

CON-NECT

Concepts Of Numbers - Networking Educators' Collaborative Thoughts

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Project Overview

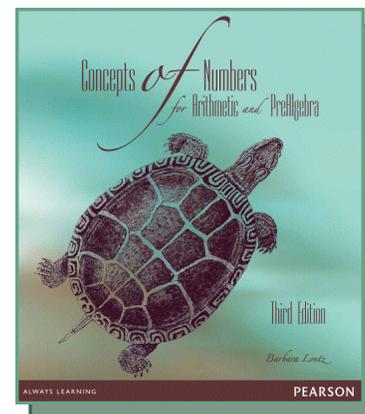
Barbara Lontz, Assistant Professor of Math at Montgomery County Community College (MCCC), was awarded a Hewlett Grant for \$270,000 from the Community College Research Center (CCRC) of Columbia University, which chose 3 projects in the U.S. with the intention to “improve and replicate”.

According to CCRC’s research, roughly 45 percent of students who place into a developmental math course one level below the college level complete their remediation requirements. Among students who begin three or more levels below college math, only 17 percent complete their entire developmental sequence.

Concepts of Numbers for Arithmetic and Pre-algebra was developed and piloted at MCCC in 2008. This curricular reform employs a conceptual rather than topic-focused approach in teaching arithmetic in order to make mathematical connections more trans-

parent and to provide students with sustained practice in foundational elements of quantitative reasoning. Internal evaluations conducted by MCCC suggest that, relative to students taking the traditional arithmetic course, a higher proportion of Concepts of Numbers students passed arithmetic and enrolled in and passed beginning algebra. Concepts of Numbers was fully scaled to all arithmetic sections at MCCC in fall 2011. Barbara Lontz, creator of Concepts of Numbers and professor of mathematics, has assembled a team of MCCC faculty, Tracy Halsey and Jim Muscatell, who are working with two community colleges to launch and scale Concepts of Numbers at these institutions beginning this past fall 2012.

These two community colleges are Berkshire Community College in Pittsfield, Massachusetts and Reading Area Community College in Reading, PA. Additionally, Barbara has made several connections at various conferences she has attended resulting in the pilots of Concepts of Numbers at additional colleges. These colleges



include, West Chester University in Pennsylvania, Palomar Community College in California, Triton Community College in Illinois, and Luzerne County Community College in Pennsylvania.

Concepts of Numbers—A New Approach to Teaching Math



“While this approach does not represent a revolution in teaching math, it is an attempt to create active learners. So, instead of presenting definitions, providing examples, and then practice problems, students are asked to figure out problems first. While attempting to complete a problem before a rule is given, students usually find a way to solve the problem.”

- Barbara Lontz, Assistant Professor of Math,

Replicating Schools

Reading Area Community College (RACC) of Pennsylvania and Berkshire Community College (BCC) of Massachusetts have been selected as the replicating institutions for this grant.

Diane Hollister from RACC says that regardless of the level of math they are teaching, they repeatedly find that students do

not understand fundamental mathematics concepts. The conceptual framework of mathematical subject matter is so critical for real understanding. Currently, RACC offers a Math Skills class as an Independent Study non-credit course. Diane is hopeful that through the adoption of *Concepts of Numbers*,

this will provide many of these students with a positive classroom environment in which models are utilized and concepts are developed would enhance their chances of success, as well as build their confidence.

Annette Guertin from BCC says that there are several factors which have prompted BCC to

consider piloting the Concepts of Numbers course. The significant increase in success rates of students as listed in the accompanying documentation is a major factor. Other factors include the consistency in success, the student evaluation comments, and the need to explore new opportunities as they present themselves.

*“Teach me, and I will forget. Show me, and I will remember. Involve me, and I will understand.”
A Chinese Proverb*

Pilot Results

MAT010 Concepts of Numbers versus MAT010 Traditional Course								
	Fall 2008	Spring 2009	Fall 2009	Spring 2010	Fall 2010	Spring 2011	Fall 2011	Spring 2012
Concepts of Numbers	74%	63%	68%	60%*	58%**	57.4%	57.72%	61%
	N = 19	N = 19	N = 19	N = 255	N = 380	N = 289	N = 704	N = 316
Traditional Arithmetic	45%	34%	41%	40%	40%	37.8%		
	N = 664	N = 429	N = 567	N = 236	N = 284	N = 150	N = 0	N = 0

Success Rates: Success is a grade of C or better. Withdraws count as non-success.

* the top 13% of Arithmetic Accuplacer scorers were accelerated into the next course (a 4 credit beginning algebra class)

** an additional top 12% of Arithmetic Accuplacer scorers were accelerated into the next course (a 4 credit beginning algebra class)

Here's what student's are saying about Concepts of Numbers!



“It made me for the first time really enjoy and understand math. Math has always been very difficult for me, but this course really helped me to realize that math is just a bunch of problems that, ‘I can’ figure out.” *Kimberlee Onopa*

“My overall experience in the *Concepts of Numbers* course went very well. I am actually surprised that I ended with a B+ in that math class because some of the concepts were very hard and I had to take my time in each section.” *Katelyn Uhlig*

“What I liked about the Fundamental course was the text. It laid out the foundations in an easy, organized fashion and made it easy to learn the concepts.” *Theresa D. Rayner*

“In *Concepts of Numbers* I was hesitant because I am 30 and I haven't been to school since 7th grade. I never had confidence in Mathematics, but once I finished that class, I could move on with an

abundance of confidence. It was a great stepping stone for *Beginning Algebra*.” *Candice Hillegas*

“The course was very easy going; it finally cleared my fears for math. I found the book to be well organized.” *Marquis Allen*

“*Concepts of Numbers* was a wonderful course to refresh you on what you already learned in high school and is a great course to get you ready for Algebra. I also think it is essential for individuals who have been out of school for a few years or more as a refresher course.” *Jesse Serrbooco*

“*Concepts of Numbers* introduced me to basic math again and showed me that I could do it. Being out of school for six years, my math anxiety was very high. I didn't have to learn a bunch of RULES from high school that I had forgotten year ago. The course was a stepping stone to my future math success.” *Steve Mauger*



Faculty Quotes & Interview

“My students enjoy math more and therefore, I enjoy teaching more. Introducing them to some algebraic ideas early on has made PreAlgebra easy to teach and more natural for the students.” -*Steve Solomon, MCCC adjunct*

“I can’t imagine ever going back to the traditional way of teaching this material.” -*Chris Matus, West Chester University*

“To be honest, I didn’t think I would like it but my mind has been changed; the students enjoy it and I look forward to teaching it again.” -*Joe Freiwald, MCCC retired FT faculty*

The following interview was conducted with Ed Moyer, adjunct math instructor at MCCC.

When did you first hear about Concepts of Numbers?

During my interview for the job. It would have been during the summer of 2010.

What do you think are the main differences between the traditional approach to teaching Arithmetic and Pre-algebra and through the conceptual approach in teaching Concepts of Numbers?

I think the method of instruction is one of the main differences. The new approach is less lecturing and less telling students how to do the problems. Students are guided through problems and we help them use their prior knowledge to help solve new problems. Also, the format of teaching by "operations" appears to be a more successful way of teaching the course, as opposed to teaching how to do all the operations for each type of number--ex. teaching adding, subtracting, multiplying and dividing fractions--rather than in the new approach where students are taught addition of whole numbers, decimals, fractions and integers. I think this new format makes more sense to students.

Have you had students who were not successful in traditional approach of Arithmetic and Pre-algebra and are re-taking this in the new format? If so, what are students’ reactions to Concepts of Numbers? If not, can you compare student reactions to this new approach?

I have never taught the old method, but I can say that almost all the student who have taken this course with me have said that they enjoy it and that the material now makes sense to them. I have also found that student stress over math appears to decrease over the length of the course. This can be seen in the math anxiety survey they take and it can also be seen in their interactions with me over the semester. Students appear to seem less stressed in class and are able to complete homework assignments.

Unit Details



Ancient Egyptian mathematics

Unit 1: History of Numbers

- Evolution of numbers in ancient civilizations
- Concepts of place value and place holders

Unit 2: The Real Number System

- All sets of numbers are introduced and classified

Unit 3: Comparisons

- Concepts of $<$, $>$, and $=$
- Comparisons of “like” and “unlike” numbers

Unit 4: Addition

- Addition and application of whole numbers, decimals, fractions, integers, and algebraic expressions
- Introduction of identity element, commutative and associative properties, and binary concepts.



Unit 5: Subtraction

- Subtraction and application of whole numbers, decimals, fractions, integers, and algebraic expressions
- Solving equations that use the Addition Property

Unit 6: Multiplication

- Multiplications and application of whole numbers, decimals, fractions, integers, and algebraic expressions (distributive prop)
- Exponents
- Properties (commutative, associative, etc.)

Unit 7: Division

- Divisions and application of whole numbers, decimals, fractions, and integers
- Solving equations that use the Multiplication Property

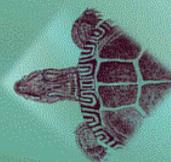
Unit 8: Combinations

- Simplifying expressions involving multiple operations, (order of operations)
- Solving multiple step applications, (ratio and proportion)
- Solving algebraic equations, $6(x+5) = -2(x-5)$

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“Planning and plodding wins the race”



The Tortoise and the Hare, Aesop