

EDUCATION 549 SYLLABUS

I. COURSE TITLE AND NAME

EDUC 549: Historical Topics for Middle School and High School Mathematics Teachers

II. COURSE DESCRIPTION

This course will develop a deepened historical and educational understanding of elementary algebra in the context of a Christian perspective on mathematics.

III. COURSE GOALS AND OBJECTIVES

Upon completing this course, teachers will be able to ...

1. *articulate a Christian philosophy of mathematics and mathematics education*
2. *demonstrate familiarity with the major developmental stages in the history of arithmetic and elementary algebra*
3. *analyze and evaluate the key conceptual phases/components in learning elementary algebra and recognize potential pitfalls in this process*
4. *evaluate ways in which history of mathematics can be incorporated into the mathematics classroom*
5. *produce and share classroom materials that incorporate historical and philosophical understandings of mathematics and that address curricular and pedagogical issues*

Course Objective	DC Grad Ed Stds	Activity/Assessment
1. Articulate Christian philosophy of mathematics education	DCGES 1a (RO)	Philosophy essay
2. Demonstrate familiarity with the major developmental stages in the history of arithmetic and elementary algebra	DCGES 6a (CS), 6c (CR)	Response to readings; Problem solving
3. Analyze/evaluate phases of algebra learning	DCGES 2b, 2d (CD), 6a (CS)	Educational essay
4. Evaluate educational use of history of mathematics	DCGES 2d (CD), 3a, 6c (CR)	Historical essay
5. Produce historically informed classroom materials	DCGES 3a, 3b, 4b, 5a (CR), 6a (CS), 6b, 6c (CR)	Unit lesson plans

IV. COURSE READINGS

- Avital, Shmuel. *History of Mathematics Can Help Improve Instruction and Learning. Learn From the Masters!* edited by Frank Swetz, 3 - 12. 1995.
- Berlinghoff, William P. and Gouvêa, Fernando Q. *Math Through the Ages. A Gentle History for Teachers and Others, Expanded Edition.* Mathematical Association of America. 2004.
- Booth, Lesley R. *A Question of Structure, or, A Reaction to "The Early Learning of Algebra: A Structural Perspective". Research Issues in the Learning and Teaching of Algebra* edited by Sigrid Wagner and Carolyn Kieran, 33 - 56. 1989.
- Fauvel, John and Van Maanen, Jan (editors). *History in Mathematics Education.* Selected pages. Kluwer Academic Publishers. 2000.
- Herscovics, Nicolas. *Cognitive Obstacles Encountered in the Learning of Algebra. Research Issues in the Learning and Teaching of Algebra* edited by Sigrid Wagner and Carolyn Kieran, 60 - 86. 1989.

- Jongsma, Calvin. *Mathematics: Always Important, Never Enough. A Christian Perspective on Mathematics and Mathematics Education*. **Online Journal of the ACMS** (posted at <http://www.acmsonline.org/journal2006.htm>). 2006.
- Jongsma, Calvin. *History of Mathematics for Algebra Educators*. LaTeX In-House Press. 2010.
- Kieran, Carolyn. *The Early Learning of Algebra: A Structural Perspective*. **Research Issues in the Learning and Teaching of Algebra** edited by Sigrid Wagner and Carolyn Kieran, 33 - 56. 1989.
- Sfard, Anna. *The Development of Algebra: Confronting Historical and Psychological Perspectives*. **Journal of Mathematical Behavior** 14: 15 - 39. 1995.
- Swetz, Frank. *Seeking Relevance? Try the History of Mathematics*. **Mathematics Teacher** 77(1): 54 - 62. Jan, 1984.
- Tall, David. *Different Cognitive Obstacles in a Technological Paradigm, or, A Reaction to "Cognitive Obstacles Encountered in the Learning of Algebra"*. **Research Issues in the Learning and Teaching of Algebra** edited by Sigrid Wagner and Carolyn Kieran, 87 - 92. 1989.

V. COURSE OUTLINE AND ASSIGNMENTS

This course has two components: a Pre-Campus portion, and a week-long On-Campus portion. In terms of content, the course has four interlocking topics: philosophy of mathematics/mathematics education; educational research on teaching and learning algebra; the value of history of mathematics for mathematics education; and history of mathematics for teaching and learning algebra.

Pre-Campus Portion (May - June: 85 hours)

- Christian Philosophy of Mathematics (15 hours)
 - Read and respond to Jongsma 2006 in an online discussion (18 pages reading)
 - Based on the reading, discussion, and personal experience, write a 5-7 page essay on philosophy of mathematics/mathematics education
- Educational Research on Teaching and Learning Algebra (25 hours)
 - Read Kieran 1989, Booth 1989, Hescovics 1989, Tall 1989, and Sfard 1995 (85 pages)
 - Based on the readings and personal experience, write a 5-7 page response assessing what researchers identify as
 - 1) the stages/main components to learning algebra, and
 - 2) the main obstacles encountered by students as they learn algebra.
- History of Mathematics for Mathematics Education (20 hours)
 - Read Swetz 1984, Avital 1995, and Fauvel 2000 (62 pages)
 - Based on the readings and teaching experience, write a 5-7 page reflection on the advantages and disadvantages to using history of mathematics, both as background for teachers and as classroom material for students
- General History of Mathematics Background (5 hours)
 - Read Berlinghoff & Gouvêa 2004 (42 pages)
 - Respond to some short-answer questions on the reading
- History of Mathematics: Computational Background for Elementary Algebra (20 hours)
 - Read Jongsma 2010 on Ancient Cultures' Numeration and Arithmetic (47 pages)
 - Solve problems and answer brief essay questions related to the topics
 - Propose historical topic for developing lesson unit plan

On-Campus Portion (July: 40 hours)

- Day One: Philosophy and History
 - Early morning: discuss philosophical essays
 - Late morning: discuss educational research findings
 - Early afternoon: discuss using history of mathematics for mathematics education
 - Late afternoon: discuss, finalize, and outline lesson unit plans
 - Evening: read Jongsma 2010 sections, work on lesson unit plans
- Day Two: Fraction Concept and Computation
 - Early morning: discuss section from Jongsma 2010 on Egyptian fraction arithmetic
 - Late morning: solve problems
 - Early afternoon: discuss section from Jongsma 2010 on Babylonian fraction arithmetic
 - Late afternoon: discuss and work on lesson unit plans
 - Evening: solve problems, read Jongsma 2010 sections
- Day Three: Egyptian and Babylonian Algebra
 - Early morning: discuss section from Jongsma 2010 on Egyptian algebra
 - Late morning: solve problems
 - Early afternoon: discuss section from Jongsma 2010 on Babylonian algebra
 - Late afternoon: work on lesson unit plans
 - Evening: solve problems, read Jongsma 2010 sections
- Day Four: Islamic and Early Modern Algebra
 - Early morning: discuss section from Jongsma 2010 on Islamic algebra
 - Late morning: solve problems
 - Early afternoon: discuss section from Jongsma 2010 on early modern algebra
 - Late afternoon: work on lesson unit plans
 - Evening: solve problems, finalize lesson unit plans
- Day Five: Expansion and Foundations of Algebra
 - Early morning: discuss later developments in algebra (coordinate geometry, expanding concept of number, nature and foundations of algebra, etc.)
 - Late morning: presentations on lesson unit plans; course conclusion

VI. MEANS OF EVALUATION

Students will be graded on their work in the following way:

- *Essays*
Each of the three essays will be worth 25 points.
- *Solved Problems*
Solved problems will be worth a total of 45 points. Problem sets will be graded individually, the final grand percentage for all solutions taken of 45 points.
- *Lesson Unit Plans*
The lesson unit plans will be worth 30 points.
- *Final Grade*
The course grade will be determined by adding up grade values for the essays, problems, and lesson unit. An 18 point scale will be used to assign a grade out of a total of 150 points.