University of Texas at El Paso
College of Education
Department of Teacher Education
MTED 5322 (13524) Fostering Algebraic Reasoning
Fall 2012

Class meeting time: R 5:30 p.m. – 8:20 p.m.
Class meeting place: College of Education, EDUC 402

Professor: Dr. David Carrejo
Office: College of Education, EDUC 811
Phone: 747-5566
E-mail: Through Blackboard or dcarrejo@utep.edu
Office Hours: M, T, and R 3:00 – 4:30 p.m., or by appointment

This syllabus is subject to change as needed. Any changes to the syllabus will be announced in class.

No cellular phones or beepers are permitted in class.

If you have or suspect a disability and need accommodations, you should contact **The Disabled Student Services Office (DSSO)** at **747-5148**. You can also email the office at **dss@utep.edu** or go by the Union Building East, Room 106. For additional information, visit the DSSO website at **www.utep.edu/dsso/**.

Required Texts

- Greenes, C.E., & Rubenstein, R. (2008). *Algebra and algebraic thinking in school mathematics.* National Council of Teachers of Mathematics: Reston, VA.

- *Geogebra: Dynamic Software for Everyone* [v. 4.0]. Available: www.geogebra.org. **This is FREE, open-source software for both Mac and Windows.**

- Other required readings will be available through Academic Search Complete (EBSCO) and electronic journals which are accessible through the UTEP library website. This is a free service for UTEP students Other readings will be available online, open-source, or will be provided by me. A bibliography of required readings is provided at the end of this syllabus.

- We will also be accessing the following websites for course materials:

    - http://ase.tufts.edu/education/earlyalgebra/default.asp
    - http://illuminations.nctm.org
    - http://sciencenetlinks.net

- Other necessary handouts will be passed out in class. MANY COURSE HANDOUTS (such as activity masters) WILL BE MADE AVAILABLE ON Blackboard (through my.utep.edu) You MUST have a valid UTEP login and password to access my.utep.edu, Blackboard, and many other relevant UTEP websites. A UTEP e-mail address is required for all e-correspondence and more effective communication.

Policy on Academic Dishonesty

The University of Texas at El Paso prides itself on its standards of academic excellence. In all matters of intellectual pursuit, UTEP faculty and students must strive to achieve based on the quality of work produced by their individual. In the classroom and in all other academic activities, students are expected to uphold the highest standards of academic integrity. Any form of scholastic dishonesty is an affront to the pursuit of knowledge and jeopardizes the quality of the degree awarded to all graduates of UTEP. It is imperative, therefore, that all faculty, insist on adherence to these standards.

Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but is not limited to cheating, plagiarism, collusion, the submission for credit of any work or materials that are not attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts. Proven violations of the detailed regulations, as printed in the Handbook of Operating Procedures (HOP) and available in the Office of the Dean of Students, may result in sanctions ranging from disciplinary probation, to failing grades on the

work in question, to failing grades in the course, to suspension or dismissal among others.

Course Objectives

Students enrolled in this course are offered a research-based and multi-faceted look at issues regarding the learning and teaching of algebra. Based on recent scholarly work, the course is organized around three major themes: 1) the nature of algebra as a domain of mathematics (including historical perspectives), 2) a constructivist-based analysis of math students' algebraic reasoning and learning, and 3) the critical challenges faced by teachers to foster robust algebraic reasoning in K-12 mathematics classrooms.

Our driving questions include:

- **What are the most powerful algebraic concepts, ideas, and methods (including modeling techniques) that are accessible to learners?**

  To try and answer this question about learning, you will be reading and analyzing relevant literature (book chapters). It is imperative that we understand what has been researched and what methods of research have been used regarding student learning in algebra.

- **How can we link theory and practice in the teaching and learning of algebra across the K-12 mathematics curricula?**

  We will explore **pedagogical content ideas and methods** when teaching algebra topics. Our understanding of these ideas and methods will be relevant for several grade levels in K-12. You will be required to complete a final project that will demonstrate your attempt(s) to answer this two-part question.

We will also reflect upon our own experiences and beliefs about mathematics. We will look at mathematics as a discipline, and, based on the presented research literature, compare more traditional ideas about what it means to 'know' and 'do' mathematics to the vision of mathematics advocated by the reform movements as well as what it means to 'know' and 'do' mathematics relying on constructivist principles on learning and teaching.

Learning Outcomes

Upon completion of the course, students will be better prepared to:

- Identify what makes a 'good mathematical task', and how can a good task support students' learning
- Understand how children make sense of key algebra concepts
- Understand how tools (including manipulatives and technology) assist children in their thinking and problem solving
- Identify their role as teacher in a math classroom
- Design a mathematics lesson based upon constructivist principles of learning and teaching
- Design instruction based on state standards for K-12 mathematics

TExES integration and SBEC standards

- Course objectives primarily reflect TExES standards and SBEC standards for educator certification.
  - TExES website: http://www.texes.ets.org/texes/
  - SBEC website: http://www.sbec.state.tx.us/SBECOnline/standtest/edstancertfieldlevl.asp?width=1024&height=768

- TExES Math Content and Pedagogy and Professional Responsibilities (PPR) Preparation Manuals: http://www.texes.ets.org/texes/prepMaterials/

Texas Math Standards and National Standards

- All TEKS, Texas Essential Knowledge and Skills, for all grades and subjects can be found at this website: http://www.tea.state.tx.us/index2.aspx?id=6148

- National Council of Teachers of Mathematics (2000). *Principals and Standards for School Mathematics*: http://standards.nctm.org/

- Curriculum Focal Points: http://www.nctm.org/focalpoints.aspx

English Language Proficiency Standards

This course integrates English Language Proficiency Standards for English Language Learners (ELLs) in order to provide strategies for language acquisition and academic success in all content areas for students at different levels (beginning, intermediate, advanced, and advanced high) in the domains of listening, speaking, reading and writing.

- ELP Standards: http://www.tea.state.tx.us/curriculum/biling/elps.html

Course Requirements

- It is expected that students will attend **all classes** and actively participate in working on projects and class discussions. Students are expected to prepare for each class session. **Lateness to class is strongly discouraged. With the emphasis on collegiality it is important that all group members be in class to contribute to the group's effort in developing an understanding of what it means to teach mathematics effectively**.
- Assignments are due on the specified dates. **Late assignments will not be accepted**.
- The schedule of topics and reading assignments may change over the course of the semester. **Any changes to the syllabus will be announced in class. Every student is responsible for these changes whether or not the student is present in class.**
- **Type or word-process all assignments**. All assignments should be double spaced with a 12 point font. Number your pages, preferably using a header or footer. Correct grammar and spelling are expected. Further guidelines for the final project will be provided in class.

Attendance Policy

There will be a student sign-in sheet at the beginning of each class. If a student misses a session, it is the responsibility **of the student** for knowing and completing all work required. **Each attendance will count towards the final grade. Two tardies (including early leaves) will count as one absence. More than two absences may result in a student earning one-letter grade lower in the course.**

Course Assignments

1. *Presentations on Required Readings*

   Working in groups of 2 (no more than 2 per group), you will be required to create a brief presentation for the articles, papers, or chapter(s) you are assigned (either overhead transparencies or PowerPoint) for a given week. One group will present/lead the discussion per week. Each presentation should highlight key points in the reading(s) and you are expected to generate discussion questions for the class. Guidelines for presentations and presentation rubric will be provided in class. All presentation materials will be turned in so they can be made available to the class.

2. *Homework (problem-based activities)*

   During this semester, you will participate, as part of this course, in several inquiry-based activities. Students will be assigned homework related to the inquiry-based assignments and these will be collected. The homework assignments and due dates will be announced in class; typically, the homework will be due the following class day.

3. *Final Project (2 parts)*

   The focus of the final project is to build a learning trajectory for students at a particular grade level and to understand how theories of learning influence curriculum. Specifically, you want to focus on how to *bridge research and practice*.

   Part I: Lesson Plans

   I require that you construct a sequence of lessons (**minimum of three**) in geometry. Topics will receive final approval from me. The completed sequence must involve either a technology (computer) component and/or two "hands-on" components. A lesson plan guide and a unit guide will be provided in class.

   Part II: Thought Paper

   You will be responsible for writing a **minimum 10 page** "white" paper supporting your lesson design (i.e. a paper that justifies why you believe the lessons you've designed are important and how they are based on a sound understanding of

constructivist-based teaching). Include an introduction section that introduces the content and the significance of the learning trajectory (i.e. why it is important for students to learn this topic or topics and why they should learn it the way you've designed your lessons). Include a theoretical framework that focuses on student/teacher learning for your given topic (**a minimum of 3 solid references** from peer-reviewed journals or edited books). Further details about the project will be given in class along with continuing guidance from me.

You will submit your project electronically **on Thursday, December 13,** by 12:00 midnight, MST, the final exam day. All materials related to the final project **must be** submitted on that day.

Grades

In this course all grades are important, but some assignments take more time and thought so therefore some may have a different weight.

- Class Attendance 15%
- Presentations on Readings 15%
- Homework Assignments 35%
- Final Project 35%

Grade Distribution:	**Grade**	**%**
	A	**93-100**
	B	**85-92**
	C	**75-84**
	D	**65-74**
	F	**0-64**

General calendar – *Topics, assigned readings, and due dates are subject to change.*

DATE	TOPIC	ACTIVITY FOCUS	ASSIGNMENT
August 30	1) Introduction to course 2) Review of syllabus 3) Introduction to Blackboard	Historical Perspectives on Algebra in the Curriculum	Reading: G&R, Chapter 1
September 6	Current Perspectives on Algebra	Algebra as: 1) a symbol system, 2) generalized arithmetic, 3) the study of functions	Reading: G&R, Chapter 2
September 13	Algebra and the Standards	1) The National Standards (NCTM) 2) Common Core Standards 3) Texas Essential Knowledge and Skills	TEKS for mathematics
The Case for Early Algebra			
September 20	Algebra as generalized arithmetic	Patterns and Recursive Thinking	**Student Chapter Presentations Begin** Reading: G&R, Chapter 8 Reading: G&R, Chapter 6
September 27	Algebra as generalized arithmetic	Integers Operations	Reading: G&R. Chapter 13 Reading: Peled & Carraher (2007)*
October 4	The Concept of Variable	Number sentences Equations An introduction to modeling	Reading: G&R, Chapter 9 Reading: G&R, Chapter 15 ***Homework 1 due***
The Middle Years			
October 11	Algebra and geometry	What is meant by "measure"? Length, Area, and Volume	Reading: Driscoll (2007)*
October 18	Algebra as a symbol system	Multiplicative reasoning and algebraic properties	Reading: G&R, Chapter 10 ***Homework 2 due***
October 25	Algebra as a symbol system	Facets of "symbol sense" Reification vs. Multiple Representations	Reading: G&R, Chapter 5
November 1	Algebra as functioned-based reasoning	Covariation	Reading: Ellis (2011)*
The High School Years and Beyond			
November 8	Algebra as functioned-based reasoning	The SimCalc Project Kinematics (Motion)	Reading: Lehrer et al. (2002)* Reading: G&R, Chapter 17 ***Homework 3 due***
November 15	Analytic Geometry	Historical perspectives on "The Analytic Art" The role of technology (Geogebra)	Reading: Bu, et al. (2011)*
November 22	**THANKSGIVING HOLIDAY – NO CLASS**		
What Algebra Teachers Need to Know			
November 29	Teaching and perspectives of algebra	Pedagogy & Assessment	Reading: G&R, Chapter 19 ***Homework 4 due***
December 6	**Last day of regular classes** Teaching and perspectives of algebra	Pedagogy & Assessment	Reading: G&R, Chapter 20 Reading: G&R, Chapter 21 ***Homework 5 due***
December 13	**Exam Week -- *Final Projects Due***		

***Bibliography of Required Readings**

- *September 27*

Peled, I. & Carraher, D.W. (2007). Signed numbers and algebraic thinking. In J. Kaput., D. Carraher, & M. Blanton (Eds.), *Algebra in the Early Grades*, (pp. 303-327). Mahwah, NJ: Erlbaum.
Available: http://ase.tufts.edu/education/earlyalgebra/publications.asp

- *October 11*

Driscoll, M. (2007). Geometric measurement [Chapter 4]. *In Fostering Geometric Thinking: A Guide for Teachers, Grades 5 – 10.* Heinemann Publishers.
Available: Blackboard

- *November 1*

Ellis, A.B. (2011). Generalizing promoting actions: How classroom collaborations can support students' mathematical generalizations. *Journal for Research in Mathematics Education*, 42(4), 308 - 345.
Available: E-Journals database (UTEP Library website)

- *November 8*

Lehrer, R., Strom, D., & Confrey, J. (2002). Grounding metaphors and inscriptional resonance: Children's emerging understanding of mathematical similarity. *Cognition and Instruction, 30*(3), 359-398. **Available: E-Journals database (UTEP Library website)**

- *November 15*

Bu, L., Spector, J.M., & Haciomeroglu, E.S. (2011). Toward model-centered mathematics learning and instruction using GeoGebra: A theoretical framework for learning mathematics with understanding. In L. Bu & R. Schoen (Eds.), *Model-centered learning: Pathways to mathematical understanding using GeoGebra* (pp. 13 – 40). Rotterdam, The Netherlands: Sense Publishers.
Available: Blackboard