

**University of Texas at El Paso**  
**College of Education**  
**Department of Teacher Education**  
**MTED 5322 (17327) Fostering Algebraic Reasoning**  
**Fall 2019**

**Class meeting time and place:** HYBRID, F2F – Thursdays in EDUC 402

**Professor:** Dr. David J. Carrejo, Ph.D.

**Office:** College of Education, EDUC 802

**Phone:** 747-5856

**E-mail:** [dcarrejo@utep.edu](mailto:dcarrejo@utep.edu)

**Office Hours:** T 9:30 a.m. – 11:00 a.m., R 3:30 p.m. – 5:00 p.m., or by appointment

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

**Students with Disabilities:** If you have or believe you have a disability; you may wish to self-identify. You can do so by providing documentation to the Center for Accommodations and Support Services (CASS) located in Union E Room 106. Students who have been designated as having a disability must reactivate their standing with CASS on a yearly basis. Failure to report to this office will place a student on the inactive list and nullify benefits received. If you have a condition which may affect your ability to exit safely from the premises in an emergency or which may cause an emergency during class, you are encouraged to discuss this in confidence with the instructor and/or the director of CASS. You may call 919-747-5148 for general information about the Americans with Disabilities Act (ADA).

### **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 [Classic 5.0]*. Available: [www.geogebra.org](http://www.geogebra.org). **This is FREE, open-source software for both Mac and Windows platforms.**
- Other required readings will be available through a course packet. A bibliography of these other required readings is provided in Appendix A at the end of this syllabus.
- We will also be accessing the following websites for course materials:
  - <http://ase.tufts.edu/education/earlyalgebra/>
  - <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](http://my.utep.edu)) You **MUST** have a valid UTEP login and password to access [my.utep.edu](http://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.

### **Standards of Academic Integrity**

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. Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but is not limited to: cheating, plagiarism, collusion [making plans to cheat with another], 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.

## Inclusiveness and equity

Learning happens only when we feel respected as a whole human being. My top priority in our classroom is to cultivate relationships of trust and respect and a sense that we see each other as whole, complex human beings. That you experience this in our classroom is important for the sake of your learning in our course *and* for the sake of your future students' learning, so that you feel able to cultivate such relationships with them. To that end, I want you to know that all of you is welcome in our classroom space—all the parts of you as a person are welcome in our discussions, our activities, our assignments, and in our assessments. We are all complex people with a variety of perspectives, experiences, challenges, assets, and resources—our gender identities, our sexual orientations, our religions, our races, our ethnicities, our economic statuses, our immigration statuses, our parenthoods, our veteran statuses, our ages, our languages, our abilities and disabilities. All the parts of you are welcome in our learning community to the extent that you feel comfortable bringing them in. I strive to show respect for the variety and wholeness in each of you, and I expect that each of you shows respect for each other as well. If you feel marginalized in our class, and you feel comfortable discussing it, I would like to know so that I can support you, protect you, and make changes that feel more inclusive and equitable. You can also talk with our Department Chair and/or you can report a complaint of discrimination to the University's Equal Opportunity Office, Kelly Hall, Third Floor, 915-747-5662 or [eoaa@utep.edu](mailto:eoaa@utep.edu).

## Course Framework

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.

## Course Objectives/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

## TEExES integration and SBEC standards

- Course objectives primarily reflect TEExES standards and SBEC standards for educator certification.
  - TEExES website: [https://tea.texas.gov/Texas\\_Educators/Preparation\\_and\\_Continuing\\_Education/Approved\\_Educator\\_Standards](https://tea.texas.gov/Texas_Educators/Preparation_and_Continuing_Education/Approved_Educator_Standards)
  - SBEC website: [https://tea.texas.gov/About\\_TEA/Leadership/State\\_Board\\_for\\_Educator\\_Certification/SBEC\\_Principles](https://tea.texas.gov/About_TEA/Leadership/State_Board_for_Educator_Certification/SBEC_Principles)
- TEExES Math Content and Pedagogy and Professional Responsibilities (PPR) Preparation Manuals: [https://www.tx.nesinc.com/PageView.aspx?f=HTML\\_FRAG/GENRB\\_PrepManuals.html](https://www.tx.nesinc.com/PageView.aspx?f=HTML_FRAG/GENRB_PrepManuals.html)

## 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 (Section 74.4): <http://ritter.tea.state.tx.us/rules/tac/chapter074/ch074a.html>

### **Course Requirements**

- It is expected that students will “attend” **all classes** and actively participate in working on projects and class discussions online. Participation is required and your participation and performance will be evaluated. Discussions will take place through postings to the Discussion Board. Students are expected to prepare for each class discussion. **With the emphasis on collegiality, it is important that all students participate to contribute to the group’s effort in developing an understanding of what it means to teach mathematics effectively.** Students must follow the rules for “netiquette” that are outlined in Appendix B of the syllabus.
- 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. Every student is responsible for these changes.**

### **Course Assignments**

#### *1. Discussion Board*

I will initiate discussions through the Discussion Board by asking a question or questions that focus on a particular topic covered during weekly activities. Early respondents can answer posted questions and introduce related issues. Later respondents must respond to and integrate earlier responses. You should always respond to questions posed by me or your classmates. Your participation should demonstrate both content knowledge and applied knowledge. Evaluation of your contribution will be based on the rubric provided in Appendix C of the syllabus.

#### *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 two**) in algebra. 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.

- Discussion Board 30%
- Homework Assignments 35%
- Final Project 35%

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

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

DATE	TOPIC	ACTIVITY FOCUS	ASSIGNMENT
<b>August 29</b> <b>Face-to-Face</b>	Introduction to Course		Syllabus Quiz Introductions on Blackboard
<b>September 5</b>	<b>Module 1:</b> Current Perspectives on Algebra	Historical Perspectives on Algebra in the Curriculum	Reading: G&R, Chapter 1 Reading: G&R, Chapter 2 Discussion Board
<b>September 12</b>	<b>Module 2:</b> Algebra and the Standards	Texas Essential Knowledge and Skills	Reading: TEKS for mathematics Discussion Board
<b>The Case for Early Algebra</b>			
<b>September 19</b> <b>Face-to-Face</b>	<b>Module 3:</b> Algebra as generalized arithmetic	Patterns and Recursive Thinking	Reading: G&R, Chapter 8 Reading: G&R, Chapter 6
<b>September 26</b> <b>Face-to-Face</b>	<b>Module 3:</b> Algebra as generalized arithmetic	Integers Operations	Reading: G&R, Chapter 13 Reading: Peled & Carraher (2007) <b>Homework 1 due</b>
<b>October 3</b>	<b>Module 4:</b> The Concept of Variable	Number sentences Equations An introduction to modeling	Reading: G&R, Chapter 9 Reading: G&R, Chapter 15 Discussion Board
<b>The Middle Years</b>			
<b>October 10</b> <b>Face-to-Face</b>	<b>Module 5:</b> Algebra and geometry	What is meant by “measure”? Length, Area, and Volume	Reading: Driscoll (2007)
<b>October 17</b> <b>Face-to-Face</b>	<b>Module 6:</b> Algebra as a symbol system	Multiplicative reasoning and algebraic properties	Reading: G&R, Chapter 10 <b>Homework 2 due</b>
<b>October 24</b>	<b>Module 6:</b> Algebra as a symbol system	Facets of “symbol sense” Reification vs. Multiple Representations	Reading: G&R, Chapter 5 Discussion Board
<b>October 31</b>	<b>Module 7:</b> Algebra as functioned-based reasoning	Co-variation	Reading: Ellis (2011) Discussion Board
<b>The High School Years and Beyond</b>			
<b>November 7</b> <b>Face-to-Face</b>	<b>Module 7:</b> Algebra as functioned-based reasoning	The SimCalc Project Kinematics (Motion)	Reading: Lehrer et al. (2002) Reading: G&R, Chapter 17 <b>Homework 3 due</b>
<b>November 14</b> <b>Face-to-Face</b>	<b>Module 8:</b> Analytic Geometry	Historical perspectives on “The Analytic Art” The role of technology (Geogebra)	Reading: Bu, et al. (2011) Discussion Board
<b>What Algebra Teachers Need to Know</b>			
<b>November 21</b> <b>Face-to-Face</b>	<b>Module 8:</b> Analytic Geometry	Historical perspectives on “The Analytic Art” The role of technology (Geogebra)	<b>Homework 4 due</b>
<b>November 28</b>	<b>THANKSGIVING WEEK</b>		
<b>December 5</b> <b>Face-to-Face</b>	<b>Module 9:</b> Teaching and perspectives of algebra	Pedagogy & Assessment	Reading: G&R, Chapter 19 Reading: G&R, Chapter 20 Reading: G&R, Chapter 21 <b>Homework 5 due</b>
<b>December 12</b>	<b>Exam Week -- Final Projects Due</b>		

## Appendix A: 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.

- *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.

- *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.

- *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.

## Appendix B: Netiquette (Discussion Board) Guidelines

In an online environment it is not possible for others to read your body language, tone of voice, or facial expressions. Therefore, a special set of rules has emerged for online communications, called *Netiquette*. Here are some basic Netiquette rules that should be followed during online discussion board, chat sessions, or e-mail:

- Never give your user ID or password to another person.
- Sometimes a good way of entering a discussion board or chat is to briefly introduce yourself.
- Before posting to a discussion board, you should read prior messages to get a sense of the flow and language of the discussion.
- Always title your messages. Be sure the subject line reflects the topic of discussion. Do not auto-reply and start a new thread leaving the old subject line in the header.
- Always check your spelling before posting a message to a discussion board. It will be the first impression you may make on someone, so it is important that your message be free of spelling errors.
- Keep your questions and comments relevant to the topic of the discussion. If another person posts a comment or question that is off the subject, do NOT reply to the discussion board. If you want to reply, do so in private e-mail directly to the original poster.
- Do not use ALL CAPS. It gives the impression that you are shouting. Capitalize words only to highlight an important point or to distinguish a title or heading. \*Asterisks\* surrounding a word can also be used to make a stronger point.
- Keep paragraphs and messages short and to the point.
- Know what you are talking about and make sense. Make sure your postings contain correct information. Try not to post comments that don't add anything to the discussion.
- Don't be afraid to ask questions within the course discussion group, or to share what you know. It's especially considerate to share the answers to your questions with others. Also, if you've researched a topic that you think would be of interest to others, summarize it and post it to the group.
- Cite all quotes, references and sources and respect copyright and license agreements.
- If you do post a different view point, first acknowledge what someone else has said. If you disagree with someone, it is better to start a message by briefly restating what the other person has said in your own words. This lets the other person know that you are trying to understand him/her.
- When presenting a controversial point of view, state whose view it is. For example, if it is your opinion, you can begin with "in my experience..." or "IMHO..." (in my humble opinion). If it is a view of someone else, you can begin with "according to \_\_\_\_\_", or "the president's view is..."
- When you post or e-mail a question, make it as easy as possible for others to understand what you ask and help you. Make sure your question is clear and specific, and provide as much information as possible. Also, make sure that you later check replies to your question and answer to them if necessary.
- Treat the others on the discussion board in a polite and respectful manner. Never mail or post anything you wouldn't say to your reader's face. Adhere to the same standards of behavior online that you follow in real life.
- Try to stay calm and do not get offended easily. If you feel the need to send an angry message, take a break. If you write the message out, do not send it immediately. Save it. Then, look at it later and try to rewrite it with a milder tone.
- Do not "flame" others on the discussion board. Flaming is the act of responding in a highly critical, sarcastic, or ridiculing manner - especially if done on a personal level. Remember that these discussions are meant for constructive exchanges and learning.

- When quoting another person, edit out whatever isn't directly applicable to your reply. Do not quote the entire body of messages you are replying to when it isn't necessary. Take the time to edit any quotations down to the minimum necessary to provide the context for your reply.
- E-mail messages should be considered private and not shared with others or quoted without permission. However, whatever you post to a newsgroup or discussion board is public. You never know who might read what you posted. Others may copy and send it to others, although it would be better to ask first.
- Do not send "Me Too!", "Thank You", etc. messages to the group. Send those directly to the original poster. A private "Thank You" is nicer, too!
- Advertisements and spam messages are not permitted on online course discussion boards.
- Sometimes emoticons are used to express emotion:
  - smile :) or :-)
  - wink ;)
  - frown :(
  - I'm confused %-)
- A few abbreviations that are commonly used are:
  - FYI = for your information
  - BTW = By the way
  - IMO = In My Opinion
  - IMHO = In my humble opinion (This is a good non-offensive way of expressing one's own opinion.)
  - LOL = laugh out loud
  - BRB = be right back
  - CYA = see you later
  - OT = Off Topic
  - OTOH = On the other hand
  - F2F = Face to face
  - <g> = grin
- Be careful about posting late at night or any time you are tired, sick, or having a terrible day. Your judgment may not be at its best during those times. When in doubt, postpone sending your message until you feel better.



## Appendix C: Discussion Participation Rubric

Criteria	Unsatisfactory	Satisfactory	Exemplary
Quantity and Timeliness	Does not submit at least one initial response early in the session and/or does not submit at least two peer responses closer to the end of the session.	Submits at least one initial response early in the session, and at least two peer responses closer to the end of the session.	Submits one initial response early in the session, and two or more thoughtful peer responses early in the session, and more than two peer responses closer to the end of the session.
	3 points	3.75 points	5 points
Spelling and mechanics	Does not submit posts that are in complete sentences. Or two or more of the complete sentences are grammatically incorrect and have greater than 2 spelling errors.	Submits posts that have one or more grammatically incorrect sentences and two spelling errors.	Submits posts that contain grammatically correct sentences without any spelling errors.
	3 points	3.75 points	5 points
Demonstrates knowledge and understanding of content and applicability to professional practice	Post(s) and responses show little evidence of knowledge and understanding of course content and applicability to professional practice.	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to professional practice.	Post(s) and responses show evidence of knowledge and understanding of course content and applicability to professional practice, and include other resources that extend the learning of the community.
	3 points	3.75 points	5 points
Generates learning within the community	Posts do not attempt to elicit responses and reflections from other learners and/or responses do not build upon the ideas of other learners to take the discussion deeper.	Posts attempt to elicit responses and reflections from other learners and responses build upon the ideas of other learners to take the discussion deeper.	Posts elicit responses and reflections from other learners and responses build upon and integrate multiple views from other learners to take the discussion deeper.
	3 points	3.75 points	5 points
<b>Total Possible Points:</b>	20 points		