessons/resources.

National Standards:

This course is based upon the following standards:

Mathematical process standards proposed by NCTM:

Problem Solving: Students identify and solve problems that arise from a variety of experiences and encompass connected mathematical ideas. They analyze problems and apply a wide range of strategies in flexible ways.

Reasoning and Proof: Students make conjectures (informed guesses), express these conjectures in multiple ways (through language and other forms of representation), and analyze and evaluate their reasonableness.

Communication: Students organize their thinking by expressing their ideas clearly, and by considering and analyzing the ideas of others.

Connections: Students recognize the connections among mathematical ideas and across experiences. They acknowledge, appreciate, and apply mathematical ideas outside the mathematics curriculum.

Representation: Representation is both a process (to represent) and a product (or artifact). Representations include such forms as symbols, pictures, charts, models, and graphic displays. Representations are not ends in themselves, but tools for understanding and communication.

NBPTS five core propositions:

Proposition 1: Teachers are Committed to Students and Learning

Dedication to making knowledge accessible to all students; belief that all students can learn; recognition of the individual differences that distinguish students from one another

Proposition 2: Teachers Know the Subjects They Teach and How to Teach Those Subjects to Students.

Mastery over the subject(s) they teach; familiarity with the skills gaps and preconceptions students may bring to the subject; use of diverse instructional strategies to teach for understanding.

Proposition 3: Teachers are Responsible for Managing and Monitoring Student Learning.

Effective instructional delivery; use of range of instructional techniques; organization of instruction to meet instructional goals; assessment of the progress of individual students as well as the class as a whole; use of multiple methods for measuring student growth and understanding; clear explanations of student performance to parents.

Proposition 4: Teachers Think Systematically about Their Practice and Learn from Experience.

Willingness to try new things; familiarity with learning theories and instructional strategies; critical examination of teaching practice on a regular basis to deepen knowledge, expand repertoire of skills, and incorporate new findings into practice.

Proposition 5: Teachers are Members of Learning Communities.

Collaboration with others to improve student learning; involvement with other professionals regarding instructional policy, curriculum development and staff development.

National Educational Technology Standards (NETS)

I. Technology Operations and Concepts

Teachers demonstrate a sound understanding of technology operations and concepts. Teachers:

- a. demonstrate introductory knowledge, skills, and understanding of concepts related to technology (as described in the ISTE National Educational Technology Standards for Students).
- b. demonstrate continual growth in technology knowledge and skills to stay abreast of current and emerging technologies.

II. Planning and Designing Learning Environments and Experiences

Teachers plan and design effective learning environments and experiences supported by technology. Teachers:

- a. design developmentally appropriate learning opportunities that apply technology-enhanced instructional strategies to support the diverse needs of learners.
- b. apply current research on teaching and learning with technology when planning learning environments and experiences.
- c. identify and locate technology resources and evaluate them for accuracy and suitability.
- d. plan for the management of technology resources within the context of learning activities.
- e. plan strategies to manage student learning in a technology-enhanced environment.

III. Teaching, Learning, and the Curriculum

Teachers implement curriculum plans that include methods and strategies for applying technology to maximize student learning. Teachers:

- a. facilitate technology-enhanced experiences that address content standards and student technology standards.
- b. use technology to support learner-centered strategies that address the diverse needs of students.
- c. apply technology to develop students' higher-order skills and creativity.
- d. manage student learning activities in a technology-enhanced environment.

IV. Assessment and Evaluation

Teachers apply technology to facilitate a variety of effective assessment and evaluation strategies. Teachers:

- a. apply technology in assessing student learning of subject matter using a variety of assessment techniques.
- b. use technology resources to collect and analyze data, interpret results, and communicate findings to improve instructional practice and maximize student learning.
- c. apply multiple methods of evaluation to determine students' appropriate use of technology resources for learning, communication, and productivity.

V. Productivity and Professional Practice

Teachers use technology to enhance their productivity and professional practice. Teachers:

- a. use technology resources to engage in ongoing professional development and lifelong learning.
- b. continually evaluate and reflect on professional practice to make informed decisions regarding the use of technology in support of student learning.
- c. apply technology to increase productivity.
- d. use technology to communicate and collaborate with peers, parents, and the larger community to nurture student learning.

Students will be required to reference their respective state mathematics content standards for specific assignments. These standards can be found online at: <http://www.educationworld.com/standards/>

Learning Objectives/Outcomes

Participants in this course will:

- 1) Explore current research on the topic of virtual manipulatives and their use in the classroom (NBPTS Prop. 4; NETS I).

- 2) Compare and contrast virtual manipulatives with traditional manipulatives and make recommendations on specific content well suited to the use of virtual manipulatives (NCTM PROCESS STANDARDS: Representation; NBPTS Prop. 3; NETS II).
- 3) Demonstrate how to design a lesson or activity which engages students in important mathematics content through the use of virtual manipulatives (NCTM PROCESS STANDARDS: Problem Solving; NBPTS Prop. 2; NETS III).
- 4) Implement and evaluate selected virtual manipulative-based lessons and demonstrate successful integration with standards-based math curriculum (NCTM PROCESS STANDARDS: Communication; NBPTS Prop. 5; NETS IV).
- 5) Collaborate with peers and colleagues in their online community to share insights, strategies, and deepen their professional practice (NBPTS Prop. 5; NETS V).

Schedule of Topics and Assignments

1. Describe one manipulative you have used and how it has supported student understanding of an important mathematics concept.

2. Read the article and additional resources in this topic. Post an insight into using virtual manipulatives in mathematics instruction.

3. Using the links in this topic, continue your exploration of virtual manipulatives. In a written response, discuss their use, compare them to physical models, note any advantages or disadvantages, and provide a rationale for using them in the mathematics classroom. (200-400 word response)

4. Select three standards or objectives and write a brief response which describes how manipulatives can support student understanding of these concepts. (Total response 200-400 words)

5. Provide a brief description and evaluation of one online source for virtual manipulatives.

6. Read the two articles in this topic. Respond in a written reflection.

7. Choose three virtual manipulatives from the NLVM website (place value blocks, integer tiles, etc.) and design a lesson for each. Post one of your lessons in the forum located in this topic.

8. In several brief paragraphs, discuss three of the additional resources or features available in eNLVM and explain how they might extend the functionality of virtual manipulatives for you and your students.

9. Summarize your students' interactions with the virtual manipulatives.

Please Note: If you are currently not teaching, you may substitute Assignment 9 with two additional lesson plans following the format in Assignment 7.

10. Take some time to reflect on your experiences with virtual manipulatives throughout this course. What kinds of challenges do you anticipate in your classroom and how will you address those challenges? Post your response in the forum.

Evidence of Learning

1) Student demonstrated evidence of understanding of course objectives through reflective written assignments. (Assignments 1, 2, 3, 6, 8, 9, 10)

2) Student's writing reflected thoughtful engagement with the course readings. (Assignments 2, 3, 6)

- 3) Student demonstrated evidence of understanding of course objectives through lesson design and evaluation. (Assignments 7 & 9)
- 4) Student made connections to local instructional goals/state standards in the design and implementation of lessons. (Assignments 4 & 7)
- 5) Student included the use of critical thinking and reflection in the evaluation of lessons implemented. (Assignment 9)
- 6) Student demonstrated appropriate and effective collaboration with online educational community. (Assignments 1, 2, 5, 7, 10)

Student/Instructor Contact

Since it is my hope that this course is a meaningful, interactive experience for students, there will be frequent course updates, notes from the instructor, and responses to forum postings.

Grading Policies and Rubrics

Evaluation:

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|-----------------------|-----|
| Written Responses (7) | 20% |
| Standards Analyses | 10% |
| Research | 10% |
| Lesson Plans (3) | 30% |
| Evaluations | 20% |
| Collaboration | 10% |

100%-90% = A

89%-80% = B

79% or below = no credit

Students who take the course for credit/no credit must earn an 80% or above to earn credit. Students who enroll in the course for a letter grade must achieve a grade of "A" or "B." Coursework that earns below a "B" mark will not receive credit; this applies to both the credit/no credit and the letter grade option.

References

Additional resources on virtual manipulatives will be included in the course management system.

Policy on Plagiarism

"All people participating in the educational process at Fresno Pacific University are expected to pursue honesty and integrity in all aspects of their academic work. Academic dishonesty, including plagiarism, will be handled according to the procedures set forth in the Fresno Pacific University Catalogue."

Graduate level course work reflects Fresno Pacific University's Desired Student Outcomes as it applies to professional development to demonstrate the following:

- Oral and written communication in individual and group settings
- Content knowledge, and application of such knowledge in the student's area of interest to affect change
- Reflection for personal and professional growth
- Critical thinking
- Cultural and global perspectives to understand complex systems
- Computational/methodological skills to understand and expand disciplines, including an understanding of technological systems"