

DEC 22 **PROCESS A**

NON-GENERAL EDUCATION CURRICULUM PROPOSAL

SCC #04-05- 360

(P)

ROANoke UNIVERSITY

Deadlines

October 1, 2004 to be implemented Fall 2005 - February 11, 2005 to be implemented Spring 2005

PROPOSAL TITLE: Mathematics Pedagogy for Elementary Teachers

Sponsor's Susan Taber E-Mail: taber@rowan.edu Ext. 3812

DEPARTMENT: Elementary/Early Childhood

COLLEGE: Education

If Liberal Arts & Sciences CHECK: History/Humanities Math/Sciences Social/Behavioral Sciences

UNDERGRADUATE GRADUATE

THE ATTACHED NON-GEN-ED PROPOSAL IS BEST DESCRIBED BY THE ITEM(S) CHECKED:

- New non-gen-ed course
- Existing non-gen-ed course
- Non-gen-ed degree requirements
- Major
- Minor, specialization, concentration, track, certificate program
- Which curricular changes fewer than three to

THE FOLLOWING SIGNATURES REPRESENT APPROVAL

Department Chair: [Signature] Date 9/24/04

Department Curriculum Chair: [Signature] Date 9/24/04

Academic Dean: [Signature] Date 10-6-04

* Dept. Curriculum Committee is Committee of the Whole, with Department Chair as Chair

COLLEGE CURRICULUM COMMITTEE

OPEN HEARING Date 12/21/04 Approved Not Approved

COLLEGE CURRICULUM CHAIR: [Signature]

Senate Curriculum Chair Signature: [Signature] Date Senate Announcement: 12/16/04

Comments: _____

EXECUTIVE VICE PRESIDENT/PROVOST Signature: [Signature] Date 12/16/04

Approved Not Approved

Date 1/7/05 Course Description Page, Ed & Approved - Reg's Taxonomy, & Course # 0802336

Registrar Signature: [Signature]

NOTIFICATION FORWARD

- SCC Chair
- Academic Dean
- Department Chair
- Registrar
- R
- CAP
- VP Student Affairs
- Others

TM 2/1/05

DB/B

COURSE PROPOSAL

Details

- a. **Course Title:** Mathematics Pedagogy for Elementary Teachers
- b. **Sponsor(s):** Dr. Susan B. Taber, Department of Elementary / Early Childhood Education
- c. **Credit Hours:** 2 semester hours
- d. **Course Level:** Undergraduate 300 level
- e. **Prerequisites:** Inquiry and Discovery in the Elementary Classroom, 0802.3XX;
Practicum: Assessment in Elementary Classrooms, 0802.3XX;
Differentiating Instruction: Teaching in the Inclusion Classroom, 0808.3XX;
Co-requisites: Practicum in Mathematics and Literacy, 0802.3XX;
Differentiated Literacy Instruction, 0830.3XX.
- f. **Suggested time and scale of implementation:** Fall 2005; Fall and Spring semesters

Curricular Effect:

- **Offerings**
This course will be required for all Elementary Teaching majors. It will partially replace the current course 0802.370 Educational Studies III - Subject Specific Pedagogy which will no longer be taught.
- **Adequacy**
The course will be taught by the mathematics education specialist (s) in the department of Elementary / Early Childhood Education. No additional staff will need to be hired. The teaching materials, including videos and computer software, that have been used for Educational Studies III will be available for use in this course. A classroom dedicated to mathematics pedagogy is included in the new Education Building.
- **Recommended Library Resources**
The library currently subscribes to *Teaching Children Mathematics* and *Mathematics Teaching in the Middle School*. No additional library resources will be required; however, the resources listed below would enhance library resources for this course.

Ball, D. L. (1993). Halves, pieces, and twos: Constructing and using representational contexts in using fractions. In T. P. Carpenter, E. Fennema, & T.A. Romberg (Eds.), *Rational numbers: An integration of research* (pp. 157-195). Hillsdale, NJ: Lawrence Erlbaum Associates.

Baroody, A. J. (1985). Mastery of the basic number combinations: Internalization of relationships or facts? *Journal for Research in Mathematics Education*, 16, 83-98.

Brooks, J. G., & Brooks, M. G. (1993). Becoming a constructivist teacher. In J. G. & M. G. Brooks, *The Case for Constructivist Classrooms*. Alexandria, VA: Association for Supervision and Curriculum Development.

Brownell, W. A. (1935). Psychological Considerations in the Learning and the Teaching of Arithmetic. In J. K. Bidwell and R. G. Clason (Eds.) *Readings in the History of Mathematics Education*. Washington, DC: National Council of Teachers of Mathematics.

Brownell, W., and Chazal, C. (1935). The effects of premature drill in third grade arithmetic. *Journal of Educational Research*, 29, 17-28.

Burns, M. (1991). Introducing division through problem solving experiences, *Arithmetic Teacher*, 38(8), 14-18.

- Carey, D. (1992). Students' use of symbols, *Arithmetic Teacher*, 40 (3), 184-86.
- Carpenter, T. P., Fennema, E., Franke, J. L., Levi, L., & Empson, S. B. (1999). *Children's mathematics: Cognitively guided instruction*. Portsmouth, NH: Heinemann.
- Clement, D. H. & McMillen, S. (1996). Rethinking 'concrete' manipulatives.' *Teaching Children Mathematics*, Jan. 1996, pp. 270-279.
- Corwin, R. (1996). *Talking mathematics: Supporting children's voices*. Portsmouth, NH: Heinemann.
- Countryman, J. (1992). *Writing to learn mathematics: Strategies that work, K-12*. Portsmouth, NH: Heinemann.
- Davidson, N. (Ed.). (1990). *Cooperative learning in mathematics: A handbook for teachers*. Menlo Park, CA: Addison-Wesley Publishing Company.
- Eggen, P. D., and Kauchak, D. P. (1988). *Strategies for Teachers: Teaching Content and Thinking Skills*. Englewood Cliffs, NJ: Prentice Hall
- Fey & C. R. Hirsch (Eds.) (1992). *Calculators in Mathematics Education*. Reston, VA: National Council of Teachers of Mathematics.
- Ginsburg, H. P. (Ed.). (1983). *The development of mathematical thinking*. Orlando, FL: Academic Press.
- Grouws, Douglas A. (Ed.). (1992). *Handbook of Research on Mathematics Teaching and Learning*. New York, NY: Macmillan Publishing Company.
- Hankes, J. E. (1996). An alternative to basic-skills remediation. *Teaching Children Mathematics*, 2, 452-457..
- Hiebert, J. (Ed.). (1986). *Conceptual and procedural knowledge: The case of mathematics*. Hillsdale, NJ: Erlbaum.
- Hiebert, J. (1987). Decimal fractions, *Arithmetic Teacher*, 34 (7), 22-23
- Hiebert, J. (1989). The struggle to link written symbols with understandings: An update, *Arithmetic Teacher*, 36 (7), 38-44.
- Hiebert, J. & Behr, M. (Eds.). (1989). *Number concepts and operations in the middle grades*. Reston, VA: National Council of Teachers of Mathematics.
- Hiebert, J., Carpenter, T. P., Fennema, E., Fuson, K. C., Wearne, D., Murray, H., Olivier, A., Human, P. (1997). *Making Sense: Teaching and Learning Mathematics with Understanding*. Portsmouth, NH: Heinemann.
- House, P. A., and Coxford, A. F. (Eds.). (1995). *Connecting Mathematics Across the Curriculum*. Reston, VA: National Council of Teachers of Mathematics.
- Investigations in Number, Data, and Space*. (1994-2003). Various authors. Palo Alto, CA: Dale Seymour Company.

Jensen, R. J. (Ed.) (1993). *Research Ideas for the Classroom: Early Childhood Mathematics*. New York: Macmillan

Johnson, D. W., Johnson, R. T., & Holubec, E. J. (1993). *Circles of learning: Cooperation in the classroom* (4th ed.). Alexandria, VA: Association for Supervision and Curriculum Development.

Kamii, C. K. (1985). *Young children reinvent arithmetic*: New York: Teachers College Press.

Kamii, C. K. (1989). *Young children continue to reinvent arithmetic: 2nd grade*. New York: Teachers College Press.

Kamii, C, Lewis, & Livingston. Primary arithmetic: Children inventing their own procedures. *Arithmetic Teacher*, Dec. 1993, pp. 200-203.

Kamii, C., & Joseph, L. (1988). Teaching place value and double-column addition, *Arithmetic Teacher*, 35 (6), 48-52.

Kazemi, E. (1998). Discourse that promotes conceptual understanding. *Teaching Children Mathematics* (March 1998), 410-414.

Kenney, M.J., & Hirsch, C. R. (Eds.). (1991). *Discrete Mathematics across the Curriculum K-12* (pp. 18-29). Reston VA: National Council of Teachers of Mathematics.

Kilpatrick, J., Martin, W. G., and Schifter, D. (Eds.). (2003). *A Research Companion to Principles and Standards for School Mathematics*. Reston, VA.: National Council of Teachers of Mathematics.

Lamon, S.J. (1999). *Teaching fractions and ratios for understanding: Essential content knowledge and instructional strategies for teachers*. Mahwah, NJ: Lawrence Erlbaum.

Lampert, M. (1990). When the problem is not the question and the solution is not the answer: Mathematical knowing and teaching. *American Education Research Journal*, 27, 29-63.

Lesh, R. A. & Landau, M. (Eds.). (1983). *Acquisition of mathematics concepts and processes*. Orlando, FL: Academic Press.

Lester, Frank K., Jr. (Ed.). (2003). *Teaching Mathematics through problem solving: Prekindergarten - Grade 6*. Reston, VA: National Council of Teachers of Mathematics.

Litwiller, B. (Ed.). (2002). *Making sense of fractions, ratios, and proportions*. Reston, VA: National Council of Teachers of Mathematics.

Ma, L. (1999). *Knowing and teaching elementary mathematics: Teachers' understanding of fundamental mathematics in China and the United States*. Mahwah, NJ: Lawrence Erlbaum.

Mack, N. (1993). Making connections to understand fractions, *Arithmetic Teacher*, 40 (6), 362-4.

Mokros, J., Russell, S.J., & Economopoulos, K. (1995). *Beyond arithmetic: Changing mathematics in the elementary classroom*. Palo Alto, CA: Dale Seymour.

Morrow, L. J. (Ed.). (1998). *The teaching and learning of algorithms in school mathematics*. Reston, VA: National Council of Teachers of Mathematics.

National Council of Teachers of Mathematics. (1991). *Professional standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics. (1995). *Assessment standards for teaching mathematics*. Reston, VA: Author.

National Council of Teachers of Mathematics (2000). *Principles and Standards for School Mathematics*. Reston, VA: Author.

National Research Council. (2001). *Adding it up: Helping Children learn mathematics*. J. Kilpatrick, J. Swafford, and B. Findell (Eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

New Jersey State Department of Education. (2003). *Core Curriculum Content Standards for Mathematics*. Trenton, NJ: Author.

Owens, D. T. (Ed.) (1993). *Research ideas for the classroom: Middle grades mathematics*. New York: Macmillan.

Payne, J. N. (Ed.) (1990). *Mathematics for the young child*. Reston, VA: National Council of Teachers of Mathematics.

Post, T. R. (Ed) (1992). *Teaching mathematics in grades K-8: Research-based methods* (Second edition). Needham Heights, MA: Allyn & Bacon.

Peck, Jencks, & Connell. (1989) Improving instruction through brief interviews. Arithmetic Teacher, 15-17

Reyes & Stanic (1988). Gender and race equity in primary and middle school mathematics classrooms, *Arithmetic Teacher*, 35 (8), pp. 46-48.

Rowan, T. E., and Bourne, B. (1994). *Thinking like mathematicians: Putting the K-4 Standards into practice*. Portsmouth, NH: Heinemann.

Schifter, D., & Fosnot, C. T. (1993). *Reconstructing mathematics education: Stories of teachers meeting the challenge of reform*. New York: Teachers College Press.

Secada, W. T., Fennema, E., & Adajian, L. B. (Eds.). (1995). *New directions for equity in mathematics education*. New York: Cambridge University Press.

Silver, E. A. & Kenney, P.A. (Eds.). (2000). *Results from the seventh mathematics assessment of the National Assessment of Educational Progress*. Reston, VA: National Council of Teachers of Mathematics.

Skolnick, J., Lanbort, C., and Day, L. (1982). *How to Encourage Girls in Math and Science*. Palo Alto, CA: Dale Seymour Publications.

Smith, M. S. and Stein, M. K. (1998). "Selecting and Creating Mathematical Tasks: From Research to Practice." *Mathematics Teaching in the Middle School*, 3, 344-350.

Sowder, L. (1988). Children's solutions of story problems. *Journal of Mathematical Behavior*, 7, 227-238.

Sowder, L. (1989). Story problems and students' strategies. *Arithmetic Teacher*, 36(9), 25-26.

Stein, M.K., Grover, B. W., & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning: An analysis of mathematical tasks used in reform classrooms. *American Educational Research Journal*, 33, 455-588.

Sullivan, P. and Clark, D. (1991) Catering to all abilities through 'good questions.' *Arithmetic Teacher*, 38 (2), pp. 14-18.

Taber, S. B. (2002). Go ask Alice about multiplication of fractions. In Litwiller, B. (Ed.) *Making sense of fractions, ratios, and proportions* (pp. 61-71). Reston, VA: National Council of Teachers of Mathematics.

Thompson, A. G., Phillip, R. A., Thompson, P. W., Boyd, B. A. (1994). Computational and conceptual orientations in teaching mathematics. In D. B. Aichele & A. F. Coxford (Eds.), *Professional development for teachers of mathematics* (pp. 79-92). Reston, VA: National Council of Teachers of Mathematics.

Thornton, C. A., & Bley, N. S. (Eds.). (1994). *Windows of opportunity: Mathematics for students with special needs*. Reston, VA: National Council of Teachers of Mathematics.

Van de Walle, J. A. (2004). *Elementary and Middle School Mathematics: Teaching Developmentally*. Fifth Edition. New York: Addison Wesley Longman.

Wearne, D., & Hiebert, J. (1994). Place Value and Addition and Subtraction. *Arithmetic Teacher*, 41, 272-274.

Whitin, D. J. (1993). Looking at the world from a mathematical perspective, *Arithmetic Teacher*, 40 (8), 438-441.

Whitin, D.J. & Wilde, S. (1992). *Read any good math lately? Children's books for mathematical learning, K-6*. Portsmouth, NH: Heinemann.

Whitin, D. J. & Wilde, S. (1995). *It's the story that counts: More children's books for mathematical learning, K-6*. Portsmouth, NH: Heinemann.

Wood, T., Cobb, P., Yackel, E., & Dillon, D. (Eds.). (1993). *Rethinking elementary school mathematics: Insights and issues (Journal for Research in Mathematics Education Monograph No. 6)*. Reston, VA: National Council of Teachers of Mathematics.

Woodward, E., Frost, S., and Smith, A. (1991). Cemetery Mathematics, *Arithmetic Teacher*, pp. 31-36.

Zaslavsky, C. (1996). *The multicultural classroom: Bringing in the world*: Portsmouth, NH: Heinemann.

- **Short-term Evaluations**

No short-term evaluations are planned.

Rationale

This course in mathematics pedagogy is designed to build on the candidates' foundational knowledge of mathematics as developed in two prerequisite mathematics courses, including Structures of Mathematics. This course is designed to help teacher candidates gain the knowledge and skills that have been identified by the National Resource Council as essential for teaching mathematics (*Adding it Up*:

Helping Children Learn Mathematics, 2001). Teacher candidates in this course will develop

- a knowledge of how elementary age students think and of how they learn mathematics,
- an understanding of children's thinking in specific domains of mathematical content,
- a fluent repertoire of instructional routines for teaching mathematics,
- skill in selecting, designing, and implementing instructional activities,
- a knowledge of the National Council of Teachers of Mathematics (NCTM) *Principles and Standards for School Mathematics* (2000) and of the *New Jersey Core Curriculum Content (NJCCC) Standards for Mathematics* (2003) and the ability to apply those Standards to the selection and analysis of instructional materials and activities,
- skill in assessing how particular instructional designs and activities play out and impact children's thinking.

This course focuses on communication and decision-making as they relate to planning and teaching. It introduces teacher candidates to research on students' learning of mathematics and provides the groundwork for making instructional decisions based on current research on effective teachers. It involves teacher candidates in using instructional technology (computers, calculators, equipment for mathematical investigation and modeling) with an emphasis on providing equal learning opportunities for all children in the classroom, including students of diverse backgrounds and with diverse abilities.

Essence of the Course

a. Objectives of the Course:

Teacher candidates completing this course will be able to:

1. Model effective communication strategies and questioning techniques that foster individual and collective investigation of mathematical concepts and processes (A1-E4) ;
2. Identify and utilize family and community resources to foster student learning of mathematics and provide opportunities for parents to share skills and experiences that enrich mathematical learning (A2-E1);
3. Demonstrate an understanding of mathematical concepts inherent to numeracy, patterns and algebra, geometry, and data representation and analysis that enable elementary students to represent mathematical concepts and physical events, represent and analyze data, communicate mathematically, and solve problems (A3-K4);
4. Analyze and select instructional activities and materials that encourage the sharing of multiple perspectives and encourage learners to develop mathematical knowledge from the vantage points of the learners (A3-V1);
5. Promote the development of critical and creative thinking about mathematics, problem solving and decision making skills by engaging students in making and investigating mathematical conjectures and developing and evaluating mathematical arguments and proofs (A3-E1);
6. Make effective use of multiple representations (including representations generated by students) and explanations of mathematical concepts that capture key ideas and link them to students' prior understanding (A3-E2);
7. Evaluate teaching resources and curriculum materials for their accuracy and usefulness in representing particular mathematical ideas and concepts (A3-E3; B1-E3);
8. Plan instruction based on students' needs, developmental progress and prior knowledge (B1-K1);
9. Identify available and appropriate resources and materials for instructional planning (B1-K2);
10. Identify a variety of instructional approaches and the use of various technologies to promote mathematical thinking and understanding (B1-K4);
11. Identify and select instruction appropriate to students' stage of development, learning styles, strengths and needs (B1-E1);
12. Identify strategies to create learning experiences that make mathematics meaningful for students, address a variety of learning styles, encourage students to pursue their own interests and inquiries and help students connect their learning to personal goals (B1-E4);

13. Enhance their knowledge of learners and evaluate students' progress and performance using a variety of formal and informal assessment techniques to modify teaching and learning strategies (B2-E4);
14. Engage in reflection and assessment of learning mathematics (B3-V2);
15. Engage in activities that help them learn about the diverse students they teach (C1-E2);
16. Use knowledge of students to design and carry out instruction that builds on students' strengths while meeting their needs and taking into account issues of social class, gender, race, ethnicity, language, sexual orientation, age, and special needs (C1-E4);
17. Prepare students for and monitor independent and group work that allows for full and varied participation of all individuals in learning mathematics (C2-E6);
18. Know and understand how students construct knowledge, acquire skills, and develop habits of mind and how to use instructional strategies that promote student learning (C3-K1);
19. Know how to identify and teach to the developmental abilities of students, which may include learning differences, visual and perceptual differences, cultural and socio-emotional differences, special physical or emotional challenges, and gifted and talented exceptionalities (C3-K3);
20. Apply learning theory to accommodate differences in student intelligence, perception, cognitive style, and achievement levels (C3-E);
21. Know of available resources related to educational strategies to accommodate individual differences in learning mathematics (C4-K2);
22. Make appropriate provisions in terms of time and circumstances for work, task assigned, communication, and response modes, for individual students who have particular learning differences or needs in mathematics (C4-E5).

b. Topical Outline / Content:

1. The NCTM and NJCCC Standards for Mathematics and their implementation in teaching and learning.
2. Developing understanding in mathematics
 - a). A constructivist view of learning
 - b). Types of mathematical knowledge
 - c). The role of models and representations in developing understanding
 - d). Teaching developmentally
3. Teaching through problem solving
 - a). Problem solving as a principal instructional activity
 - b). Designing and selecting effective tasks
4. Building assessment into instruction
 - a). Assessment tasks
 - b). Using observation in assessment
 - c). Diagnostic interviews
5. Teaching all children mathematics
 - a). Planning for diversity
 - b). Multicultural and social equity
 - c). Modifications for learning disabilities
 - d). Strategies for teaching mathematically talented students
6. Technology and school mathematics
 - a). The role of calculators
 - b). The computer as a tool for mathematics
 - c). Selecting and utilizing instructional software

d). Mathematics education resources on the Internet

7. Teaching and learning mathematical concepts and procedures

a). Developing early number concepts and number sense

Counting

Number relationships 1-20

Estimation and Measurement

b). Developing meanings for the operations

Addition and Subtraction

Multiplication and Division

c). Developing computational fluency and strategies for whole numbers

d). Development of whole number place value

e). Developing fraction concepts

f). Developing computational flexibility and strategies for fractions

g). Developing decimal and percent concepts and decimal computation

h). Developing measurement concepts

i). Developing geometric thinking and geometric concepts

j). Exploring concepts of data analysis and probability

k). Development of algebraic reasoning

c. Evaluation of Students and Grading Procedure

Students will be evaluated through a combination of in-class participation, written reflections, written reports and reflections on teaching experiences, including micro-teaching, written report and analysis of a student interview, exams and quizzes, and a course portfolio.

d. Course Evaluation

The procedures that will be used to assess the success of the course in meeting the goals and objectives of the College of Education are: student course evaluations and appropriate departmental and program curriculum review processes.

Results of Consultations

The following departments were consulted:

Mathematics Department, Ronald Czocho

Office of Field Experiences, Robert Kern

Department of Reading, Cindi Hasit

See Appendix for results of consultations.

Catalogue Description

Mathematics Pedagogy for Elementary Teachers 0802.3##

This course in mathematics pedagogy for the elementary education candidate focuses on the knowledge and skills essential for teaching mathematics. Utilizing current research findings about how students develop mathematical concepts and processes, candidates will develop an understanding of teaching and learning mathematics at the elementary level. Teacher candidates will develop a repertoire of instructional strategies and will develop and analyze effective mathematics lessons. A field component is required.

Prerequisites: Inquiry and Discovery in the Elementary Classroom, 0802.3XX; Practicum: Assessment in Elementary Classrooms, 0802.3XX; Differentiating Instruction: Teaching in the Inclusion Classroom, 0808.3XX;

Co-requisites: Practicum in Mathematics and Literacy, 0802.3XX; Differentiated Literacy Instruction in, 0830.3XX.