

# SABES Math Bulletin

..... Building Research Into Practice

..... Volume 1, Issue 4, June, 2007

## Welcome to the SABES Math Bulletin

Most of us lack sufficient reading time to tackle an 85-page literature review that includes an additional 21-page appendix. That's where the *Math Bulletin* steps in to make life a little simpler. For instance, in this issue we preview the introduction and one section of *A Review of the Literature in Adult Numeracy: Research and Conceptual Issues* report and highlight key findings for you. The "Review" was recently commissioned by the Office of Vocational and Adult Education (OVAE) of the US Department of Education and represents the first substantive effort by the US DOE to study adult numeracy education.

The section we examine focuses on: "Adult Numeracy and Mathematics Instructional Approaches and Interventions," which suggests two conclusions:

- There is considerable overlap in the documents that inform state adult education math/numeracy standards.
- There are few reliable research studies about effective (or ineffective) ABE instruction, particularly in numeracy.

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In future issues the SABES Math Bulletin will cover other "Review" sections including: "Issues in Conceptualizing Adult Numeracy;" "Assessment Issues in Adult Numeracy;" "Professional Development in Adult Numeracy;" and the "Summary and Implications for Future Research." We hope our coverage will illuminate issues in the field of adult numeracy and connect practitioners with numeracy research literature and ideas. Simultaneously, we hope to strengthen understanding of how research is constructed and conducted.

So, enjoy this summer issue of the *Math Bulletin* by letting your mind connect with new ideas about teaching math and numeracy to your adult students. By late summer early autumn, you'll be ready for more ideas and we'll be ready to share them.

**Tricia Donovan, Bulletin Editor**

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# *Highlights from A Review of the Literature in Adult Numeracy: Research and Conceptual Issues*

The American Institutes for Research (AIR) (2006). A review of the literature in adult numeracy: Research and conceptual issues, Office of Vocational and Adult Education, Division of Adult Education and Literacy, US Department of Education, Washington, DC, March.

The full review is available online at:

[http://www.air.org/projects/Adult%20Numeracy%20Lit%20Review%203-24-06%20\\_2\\_%20-%20FINAL.pdf](http://www.air.org/projects/Adult%20Numeracy%20Lit%20Review%203-24-06%20_2_%20-%20FINAL.pdf)

## **A Bit of Background**

### **Project Goals**

- Develop a thorough understanding of the current state of the field of adult numeracy.
- Identify the gaps in knowledge about common strategies for teaching adult numeracy and how these strategies differ across different types of learners.
- Identify the type of professional development and teacher certification that should be required for teachers of adult mathematics.
- Identify the types of assessment instruments that might be appropriate for measuring adult quantitative skill acquisition. (pp.1-2)

### **Project's Research Questions—the five addressed by the AIR study:**

1. How does adult numeracy develop, and how does it differ from the development of quantitative literacy in children?

2. What are the social variables that affect quantitative skill acquisition in adults? How should programs address these social variables to enhance skill acquisition?
3. What instructional practices exist in mathematics education for adult learners that are worthy of replication?
4. What outcomes are most important to address in the evaluation of adult education programs in mathematics? What are the best tools for assessments for evaluating these outcomes?
5. What practices exist in professional development and certification requirements for teachers of adult mathematics education that are worthy of replication? (p.2)

### **Project Staff**

Principal Investigator: Larry Condelli, AIR Co-

Project Directors: Kathy Safford-Ramus, Saint Peter's College and Renee Sherman, AIR.

Project Members: Diana Coben, King's College; Iddo Gal, University of Haifa; and Anestine Hector-Mason, AIR

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## “Review” Introduction Excerpts

*“In the context of Adult Basic Education (ABE), more emphasis is needed on providing quality numeracy instruction to adults to help them achieve the mathematical knowledge and skills that will enable them to adjust to (the) growing societal demand (for numeracy skills in all aspects of adult life).” (p.1)*

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### Defining the Need...

“...35% of all U.S. students are scoring “below basic” on the National Assessment of Education Progress (NAEP) (NCES, 2002, Math Assessment), with even higher proportions of Hispanic, African American, and low-income students scoring “below basic.” (p.1)

“...an increasing number of 18- to 25-year olds are enrolling adult education programs: the very same students who lack numeracy skills.” (p.1 )

diverse student population that bring different needs, interests, skills, and behavior and attitudes toward numeracy.” (p.1 )

“Although numeracy instruction plays a significant role in adult education in countries— notably Australia, the Netherlands, and, more recently, the United Kingdom – the United States has experienced limited attention to numeracy instruction and little research on how local adult education programs teach mathematics or numeracy.” (p.1)

### An Inadequate Response...

“The concern... is exacerbated by the fact that adult education programs are not adequately prepared to provide numeracy education to a

Schmitt (2002) points out that “GED preparation has been the driving force in mathematics instruction in most adult education program....” (p.1)

## Adult Numeracy and Mathematics Instructional Approaches and Interventions

*“In this section we briefly review the predominant instructional frameworks about teaching mathematics to adults. We then present a review of the empirical research evaluating instructional approaches toward teaching mathematics to (ABE) students....” (p.21)*

### Instructional Frameworks

AIR researchers looked at several professional society instructional standards that have been used by ABE teachers and administrators to inform their instruction and setting of curriculum standards. Among those considered: The National Council of Teachers of Mathematics (NCTM) Standards (1989 and 2000), the

American Mathematical Association of Two-Year Colleges (AMATYC) *Crossroads in Mathematics: Standards for Introductory College Mathematics before Calculus* (1995), the Adult Numeracy Network’s (ANN) mathematics standards framework (1996) and the National Institute for Literacy’s (NIL) *Equipped for the Future (EFF) Math Content Standards* (2000). (pp.21-23)

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These national standards have played a key role in the development of many state adult education mathematics/numeracy standards., and most recognize, in some form, the NCTM content areas of **number and operations, algebra, geometry, measurement, statistics and probability**. The development of skills in each content area is believed to benefit from early efforts to introduce and connect concepts.

For further information, see these web sites:

NCTM: <http://www.nctm.org/>  
ANN: <http://www.literacynet.org/ann/>

AMATYC: <http://www.imacc.org/standards/>  
EFF: <http://eff.cls.utk.edu/>

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## Research Evaluating Instructional Approaches

“...very few research studies have used ABE students to study the effects of adult numeracy instruction, and the research that does exist is neither theory-driven not guided by any systematic approach.” (p.23)

Previous research reviews found fewer than 20 studies on instructional impact on adults, nine of which were conducted in the US. AIR notes that most of the research uses “introspective and qualitative methods” which are not “academically rigorous.” (p.23)

By researching several databases (Proquest, ERIC, EBSCO, MATHS4Life, Dissertation Abstracts International, NALD, and Reference Manager) as well as conducting generic and specific website searches, the researchers identified 223 studies, 91 of which related specifically to adult numeracy. They applied criteria that reduced the number of studies reviewed to 15. They deleted any studies that

- Were not empirical research on instructional interventions,
- Did not include adults in ABE classes,
- Were conducted prior to 1985,
- Did not have outcomes related to learning mathematics,
- Did not have a comparison group, and
- Included fewer than five students per group. (p.24)

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## **Research Findings**

The remaining 15 studies provided a sampling of findings (pp. 26-34) on four main topics: computer use, cooperative learning, discovery learning, and ABE instructional interventions.

### **Computer Use**

“The research on the use of technology in instruction has not demonstrated that it improves the learning of mathematics by adults over instruction that does not use technology.” From results of 13 studies involving ABE students and four developmental math studies, researchers learned that only two “found statistically significant increases in achievement for CAI (computer aided instruction).” The report notes that several studies had methodological shortcomings and that wide variations of the technologies assessed and approaches used make it “difficult to draw conclusions about instruction....”

### **Cooperative Learning**

Three studies revealed different outcomes. In one study (Costner, 2002) students “found the use of group work and classroom discussion helpful.” A second study (Berry, 1996) showed that “Of the variables measured, only attitude increased significantly during the 6-week study. For students in the 12-week semester, the intervention group (which received peer-tutoring, not just lecturing) showed significant improvement in mathematics achievement and attitude as well as reduced anxiety. A third study (Ellis, 1992) found that experimental in-class study groups resulted in “no significant differences between the experimental and control groups” in terms of achievement and completion rates.

### **Discovery Learning**

The researchers looked at three studies involving adult developmental math (community college) students.

Bartlett (1993) used a guided discovery approach to teaching mathematics in one section of developmental math at a university and she compared this experimental group with the same class taught in a previous quarter without the approach. She found that the “experimental method was effective in improving mathematics performance of adult students”, as measured by the Math Anxiety Rating Scale (MARS) and a researcher-designed math test. Ramus (1997) found a “self-reported positive change in attitude toward mathematics and increase confidence that transferred to other activities outside the classroom” among those exposed to the discovery method of teaching. However, she noted that the examination results were “less conclusive.”

Pace (1989) formed two experimental groups who explored concepts of area and perimeter using activities embedded in applied problem-solving settings. She found that “Those in the treatment program performed significantly better than their counterparts” (who did not engage in discovery geometry activities).

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## ABE Instructional Interventions

Inference training, used primarily to increase reading skills, was shown by Farr (1987) to improve reading and results showed “a correlation between mathematics performance and reading performance.” Students who received inference training did improve their math problem solving.

Irby, et al. (1992) compared traditional GED class students with GED students enrolled in a family literacy program. “The results indicated that students in the family literacy project showed a higher average gain in reading and mathematics compared with the GED class.”

## What's Next?

Consider what the research says and how to integrate the findings into your classroom teaching. Start collecting your own data. Do your findings reflect the AIR research review’s findings?

# A Research Basics Reminder and AIR Defines

## AIR Defines Qualitative and Quantitative Research (from the AIR website

[http://www.air.org/topics/topic\\_qualitative\\_quantitative.aspx](http://www.air.org/topics/topic_qualitative_quantitative.aspx))

<p><b>Quantitative research</b> deals in numbers, logic and the objective, focusing on logic, numbers, and unchanging static data and detailed, convergent reasoning rather than divergent reasoning. Its main characteristics are:</p>	<p><b>Qualitative research</b>, on the other hand, deals in words, images and processes data as words, emotions, feelings, color, and music. Its characteristics are:</p>
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- The data is usually gathered using more structured research instruments.
- The results provide less detail on behavior, attitudes and motivation.
- The results are based on larger sample sizes that are representative of the population.
- The research can usually be replicated or repeated, given its high reliability.
- The analysis of the results is more objective.

- The data is usually gathered using less structured research instruments.
- The findings are more in-depth since they make greater use of open-ended questions.
- The results provide much more detail on behavior, attitudes and motivation.
- The research is more intensive and more flexible, allowing the researcher to probe with greater latitude.
- The results are based on smaller sample sizes and are often not representative of the population.
- The research can usually not be replicated or repeated, given its low reliability.
- The analysis of the results is much more subjective.