

An Analysis of Preservice Teacher's Knowledge of Mathematics Competencies

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Impetus for Study

- 95 % + passing rate on TExES for Texas State preservice teachers.
- Disaggregate data indicate that EC -4 certification seekers are not performing well on the math portion of the tests.
- EC - 4 TExES has 15 math questions out of 100 total questions.

Certification Seekers Demographics 2005 - 2006 (n = 425)

EC - 4	85.7% Generalist	4.7% Bilingual
4 - 8	2.8% Math	0.5 % Math/Science
8 -12	0.5% Math	0.5% Science
EC -12	0.9% Phys Ed	1.4% Special Ed

••• Entry level Math Prerequisites at Texas State University

- All entering students must have at the minimum:
 - Algebra I
 - Algebra II
 - Geometry
- Any course that requires the above courses as a prerequisite.

Where are our students learning math?

- Math at other institutions
 - Two-year institution - 43.3 %
 - Four-year institution - 4.7 %
 - HS AP credit - 1.0 %
- 49 % of Texas State preservice teachers receive math credit from sources other than Texas State.

... Texas State University Preservice Teacher Demographics

- 2005 - 2006 Core Block Cohorts (n = 425)
 - (Includes all certification seekers)
 - Male - 5.7 %
 - Female - 94.3 %
 - African American - 2.7 %
 - Asian - 0.7 %
 - Caucasian - 75.5 %
 - Hispanic - 18.1 %
 - Other - 3.0 %

... Math courses required for preservice teachers

- EC - 4

- College Algebra
 - Or
- Mathematics for Business and Economics I
- Principles of Math I
- Informal Geometry

- 4 - 8

- Principles of Math I
- Informal Geometry
- Elementary Statistics
- Calculus I
 - Or
- Calculus for Life Science
- Calculus II
 - Or
- Calculus for Life Sciences II
- Modern Geometry
- Principles of Math II
- Math Understandings
- Introduction to the History of Mathematics

... 2005 - 2006 EC-4 Generalist TExES Results (n = 214)

Domain	II - Mathematics (15 math questions)			
Competency	12 Math Instruction	13 Number Concepts Patterns Algebra	14 Geometry, Measurement Probability Statistics	15 Math Processes
Average Score %	78	72	62	80
Total Score %	73			

... 2005 - 2006 EC-4 Bilingual
Generalist TExES Results (n = 21)

Domain	II - Mathematics			
Competency	16 Math Instruction	17 Number Concepts Patterns Algebra	18 Geometry Measurement Probability Statistics	19 Math Process
Average Score %	81	67	61	69
Total Score %	70			

2005 - 2006 4 -8 Mathematics TExES Scores (n = 8)

Domain	1 Number Concepts	2 Patterns & Algebra	3 Geometry & Measure	4 Prob & Stats	5 Math Process & Perspectives	6 Math Learning Instruction & Assessment
Score %	81	83	89	87	77	85
Total Score %	84					

2005 - 2006 8 - 12 Mathematics TExES Scores (n = 16)

Domain	1	2	3	4	5	6
	Number Concepts	Patterns & Algebra	Geometry & Measure	Prob & Stats	Math Process & Perspective	Math Learning Instruction & Assessment
Score %	77	72	68	71	63	71
Total Score %	70					

Formative Math Assessment for Preservice Teachers

- Curriculum and Instruction Math Assessment (CIMA)
- Prerequisite for admission into Core Block
- Created by Texas State Math faculty and Curriculum and Instruction faculty
- Test questions from math faculty, released TExES, TIMMS, other state released tests.

CIMA Administration

- CIMA pilot study administered fall 2004 spring 2005
 - Reliability indices for each domain was greater than 0.80
 - Construct validity
 - Expert validation
- CIMA administered in fall 2005 and spring 2006
- Need for short answer questions evident.

CIMA Domains

- Reflective of National and State Standards
 - Domain I - Number Concepts
 - Domain II - Patterns and Algebra
 - Domain III - Geometry and Measurement
 - Domain IV - Probability and Statistics
 - Domain V - Math Processes and Perspectives
 - Domain VI - Math Learning , Instruction and Assessment

Criteria for Mastery in Math

- Six domains
 - Students must achieve a score of 75% in each domain
- Nineteen competencies
 - Students must achieve a score of 50% in each competency

• Courses with significant contribution to mastery in Domains of interest

- Domain I - Number Concepts
 - College Algebra, Principles of Math I
- Domain II - Patterns and Algebra
 - College Algebra, Principles of Math I
- Domain III - Geometry and Measurement
 - College Algebra, Informal Geometry, Modern Geometry
- Domain IV - Probability and Statistics
 - Elementary statistics, Business Math
- Domain V - Math Processes and Perspectives
 - College Algebra, POM I, Informal and Modern Geometry, Pre Calculus, Calculus, Elementary Statistics, History of Math
- Domain VI - Math Learning, Instruction and Assessment

Summary of CIMA Scores by Domains 2005 - 2006

Domain	Mean	STD
I - Number Concepts	77.7	15.3
II - Patterns and Algebra	57.4	16.7
III - Geometry and Measurement	57.7	17.9
IV - Probability and Statistics	59.6	15.8
V - Math Processes and Perspectives	30.2	16.4
VI - Math Learning , Instruction and Assessment	48.8	15.6
Total Score	55.2	11.0

Preliminary Findings from CIMA

- Logistic Regression analysis
 - Domain outcomes dichotomized into pass/fail
 - Model correctly classifies 94.6% of the cases
- Each Domain analyzed to determine odds ratio for likelihood of achieving mastery
 - Minimum odds ratio of 1.5
- Data will aid in aligning math courses with domains in CIMA
 - Results in course alignment with national and state standards

... Math Courses Taken vs. Success Rate on TExES

College Algebra	Domain I - Number Concepts	
Yes - 76.2 %	Pass - 58.1 %	Fail - 18.1 %
No - 23.8 %	Pass - 16.4 %	Fail - 7.4 %
Principles of Math	Domain I - Number Concepts	
Yes - 47.3 %	Pass - 38.3 %	Fail - 9.1 %
No - 52.7 %	Pass - 36.2 %	Fail - 16.4 %
College Algebra	Domain II - Patterns and Algebra	
Yes - 76.2 %	Pass - 15.1 %	Fail - 61.1 %
No - 23.8 %	Pass - 5.0 %	Fail - 18.8 %
Principles of Math	Domain II - Patterns and Algebra	
Yes - 47.3 %	Pass - 9.7 %	Fail - 37.6 %
No - 52.7 %	Pass - 10.4 %	Fail - 42.3 %

... Math Courses Taken vs. Success Rate on TExES cont...

College Algebra	Domain III - Geometry and Measurement	
Yes - 76.2 %	Pass - 18.8 %	Fail - 57.4 %
No - 23.8 %	Pass - 5.0 %	Fail - 18.8 %
Informal Geometry	Domain III - Geometry and Measurement	
Yes - 21.8 %	Pass - 7.0 %	Fail - 14.8 %
No - 78.2 %	Pass - 16.8%	Fail - 61.4 %
Modern Geometry *	Domain III - Geometry and Measurement	
Yes - 5.0 %	Pass - 1.3 %	Fail - 3.7 %
No - 95.0 %	Pass - 22.5 %	Fail -72.5 %

... Math Courses Taken vs. Success Rate on TExES cont...

Business Math	Domain IV - probability and Statistics	
Yes - 8.4	Pass - 2.0 %	Fail - 6.4 %
No - 91.6 %	Pass - 17.8 %	Fail - 73.8 %
Elem Statistics *	Domain IV - probability and Statistics	
Yes - 3.4 %	Pass - 1.7 %	Fail - 1.7 %
No - 96.6 %	Pass - 22.1 %	Fail - 78.5 %
College Algebra	Domain V - Processes and Perspectives	
Yes - 76.2 %	Pass - 0.4 %	Fail - 75.8 %
No - 23.8 %	Pass - 0.3 %	Fail - 23.5 %
Principles of Math	Domain V - Processes and Perspectives	
Yes - 47.3 %	Pass - 0.3 %	Fail - 47.0 %
No - 52.7 %	Pass - 0.4 %	Fail - 52.3 %

Individual Learning Plans

- Each pre-service teacher will have a specific ILP designed based on their test results (domains and competencies mastered)
 - Students work on ILPs in the Mastery Learning Lab
 - <http://mll.txstate.edu>
- Consist of enhancement activities provided via modules reflective of domains and competencies of TExES.

Math Modules

- Address each Domain and all Competencies
- Math and science competencies may be integrated within one module
- Technology
 - Probes and data loggers
 - Manipulatives
 - Computer and internet resources
- Utilize both academic and non-academic language
- Modules being developed to incorporate ELL and math concepts and instruction
- Modules designed to represent math concepts in multiple formats

Conclusions and Issues

- TExES and CIMA data indicate that Texas State preservice teachers lack a thorough understanding of mathematics content as defined by the TExES domains.
- Preservice teachers are postponing math coursework.
- Lack of math content area knowledge will negatively impact K - 12 math instruction for ALL students.
- Need for alignment and revision of math curriculum for preservice teachers to ensure a thorough understanding of mathematical concepts, processes and how to communicate these.