A Two-Year College’s Opportunities for Teaching Teachers in the Era of the Common Core

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University System Institutions

35 institutions:

- 4 research universities
- 2 regional universities
- 13 state universities
- 14 state colleges
- 2 two-year colleges
Core Curriculum

42 semester hours

U. S. Perspectives Overlay

Global Perspectives Overlay

Critical Thinking Overlay

- Area A1  Communication Skills—writing in English at least 6 semester hours
- Area A2  Quantitative Outcomes—at least 3 semester hours
- Area B  Institutional Options—at least 3 semester hours
- Area C  Humanities, Fine Arts, and Ethics—at least 6 semester hours
- Area D  Natural Sciences, Mathematics, and Technology—at least 7 semester hours
- Area E  Social Sciences—at least 6 semester hours
- Area F  Lower Division Major Requirements—at least 18 semester hours
College Algebra
Pre-calculus
Quantitative Skills and Reasoning
Mathematical Modeling

At Georgia Highlands College, early childhood education majors are recommended to take Quantitative Skills and Reasoning. However, many take College Algebra.
This course places quantitative skills and reasoning in the context of experiences that students will be likely to encounter. It emphasizes processing information in context from a variety of representations, understanding of both the information and the processing, and understanding which conclusions can be reasonably determined.

MATH 1001
Quantitative Skills and Reasoning
1. Sets and Set Operations
2. Logic
   - Negations, Quantifiers,
   - Conditional Statements,
   - Conveses
   - Inductive and Deductive Reasoning,
   - Valid Arguments
3. Basic Probability
4. Data Analysis
   - Basic Descriptive Statistics
     - Mean, Median, Mode
     - Standard Deviation
   - Correlation, Causality, and Inferences
   - Interpreting Graphical Displays
   - Sampling and Randomness
5. Modeling from Data
   - Scatter Plots, Regression Lines
     - Linear Models
     - Quadratic Models
     - Exponential Models
     - Logarithmic Models

Common Topics for Quantitative Skills and Reasoning
At Georgia Highlands, students take a two-course science sequence and one mathematics course.

Mathematics courses options:
- Precalculus (Trigonometry)
- Elementary Statistics
- Calculus I or Applied Calculus

Early childhood education majors are encouraged to take Elementary Statistics for their Area D mathematics course.
Early childhood education majors take three education courses:

- Investigating Critical and Contemporary Issues in Education
- Exploring Socio-Cultural Perspectives on Diversity in Educational Contexts
- Exploring Learning and Teaching

Early childhood education majors take two science classes (life science/earth science and physical science)

Early childhood education majors take MATH 2008 Foundations of Numbers and Operations
- Topics
  - Problem-Solving
  - Standards
  - Whole Numbers
  - Numeration Systems
  - Mental Arithmetic/Estimation
  - Divisibility, GCF, LCM
  - Integers
  - Rational Numbers
  - Proportional Reasoning
  - Percent

MATH 2008
Foundations of Numbers and Operations
Early childhood education recommendations
  - A2 Mathematical Modeling
  - D Elementary Statistics

Area F
  - Same as Georgia Highlands

Upper Division Courses

Math 3316 Ratios and Proportions for Elementary Teachers

Math 3317 Geometry and Measurement for Elementary Teachers

Math 3318 Algebra for Elementary Teachers

Teaching of Specialty Subjects
ECE 4401 Mathematics in Elementary and Early Childhood Education

Kennesaw State University
Conceptual development of the rational numbers and extension to the real numbers, operations and problem solving with real numbers, patterns and relationships, and proportional reasoning. Experience and exploration with appropriate technology and physical models will be an integral part of the study of these ideas.

MATH 3316
Rational Numbers and Proportional Reasoning for Elementary Teachers
Critical content and conceptual development of measurement; transformational geometry; symmetry in the plane; and constructions. Geometric concepts will be explored and developed using physical models, visual models and educational software.
Understanding and use of the major concepts and techniques of algebra for grades P-5, including expressing, transforming, and generalizing patterns and quantitative relationships through a variety of representations, including tables, graphs, algebraic symbols, verbal descriptions, manipulatives, and geometric figures. Solving problems using multiple strategies, manipulatives, and technological tools will also be a focus.
• Early childhood education majors

• Area A—encouraged to take College Algebra

• Area D—required to take Introduction to Computer Concepts

• Area F—same requirements as Georgia Highlands

• Upper Division Courses
  • MATH 3803 Algebra for Teachers
  • MATH 3703 Geometry for Teachers
  • MATH 4713 Probability and Statistics for Teachers
  • ECED 4263 Teaching Content and Processes: Mathematics Education

State University of West Georgia
What is needed?

Opportunities for Four-Year Programs in Education
- Northwest Georgia Educational Services Agency
- Serves 16 school districts
- One of 16 RESAs

Opportunities with Mathematics-Science Partnerships
- Led 7th/8th-grade groups at three sites
- Two-week summer workshops for two summers
- Five meetings throughout the school year
- Focus on algebra and geometry in year 1

Years 1 and 2
MSP
The Painted Cube Problem

Perseverance in Problem-Solving
Seeing Growing Patterns in Different Ways

T-chart

<table>
<thead>
<tr>
<th>X</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>4</td>
<td>9</td>
<td>16</td>
<td>25</td>
<td>(n+2)^2</td>
</tr>
</tbody>
</table>

Second set of differences is constant $\rightarrow$ quadratic

$y = (x+2)^2$

or

$y = x^2 + 4x + 4$

I saw growth by looking at the squares in the middle and developed a formula based on position.

Saw the 1st one as a $3\times3$ and 2nd one as a $4\times4$ area and developed an equation based on position.
CONSTRUCTIONS, DILATIONS, SCALING FACTORS
Seeing the same principle in different representations—building similar pentominoes
Tangrams—Find the perimeter and area of each piece
Making dodecahedral ornaments
Teaching for transfer—understanding where the mathematics taught now leads in two years—from inequalities to linear programming.

- Fertilizer: \(2w + 4c \leq 120\)
- Workers: \(3w + 2c \leq 100\)
- Acres: \(w + c \leq 45\)

Profit:
\[
\begin{align*}
\text{Profit} &= \$200w + \$300c \\
&= \$200(20) + \$300(20) \\
&= \$4000 + \$6000 \\
&= \$10,000
\end{align*}
\]
Determining whether alternate algorithms work

1. Subtract “1” from the whole-number part of the first mixed number.
2. Subtract the first numerator from the second numerator and store the number mentally or on paper.
3. Subtract the “stored” number from the denominator, which gives the numerator of the answer. Write this number over the denominator.
4. Subtract the whole-number part of the mixed numbers.
5. Write the answer in lowest terms.

Example 1:

\[ \frac{7}{9} - \frac{2}{9} = \frac{5}{9} \quad 9 - 5 = 4 \]

\[ \frac{3}{4} \quad \frac{2}{3} - \frac{7}{9} = \frac{4}{9} \]

Example 2:

\[ \frac{10}{15} - \frac{1}{3} = \frac{9}{15} \quad 15 - 9 = 6 \]

\[ \frac{10}{15} \quad \frac{10}{15} = \frac{7}{15} \quad \frac{6}{15} \]

Has anyone else worked problems using this method? I am interested in other quick tricks.

Terri L. Curtis
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Mathematics Teaching
in the Middle School April, 1994
Determining whether alternate algorithms work

Does \( \frac{a}{b} \div \frac{c}{d} = \left( \frac{a}{c} \right) \div \left( \frac{b}{d} \right) \)?

Does \( \frac{15}{28} \div \frac{5}{7} = (15 \div 5)/(28 \div 7) = \frac{3}{4} \)?

Does \( 62 - 47 = -5 + 20 = 15 \)?
An 11-year-old conjectures that

if
\[
\frac{12}{32} = \frac{3}{8} \quad \frac{123}{328} = \frac{3}{8}
\]

and if
\[
\frac{80}{120} = \frac{2}{3} \quad \text{then} \quad \frac{802}{1203} = \frac{2}{3}
\]

Does this really work?

Analysis
- Learning Mathematics for Teaching (LMT)
  - 9 out of 12 increased in Number and Operations
  - 7 out of 12 increased in Geometry
  - 10 out of 12 showed significant gains in Algebra
  - 4 had significant gains in all three areas
  - 6 had significant gains in two of the three areas

Evaluation after first year
(Midpoint of MSP grant project)
Higher education faculty split time in workshops throughout the year among groups for teachers of grades three and four, grades five and six, and grades seven and eight

Higher education faculty team-taught with RESA staff courses for teachers to get an elementary mathematics endorsement
Two panels (one of each of the two years of MSP)
- Writing items
- Analyzing distracters
- Editing
- Trying with students
- Considering item difficulty and discrimination values
- 3rd Grade Bank—50 items
- 4th Grade Bank—100 items
- 5th Grade Bank—75 items
- 6th Grade Bank—90 items
- 7th Grade Bank—67 items
- 8th Grade Bank—106 items
- Estimation
- Algebraic Thinking

Examples of Difficulties for Elementary Teachers
Sample Third-Grade Item

M3N2b Use mental math and estimation strategies

32. Sara wanted a hamburger that cost $3.89, fries for $2.62, and a lemonade for $0.89. She has $10.00. Estimate how much change she will receive.

1. $1.00
2. $2.00
3. $4.00
4. $7.00
Sample Third-Grade Item

M3A1c Use a symbol to represent an unknown

34. Melanie had 7 more Tootsie Rolls than peanut butter cups on Monday. If □ stands for the number of peanut butter cups, which expression below would describe the total number of Tootsie Rolls and peanut butter cups Melanie has?

a. □ + 7
b. 7 - □
c. □ + □
d. □ + □ + 7
Thinking through an estimation question

Giving advice to teachers

Meet Third-Grader
Barton Sopata
M6N1g Solve problems involving fractions, decimals, and percents.

Eric was asked to explain how he knew that 4/9 was “close” to 1/2. Which of the following explanations contains an error?

• Since half of the denominator is 4.5 and the numerator of the given fraction is 4, I know that 4/9 is close to 1/2 but less than 1/2.

• The fraction 4/9 can be thought of as 49%. The fraction 1/2 is equivalent to 50%. Since 49% is close to 50%, 4/9 is close to 1/2 but less than 1/2.

• I know that 9 ÷ 4 = 2 1/4 and 2 ÷ 1 = 2. Since 2 1/4 is close to 2, then 4/9 is close to 1/2 but less than ½.

• Since 4/8 is equivalent to 1/2 but 4/8 is more than 4/9, 4/9 is close to 1/2 but smaller.
- Delivery of science courses for elementary science endorsement

- On-site (at schools) support for teachers participating in grant

- Summer workshops for 7th/8th and High School Teachers

2011-2012
Year One of Second MSP Grant
- Mathematics-science connections
  - Density
  - Light intensity
  - Hooke’s Law
  - Radioactive decay

- Use of technology
- Requests for resources on particular topics
  - Voice-over PowerPoints
  - Webinars

- Email questions/answers and website links, etc.

- Hire qualified high school teachers to teach part-time at GHC
• Math Contests
• Math Trails
• Fabulous Fridays

Other Opportunities
Acquainting GHC faculty with NCTM process standards

Providing rubric for class observations

See Draft MET II Recommendation 5

Recognize that there are opportunities for professional growth for university faculty in mathematics and mathematics education.
Problems, Issues, Questions, Comments, Conclusions

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