University of Texas at El Paso
College of Education
Department of Teacher Education
MTED 5318 (23338) "Current Topics in Mathematics Education: Learning Theory for Mathematics EC-12"
Spring 2011

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

Professor: Dr. David Carrejo
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Office Hours: M and R 3:00 – 4:30 p.m.

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

- Donovan, M.S., & Bransford, J.D. (2005). *How students learn: Mathematics in the Classroom.* Washington, DC: National Academies Press. Also available: www.nap.edu

- 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 found online, open-source, or will be provided by me. A bibliography of required readings appears at the end of this syllabus.

- 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.

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Course Objectives

Students enrolled in this course will explore some fundamental theories that lie at the heart of learning mathematics. These theories will focus on critical concepts in mathematics -- number sense (including whole number and place value development), ratio and proportion, function, and mathematical modeling (primarily involving the mathematics of change).

Our driving questions include:

- **How do children make sense of certain mathematics concepts?**

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

- **What makes a 'good mathematical task', and how can a good task support students' learning?**

  We will explore **pedagogical content ideas and methods** when teaching these mathematics 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.

- **How can tools (including manipulatives, calculators, and other technology) assist children in their thinking and problem solving?**

  Our approach will involve the use of hands-on activities utilizing simple manipulatives, interactive software (including Excel and Geometer's Sketchpad), and other forms of technology (e.g. inclined planes, motion detectors, and graphing calculators).

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
- How children make sense of key mathematical concepts
- How tools (including manipulatives, calculators, and other 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 what they learn from their students

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/default.asp
- 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: www.tea.state.tx.us/teks/#Grade
- 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. *Inquiry Assignments and Reflections*

   During this semester, you will participate, as part of this course, in several inquiry-based activities. Students will complete journal entries as part of the inquiry-based assignments and these will be collected. There will be at least five inquiry activities, which will relate to topics covered in the course. We will use various technologies with some of these activities, such as motion detectors, Geometer's Sketchpad, and Microsoft Excel. The reflections and due dates will be announced in class; typically, the reflections will be due the following class day. Guidelines for the reflections and the scoring rubric will be provided in class.

3. *Final Project*

   Curriculum Unit

   At the beginning of the semester, you will form groups of 2 (no more than 2 per group) for a curriculum unit project. I require that you construct a curriculum in one of the following domains: number/numeracy, geometry (including ratio and proportion), or algebra. Topics will receive final approval from me.

   Each person in the group is required to construct at least two lessons that are part of the unit (for a total of four). The completed unit must involve either a technology (computer) component and/or two "hands-on" components. You and your partner will be responsible for writing a minimum 10 page "white" paper supporting your unit (i.e. a paper that justifies why

you believe the unit you've designed is important and how it is 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 unit). 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.

A lesson plan guide and a unit guide will be provided in class.

The focus of this 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*. I strongly encourage you to work with your partner to brainstorm, design, and plan this unit in a collegial fashion.

Each group will submit their project electronically **on Monday, May 9,** 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** 20%
- **Inquiry Assignments/Reflections** 25%
- **Final Project** 40%

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
January 24	1) Introduction to course 2) Review of syllabus 3) Introduction to Blackboard	What does it mean to "do" mathematics? What does it mean to"learn" mathematics?	
February 7	Mathematical Understanding	Who learns and how? Who learns and what?	*Reading:* HSL Chapter 5: Mathematical Understanding *Reading:* NCTM Curriculum Focal Points
February 14	Mathematical Understanding	Who learns and how? The Constructivist Perspective	**Student Presentations Begin** *Reading*: Von Glasersfeld (An Exposition of Constructivism)* *Reading*: Cole & Wertsch (on Piaget & Vygotsky)*
February 21	Mathematical Understanding	The role of inquiry and experimentation	*Reading*: Confrey ("Voice and Perspective")* Reading: Von Glasersfeld (View of Science)*
February 28	Number Sense	Measurement and Estimation	*Reading*: *HSL* Chapter 6: Number Sense Reading: Joram, et al. (Measure)* ***Inquiry Reflection 1 due***
March 7	Number Sense	Addition and Subtraction	*Reading*: Hiebert and Wearne (Place Value)* *Reading:* Fuson et al. (Multi-digit Addition and Subtraction)*
March 14	SPRING BREAK – NO CLASS		
March 21	Rational Numbers	Multiplicative reasoning	*Reading*: *HSL* Chapter 7: Rational Numbers *Reading*: Confrey ("Splitting")* ***Inquiry Reflection 2 due***
March 28	Geometry	Similarity and Geometry	*Reading*: Lehrer et al. (Similarity)*
April 4	Algebra	Introduction to Algebraic thinking	*Reading:* Nathan & Koedinger (Views of Algebra)* *Reading*: *HSL* Chapter 8: Functions ***Inquiry Reflection 3 due***
April 11	Algebra	Algebra as generalized arithmetic Algebra as modeling	*Reading*: Schlieman et al. (Algebra in Elementary School)* Reading: Carraher & Schielmann*
April 18	Mathematical Modeling	Radioactive Decay Density	Reading: Carrejo & Marshall (Mathematical Modeling)* Reading: Confrey & Smith (Exponential Functions)* ***Inquiry Reflection 4 due***
April 25	Mathematical Modeling	Kinematics	*Reading:* Noble et al. (SimCalc)*
May 2	**Last day of regular classes** Technology Final thoughts	Survey of technology in mathematics education Finding hreads & making connections	*Reading*: HSL Chapter 13: Pulling Threads *Reading:* Cuoco & Goldenberg* ***Inquiry Reflection 5 due***
May 9	**Final exam day**		***Final Projects Due***

***Bibliography of Required Readings**

Carraher, D.W. & Schliemann, A.D. (2002). Modeling reasoning. In K. Gravemeijer, R., Lehrer, B., Oers, and L. Verschaffel (Eds.). *Symbolizing, Modeling and Tool Use in Mathematics Education (pp. 295-304).* The Netherlands: Kluwer Academic Publishers.

Carrejo, D., & Marshall, J. (2007). What is mathematical modeling? Exploring prospective teachers' use of experiments to connect mathematics to the study of motion. *Mathematics Education Research Journal 19*(1), 45-76. http://www.merga.net.au/node/41?volume=19&number=1

Cole, M., & Wertsch, J. (2003) *Beyond the Individual-Social Antimony in Discussions of Piaget and Vygotsky*. Available: http://www.massey.ac.nz/~alock/virtual/colevyg.htm

Confrey, J. (1995). Student voice in examining "splitting" as an approach to ratio, proportions and fractions. In L. Meira & D. Carraher (Eds.), *Proceedings of the 19th International Conference for the Psychology of Mathematics Education* (Vol. 1, pp. 3-29). Recife, Brazil: Universidade Federal de Pernambuco.

Confrey, J. (1998). Voice and perspective: Hearing epistemological innovation in students' words. In M. Larochelle, N. Bednarz & J. Garrison (Eds.), *Constructivism and education* (pp. 104-120). New York, NY: Cambridge University Press.

Confrey, J., & Smith, E. (1995). Splitting, covariation, and their role in the development of exponential functions. *Journal for Research in Mathematics Education, 26*(1), 66-86.

Cuoco, A., & Goldenberg, E.P. (1996). A role for technology in mathematics education. *Journal of Education, 178*(2), 15-32.

Fuson, K., Wearne, D., Hiebert, J, Murray, H., Human, P., Olivier, A., Carpenter, T., Fennema, E. (1997). Children's conceptual structures for multidigit numbers and methods of multidigit addition and subtraction. *Journal for Research in Mathematics Education, 28*(2),130-162.

Hiebert, J. & Wearne, (1992). Links between teaching and learning place value with understanding in first grade. *Journal for Research in Mathematics Education, 23*(2), 98-122

Joram, E., Subrahmanyam, K., & Gelman, R. (1998). Measurement estimation: Learning to map the route from number to quantity and back. *Review of Educational Research, 68*(4), 413-449.

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.

Nathan, M. J. & Koedinger, K. R. (2000). An investigation of teachers' beliefs of students' algebra development. *Cognition and Instruction, 18*(2), 207-235.

Noble, T., Nemirovsky, R., Dimattia, C., & Wright, T. (2004). Learning to see: Making sense of the mathematics of change in middle school. *International Journal of Computers for Mathematical Learning, 9,* 109–167.

Schliemann, A.D., et al. (2003, July). Algebra in elementary school. *Proceedings of the 27th International Conference for the Psychology of Mathematics Education.* H onolulu, HI.

Von Glasersfeld, E. (1983). An Exposition of Constructivism: Why Some Like It Radical. Available: http://www.oikos.org/constructivism.htm

Von Glasersfeld, E. (2001). The radical constructivist view of science. *Foundations of Science, 6***,** 31–43.

Inquiry Reflections

This assignment is intended to help you consolidate your learning and to begin the process of developing ideas related to your learning experience. A minimum one (1)-page paper (double-spaced) is required. The paper should be a deep reflection on the content of the materials studied or developed, discussing a specific concept (or concepts) revealed during the experience. This is an individual assignment, not a group project and will be graded using the attached rubric.

Based on our work in class and the class readings address the following:

1) Identify the concept(s) that has become an insight to you.
2) Describe how and why it is new or different from how you have thought or what you have done before. You may wish to use the following to begin addressing this issue:
    a. A thought that really struck me…
    b. Here's why…
    c. This reminds me of…
    d. I was wondering…
    e. What puzzles me is…
3) What implications could it have for future practice?

Allocation of Points for Inquiry Reflection

If you meet each goal completely, you will receive full points for that goal. Incomplete or skipped goals will receive partial or no points.

Goal:	**Points:**
Clear identification of concept and related insight clearly explained. *10 points*	
Described how or why the concept was new or how the concept is related to something that you knew before. *10 points*	
Reflected on the implication(s) for future learning or practice. (You are encouraged to refer to the readings handed out in class.) *10 points*	

Total: /30 points

A: 26 – 30 points
Reflection about concept well presented with depth and detailed explanation. Impact on individual teaching and reflection about personal practices well presented and description of how or why the concept was new is supported well in the paper.

B: 21 – 25 points
Reflection about activities and how they could/will impact teaching and learning weak (superficial/lacked depth) and needs work. Impact on current teaching lacked depth and showed little personal reflection. Implications for future practice limited or also weak.

C: 15 – 20 points
Overall, the assignment very weak and reflection non-existent. No discussion of how or why the concept was new or related to something you knew before. Listed or identified the concept but little or no discussion with any depth about impact on current or future practice.

Fail: 15 points or fewer
Failed to meet structure requirements (or turn in assignment). Very shallow presentation.