

Fresno Pacific University  
Center for Professional Development

### Course Syllabus

**MAT 926A Developing Algebraic Thinking** (Grades 6-8) (ONLINE)

Number of Units: 3 semester units

Instructor: Paul Reimer

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### Course Description

This online course will introduce students to the nature of algebraic thinking in grades 6-8. It will suggest interactive and engaging activities designed to support deeper understanding of foundational algebraic concepts in preparation for students' formal study of Algebra I. Teachers will explore growth patterns and functions, variables, linear relationships, and coordinate graphs. Based on the included text and research-based journal articles, teachers will design and implement a unit of grade-level appropriate algebraic thinking activities with their students.

All of the online readings and activities included in this course support the principles and standards communicated by the National Council of Teachers of Mathematics as well as the NBPTS five core propositions. This course completes a series of algebraic thinking courses offered through Fresno Pacific University, joining courses targeted at the K-2 and 3-5 grade levels.

### Included Course Materials

Friel, S., Rachlin, S., Doyle, D. (2001). *Navigating Through Algebra in Grades 6-8*. Reston, VA: National Council of Teachers of Mathematics. (ISBN-13: 9780873535014)

The following journal articles are used with permission and are posted for viewing in the course management system:

Pitts, Bannister, V.R., & Wilkins, J. L. M. (2007). "I Can't Write All the Way to 100": Recognizing Students' Emerging Algebraic Strategies. *Mathematics Teaching in the Middle School*, 13(5).

Lee, L., & Freiman, V. (2006). "Developing Algebraic Thinking through Pattern Exploration." *Mathematics Teaching in the Middle School*, 11(9).

Vennebush, G., E. Marquez, & J. Larsen. (2005) "Embedding Algebraic Thinking throughout the *Mathematics Curriculum*." *Mathematics Teaching in the Middle School*, 11(2).

### Course Requirements

To complete this course satisfactorily, students will complete the assignments outlined in the Schedule of Topics and Assignments section of the syllabus.

In summary, students will

1) Reflect thoughtfully on personal experiences with and attitudes toward algebra.

- 2) Identify aspects of algebraic thinking appropriate for current instructional standards.
- 3) Analyze their understanding of algebraic thinking through a problem solving activity.
- 4) Create/modify two tasks from their curriculum to support algebraic thinking.
- 5) Design, teach, and reflect on four algebraic thinking lessons.
- 6) Create two original pattern questions to be explored with students.
- 7) Explore student thinking through analysis of work sample and summarize insights.
- 8) Reflect on appropriate technology use in developing algebraic thinking.

### **National Standards**

This course is based upon the following standards:

#### **NCTM Algebra Standards for Grades 6-8**

Understand patterns, relations, and functions

- represent, analyze, and generalize a variety of patterns with tables, graphs, words, and, when possible, symbolic rules;
- relate and compare different forms of representation for a relationship;
- identify functions as linear or nonlinear and contrast their properties from tables, graphs, or equations.

Represent and analyze mathematical situations and structures using algebraic symbols

- develop an initial conceptual understanding of different uses of variables;
- explore relationships between symbolic expressions and graphs of lines, paying particular attention to the meaning of intercept and slope;
- use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships;
- recognize and generate equivalent forms for simple algebraic expressions and solve linear equations

Use mathematical models to represent and understand quantitative relationships

- model and solve contextualized problems using various representations, such as graphs, tables, and equations.

Analyze change in various contexts

- use graphs to analyze the nature of changes in quantities in linear relationships.

#### **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.

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**

By the end of this course, students will be able to:

1. Demonstrate through written reflection an understanding of the value of incorporating algebraic thinking into mathematics instruction (NCTM Process Standards: Communication; NBPTS Prop. 2)
2. Identify foundational concepts and experiences that support algebraic learning (NCTM Algebra Standards; NCTM Process Standards: Problem Solving; NBPTS Prop. 2)
3. Design, teach, and reflect on algebraic thinking lessons which engage students in problem solving, generalizing, and critical thinking (NCTM Algebra Standards; NBPTS Prop. 2)
4. Evaluate student responses to lessons and activities designed to promote algebraic thinking (NCTM Process Standards: Communication; NBPTS Prop. 3)
5. Model and explain how selected algebraic thinking activities align with current standards-based mathematics instruction (NCTM Process Standards: Connections; NBPTS Prop. 4)
6. Collaborate with peers and colleagues in their online community or at their school/district sites to share insights, strategies, and deepen their professional practice (NBPTS Prop. 5)

## **Schedule of Topics and Assignments**

Please note: Word count guidelines for written responses are approximate; they are provided to give you a general sense of the length expectation for each assignment.

### **1) Getting Started**

Personal experiences with algebraic thinking

### **2) What is Algebraic Thinking?**

Explore research and foundational concepts

### **3) Let's Think Algebraically!**

Problem solving

### **4) Algebraic Thinking in the Classroom**

Reflect on current research and pedagogical implications

### **5) Exploring Patterns**

Create pattern questions to explore with students

### **6) Lesson Design: Navigating through Algebra in Grades 6-8**

Design and implementation of lessons

### **7) Looking at Student Thinking**

Assessing student understanding

### **8) Using Technology**

Explore technology to enhance learning

### **9) Reflection**

Personal reflection, share with colleague, summarize conversation

### **Evidence of Learning**

- 1) Student demonstrated critical thinking and thoughtful engagement with the course objectives through reflective written assignments. (Assignments 1, 2, 4, 5, 7, 9)
- 2) Student demonstrated thorough understanding of the foundational concepts of algebraic thinking in the middle grades and awareness of effective pedagogical methods. (Assignments 2, 3, 4, 5)
- 3) Student applied new learning to teaching practice through thoughtful lesson design and reflection. (Assignments 4, 5, 6)
- 4) Student made connections to local instructional goals/state standards in the design and implementation of algebraic activities. (Assignment 6)
- 5) Student demonstrated effective and appropriate integration of technology in exploring algebraic concepts. (Assignment 8)
- 6) Student demonstrated appropriate and effective collaboration with online or school site community. (Assignment 9)

### **Instructor/Student 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 and assignments.

### **Grading Policies and Rubrics**

Evaluation:

Written Responses	30
Forum Postings	20
Lesson Plans	30
Pattern Questions	10
Problem Solution	10

100%-90% = A

89%-80% = B

79% or below = no credit

Students who take the course for credit/no credit must earn a 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.

Assignment Rubrics which provide detailed expectations regarding the quality of submitted work will be available in Moodle.

### **References**

Additional resources on algebraic thinking are located on the CD-ROM provided with the course text.

### **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"