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Algebraic Reasoning, Spring 2014 (15:254:552)
HYBRID COURSE (Index # 19080)
On-Campus Full Class Meeting Dates: 1/21, 2/4, 2/11, 3/4, 3/11, 3/25, 4/1, 4/8, 4/29, 5/6
Tuesday, 4:30-7:10, GSE Room 211
Graduate School of Education, 10 Seminary Place
Alice Alston, Instructor

CONTACT INFO

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OFFICE HOURS
Tuesdays (on-campus dates only), 2:30-4:30 or by appointment

COURSE DESCRIPTION AND LEARNING OBJECTIVES

This course is designed to provide participants with opportunities to think deeply about the development of algebraic ideas among upper elementary and middle school students in a variety of school communities with special attention given to the Common Core State Standards for Mathematical Practice and the appropriate content standards. Course activities will blend in-person, on-campus sessions for the whole class and independent analysis for small groups and individuals with interactions done asynchronously online through a course eCollege web site. On-campus activities will include working as a class on mathematical problem-solving tasks involving fundamental algebraic ideas and considering together how K-12 students might engage mathematically as they build solutions to similar problems.

A major resource for the course is the Video Mosaic Collaborative (VMC), where series of annotated video clips from the RBDIL archives are available for use by preservice and inservice educators. The video data provides examples of children engaged in similar algebraic tasks to the ones that you will solve together. These tasks were developed within the Robert B. Davis Institute for Learning (RBDIL) research projects and a number of the classroom sessions that provided the video data were facilitated by the late Professor Robert B. Davis, whose philosophical perspective underlies the development of ideas presented in the course. The VMC Analytic Tool will also be a resource, allowing you to develop particular narratives from the video clips for individual research presentations related to various themes that you identify during the course.

The online component of the course work will include studying and discussing particular relevant video clips. Reading assignments, also posted on line, will introduce participants to the theoretical perspectives about learning and teaching algebraic ideas that have been the basis for this research during the past two decades, particularly the work of the Professor Davis. Other readings will provide background about research in the development of algebraic thinking from the broader math education community. Guiding questions for engaging in reflection and discussion about the

video clips and readings and their relevance to teaching practices will accompany the online discussion following each class session.

A primary activity of the course will be two action-research analytic projects based on your study of video clips on the VMC where children in several different environments are engaged in reasoning about basic algebraic ideas. Working first as a part of a small group and then individually, you will be expected to construct analytics from the VMC clips that you study. The goal of each project is to construct a mathematical and pedagogical narrative presentation for a defined purpose, either for mathematical research or practice.

All course activities will be carried out within a context that includes consideration of relevant research, both as it relates to instruction and relates to the Common Core State Standards (CCSS) and the NCTM Standards.

COURSE MATERIALS

All required materials needed for the course will be available on the eCollege shell. Students registered for the course will have access to the materials for particular sessions as they occur.

COURSE REQUIREMENTS

You are expected to be an active participant in all of the on-campus activities, the VMC analytic projects, and the ongoing web-based discussions. Successful completion of the course requires that you engage in these activities and submit all assignments. Specific requirements include that you:

1. Attend all on-campus sessions, where you will engage as "learners" in the mathematical tasks that are captured in the video clips, learn about the VMC repository and how to use the analytic tool.

2. Be knowledgeable about and willing to discuss all the assigned readings, the context of your analytic projects and that of your colleagues, and shared video clip viewings.

3. Actively participate in online class discussions by responding to guiding questions as posted on the eCollege website discussion threads after each class session. You are expected to make at least one original posting and respond to at least two group-member postings between each on-campus sessions.

4. Use the VMC analytic tool by studying existing analytics and working with your small group to construct a "pilot" analytic focusing on the clips from the first content component of the course.

5. Complete an *Individual Analytic Research Project*. You will work individually to construct a publishable analytic about students algebraic reasoning, defining a particular mathematical and pedagogical theme and selecting from any of the VMC clips that we study during the course.

The goal is for you to study the video clips in order to identify the emergence of particular mathematical ideas and ways of reasoning demonstrated by particular student(s) as they engage in problem solving tasks that you will have done for yourselves in this course. Your completed project will include a series of events with accompanying research-based narrative descriptions that illustrate how the students reasoned about and solved the various problems, how they built representations for the ideas, and relevant pedagogical issues that you identify as critical.

You will be expected to summarize your work with a presentation of your findings that will be presented to the entire class and an individual final report of your analysis.

6. Complete a short (1-2 pages) *reflection paper* about your work in this course. This will be the final assignment and due on May 10 at the latest. You should reflect on your knowledge of the mathematics, how students learn, and implications for teaching with regard to NCTM Standards. You may review your postings on the course web site and notes from problem solving and sharing of solutions as you develop your reflective assessment, which should be about one to two pages in length.

GRADING CRITERIA

Requirements 1. & 2. 15% of grade

Requirement 3. 20% of grade

Requirement 4. 20% of grade

Requirement 5. 35% of grade

Requirement 6. 10% of grade.

ALL students are expected to contribute regularly to the course. Evaluations will attend to:

(1) The quality and frequency of your postings about your own mathematical thinking, the readings, and your analyses of the video clips. This means that you are expected to initiate discussions in each unit and also respond to others' postings. *Your grade will be lowered* if you are not actively engaged in postings on a regular basis between each class meeting;
(2) The quality of your final reflection (you should review your ideas and experiences across the course and provide a thoughtful reflection about your learning);
(3) The two Analytics you will create that focus on children's algebraic reasoning and include implications for teaching. Evaluation of each analytic will attend to your insights into the learning process, evidence of how students are building particular mathematical ideas and relevance to the CCSS as evidenced by the events you select and annotate with your text descriptions to form a coherent narrative.

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TENTATIVE COURSE OUTLINE AND ASSIGNMENTS

(Task selection and reading assignments may be modified as we "construct" the course.)

On campus sessions	**Activities and Assignments for the following session**
1/21/2014 First Classical Lesson Assignments for next session	**Class Activities:** Introduction to the course and discussion of our perceptions about Algebra and algebraic reasoning in light of the 8 Common Core State Standards for Mathematical Practice in relation to our course requirements, including the action research analytics. Review syllabus and discuss course requirements. True, false, legal and illegal sentences. Pebbles in the Bag. **Read:** (1) From R. Davis (1984). *Learning Mathematics: the Cognitive Science Approach to Mathematics Education.* Ablex. New Jersey. a. "Mathematics" and "Mathematics Education". Chapter 1. b. The 'Paradigm' Teaching Strategy. Chapter 21. (2) From R. Davis, C. Maher & N. Noddings (1990). *Constructivist Views on the Teaching and Learning of Mathematics.* JRME Monograph #4. R. Davis, Chapter 7. Discovery Learning and Constructivism. **Watch video clips:** Early Algebra Ideas – Series One (Algebraic Ideas with One Variable): Clips 1 and 2 and Series Two (Algebraic Ideas with Two Variables): Clips 1 and 2 **Post responses to eCollege questions:** Your first individual response to the questions is to be posted before Monday, January 27, and at least two responses to the comments of others in the class should be posted by Monday, February 3.
2/4/2014 Solving Equations with One Variable Assignments:	**Class Activity:** Discuss the Videotapes and your responses to the Discussion Thread questions. Solve and discuss Davis's "Equations to Solve". **Read:** **(1)** JRME Monograph #4. Noddings. Chapter 1. Constructivism in Mathematics Education. **(2)** Algebra Core Content Standards **(3)** Schifter, D. (March1996). A constructivist perspective on teaching and learning mathematics. Phi Delta Kappan Journal, pp.492 – 499. **Watch video clips:** Early Algebra Ideas Involving One Variable – Clips 3 - 11

	Post responses to eCollege questions: Your first individual response to the questions is to be posted before Friday, February 7 and at least two responses to the comments of others in the class should be posted by the morning of Tuesday, February 11.
2/11/2014 Introducing Analytics and Analytic Tool Assignments	**Class Activities:** (1) Review or learn about – and how to build – an analytic using the VMC analytic tool. (2) Discuss the video clips with one variable that you have watched in the context of your readings and the CCSS content standards for algebra. What might be good themes for analytics built from these clips? **First Analytic assignment due electronically to me before March 4:** Work with your partner or group to create a short (only 4 or 5 events) analytic from the video clips that you have been watching. Decide together on the theme – both mathematical and pedagogical that you are developing and carefully construct your overall description and the descriptions for each event. **Read:** Hmelo-Silver, C. E., Maher, C. A., Palius, M. F., Sigley, R., Alston, A., Agnew, G., Mills, C. (2013). Building multimedia artifacts using a cyber-enabled video repository: The VMCAnalytic. *Proceedings of the 46th Hawaii International Conference on System Sciences (HICSS)* Hawaii: IEEE.
3/04/2014 Analytics based on Algebraic Reasoning about one variable Assignments:	**Class Activity:** (1) Share group analytics. Be prepared to discuss your reasons for selecting the particular clips. Including the following questions: What is the theme of your narrative - What were the particular significant events that you recognized – and - What might be the focus for using your analytic. As you think about your individual analytic – How might your theme change or develop and what might you want to look for in future clips? (2) Discussion about Constructivism from the perspective of Davis's approach. **Read:** Davis (1994) What mathematics should students learn? *The Journal of Mathematical Behavior, 13(1),* 3 - 33. **Post responses to eCollege Discussion Thread:** Continue as in the previous weeks – try to get your first response in within 4 or 5 days – then respond as

	frequently as possible – at least two more times between each class session.
3/11/2014 Guess My Rule (Linear functions) Assignments	**Class Activity:** Algebraic Reasoning with two variables (1) First (linear) Guess My Rule problems (Problems 1 – 6) (2) Ladders, Geese and the Museum problems. Function problems building from our earlier Guess My Rule activities to the series of function problems, including the Ladder and Museum Problems. (3) Watch Ariel's interview **Read:** (1) Alston and Davis. Development of Algebraic Ideas: Report from 1996 Brazil Seminar (2) Francisco, J. & Hähkiöniemi, M. (2006). Insights into students' algebraic reasoning. In J. Novotná, H. Moraová, M. Krátká & N. Stehlíková (Eds.) Proceedings of the 30th conference of the international group for the psychology of mathematics education (PME), Prague, Vol. 3, 105-112. **Watch video clips:** Early Algebra Ideas Involving Two Variable – Clips 3 - 14 Early Algebra Ideas in context – IML Series 5 and 6 (all clips) and Series 7, Clips 2, 3 and 4.
3/25/2014 Non-linear Guess My Rule Assignment	**Class Activities:** (1) Discussion about Constructivism from the perspective of Davis's approach. (2) Guess My Rule Problems 7 - 9. (3) Tower of Hanoi **Read:** (1) SREB Report (2000). Getting Students Ready for Algebra 1: What middle grades students need to know and be able to do. (2) Davis, R. B. (1992). Understanding 'understanding'. *The Journal of Mathematical Behavior, 11*, 225-241. **Watch video clips:** Early Algebra Ideas Involving Two Variables – Clips 15 - 18 PUP Math VMC Tower of Hanoi **Post responses to eCollege discussion thread**

4/01/2014 Context problems for Systems of Equations Assignments:	**Class Activities:** (1) Discussion of expectations for final analytic assignment. (2) Context Problems involving systems of equations used in Lesson Study (Roya Basu's dissertation). **Read:** (1) Alston, A., Pedrick, L., Morris, K. & Basu, R. (In 2011). Lesson study as a tool for developing teachers' close attention to students' mathematical thinking. In L. Hart, A. Alston and A. Murato (Eds.) *Lesson Study Research and Practice in Mathematics Education: Learning Together.* Dordrecht. Springer. (2) Scanlon, D. (1995). Algebra is cool: Reflections on a changing pedagogy in an urban setting. In D. Schifter (Ed.) *What's Happening in Math Class? Envisioning New Practices through Teacher Narratives. Vol. One*. New York. Teachers College Press. **Post responses to eCollege discussion thread:**
4/08/2014 Exploring Binary Expansion Assignment	**Class Activities:** Mathematical models for binary expansion (Eman Aboelnago's dissertation (1) Symbolic (2) Geometric (3) Towers and Pascal **Read:** (1) Kovac, D (2012) Masters project (2) Speiser, Robert (2011). How far can you go with block towers? In C. Maher, A. Powell, & E. Uptegrove (Eds) *Combinatorics and reasoning: Representing, justifying and building isomorphisms.* Chapter 13. **Watch video clips:** Stephanie interviews 2, 3 and 4 Kovac Analytic Work on analytic. **Post responses to eCollege discussion thread:**
4/29/2014	Completing things – and beginning to share final analytics
5/06/2014	Sharing final analytics -

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5/13/2011	*Reflection Paper and final analytic project DUE electronically*

As a general guideline for engaging in online discussions, we offer a few words on "Netiquete." This is drawn from Palloff, R. M., & Pratt, K. (1999). *Building learning communities in cyberspace*. San Francisco: Jossey-Bass, p. 101.

- Check the discussion frequently and respond appropriately and on the subject
- Focus on one subject per message and use pertinent, informative, and not-too-long subject titles
- Capitalize words only to highlight a point or for titles. Capitalizing otherwise is generally viewed as SHOUTING
- Be professional and careful with your online interaction
- Cite all quotes, references, and sources
- When posting a long message, it is generally considered courteous to warn readers at the beginning of the message that it is a lengthy post
- It is inappropriate to forward someone else's message(s) without their permission