

SABES Math Bulletin

Building Research Into Practice
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As part of the three-year SABES Math Initiative, quarterly newsletters highlighting research and professional literature related to math instruction will be available to adult educators on line. Feel free to download and copy the newsletters for friends. It's all part of spreading the word about best practices and general information regarding math teaching and learning.

Why focus on research (and professional literature)?

A review of ABE policy history (outlined in the NCSALL Review of Adult Learning and Literacy, Volume 5, pp. 4-5) reveals that the key date to remember in answering this question is 2002.

2002: The United States Department of Education issued a report called Strategic Plan 2002-2007. The plan included six goals, two of which were particularly relevant to the field of adult education.

Goal 4, transform education into an evidence-based field, included two subgoals: 4.1 raise the quality of research

funded or conducted by the DOE, and 4.2 increase the relevance of research to meet the needs of customers. Goal 4 was described thusly:

We will change education to make it an evidence-based field. We will accomplish this goal by dramatically improving the quality and relevance of research funded or conducted by the department, but providing policymakers, educators, parents, and other concerned citizens with ready access to syntheses of research and objective information that allow more informed and effective decisions, and by encouraging the use of this knowledge (especially within federal education programs).

—U.S. Department of Education, Strategic Plan
2002-2007, p. 59

Goal 5, Subgoal 5.5, enhance the literacy and employment of American adults, called for the DOE to fund evaluation, research, demonstration, and training activities with state and local partners. This subgoal resulted in increased proposals for regulation of ABE teachers (performance standards and certification standards) and increased emphasis on accountability efforts. These Strategic Plan goals also led to increased emphasis on designing and implementing ABE curricula and program services based on research.

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About the Math Bulletin

The SABES Math Bulletin represents our efforts to present research findings and professional information to you, the teacher, in a way that makes it accessible and useful. You will find a variety of sources and information in this brief bulletin. We will summarize information and include citations so you can explore articles further if you wish. Our intention in writing this bulletin is to pique your interest and inform your practice by providing substantive and exciting data, both quantitative and qualitative. In this first issue, we present some general information about research, some data from adult numeracy assessment surveys, and an excerpt from *Adult Numeracy Development: Theory Research, Practice*, edited by Iddo Gal. The latter articles provide provocative stimuli for teacher discussion.

Tricia Donovan, Bulletin Editor

Research Defined

According to Thomas R. Guskey, (2000, Evaluating Professional Development, Corwin Press, Inc., CA, pp. 44-45) Worthen and Sanders (1987, pp. 29-34) identify 12 characteristics of research:

- 1. Motivation of the inquirer:** Researchers are interested in advancing knowledge.
- 2. Objective of the inquiry:** Research seeks conclusions.
- 3. Laws versus descriptions:** Research clarifies relationships among two or more variables, not a particular thing in a unique context.
- 4. Role of explanation:** Research seeks credible explanations of educational phenomena (it does not seek to determine merit or worth).
- 5. Anatomy of the inquiry:** Research is an independent and autonomous enterprise, not generally undertaken at the request of a client.
- 6. Properties of the phenomena assessed:** Research attempts to generate scientific knowledge, not to assess the value of something.
- 7. Generalizability:** Research focuses on concepts perceived to be relatively permanent, broadly applicable, and relevant to numerous settings.
- 8. Criteria for judging the activity:** Research is judged by the degree to which results are not confounded by various sources of error and can be generalized to other situations with similar characteristics.
- 9. Identifiable clients:** The clients for research are rarely identified or taken into consideration.

10. Relevance of time: Research seldom must consider time constraints.

11. Disciplinary base: Although multidisciplinary approaches are advisable in research, many studies employ a single perspective or approach.

12. Preparation: The best preparation for most researchers is likely to be a thorough mastery of their specific discipline coupled with the application of the tools of the discipline.

Guskey reminds us that these characteristics describe research in its "purest form," and that in practice characteristics are seldom as clear. (Guskey, 2000, p. 45). See Page X for definitions.

Massachusetts Numeracy Levels Assessed

The National Assessment of Adult Literacy (NAAL), which is conducted by the National Center for Education Statistics (NCES), describes the English literacy and numeracy of America's adults 16 years of age and older. As part of the adult literacy assessment, NCES offered states the opportunity to acquire samples that provide in-depth information on adult literacy in their states. Massachusetts was one of six states to purchase a sample.

On the next page you will find a description of the NAAL and the Massachusetts SAAL (State Assessment of Adult Literacy) followed by Massachusetts data from the SAAL and

a brief description/interpretation of that data adapted from the American Institute of Research (AIR) report, Highlights from the 2003 Massachusetts State Assessment of Adult Literacy, <http://www.air.org/naal/>.

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Teach Logical Reasoning

The process of reasoning is basic to all mathematics. Mathematics is first and foremost a way of thinking, rather than a body of facts. This is an important distinction...to understand.

Burns, Marilyn, *About teaching mathematics: A K-8 resource*, 2000, p. 100)

Massachusetts Numeracy

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These data provide a tool for assessing the current literacy of Massachusetts's adults, as well as for making comparisons between Massachusetts and the nation.

Background

NAAL was administered to a nationally representative sample of more than 19,000 adults in the United States. The state samples, which were also incorporated into the national sample, were between 1,000 and 1,500 adults.

NCES has been conducting national assessments of adult literacy since 1985. The most recent assessment before the 2003 NAAL was the 1992 National Adult Literacy Survey. Information about NAAL, including the recently published report, *A First Look at the Literacy of America's Adults in the 21st Century*, is available at: <http://nces.ed.gov/naal>.

SAAL

2003 Massachusetts State Assessment of Adult Literacy (SAAL). Administered in Massachusetts in 2003 and early 2004, the assessment measures the prose, document, and quantitative literacy of Massachusetts's adults.

The sole difference between the NAAL and the Massachusetts SAAL was that the Massachusetts sample was limited to adults residing in households, while the NAAL sampled adults in households or prisons. To allow appropriate comparisons between Massachusetts and the nation, the national literacy results presented in the AIR report are based only on the national household sample.

Defining Literacy and Numeracy (Quantitative Literacy)

The NAAL and SAAL define literacy as "using printed and written information to function in society, to achieve one's goals, and to develop one's knowledge and potential." Results are reported on three literacy scales including one for quantitative literacy, or numeracy.

Quantitative Literacy: The knowledge and skills required to perform quantitative literacy tasks (i.e., to identify and perform computations, either alone or sequentially, using numbers embedded in printed materials). Examples include balancing a checkbook, figuring out a tip, completing an order form, or determining from an advertisement the amount of interest on a loan.

Description of Numeracy Levels

Unlike indirect measures of numeracy, which rely on self-reports or educational attainment, the NAAL and the SAAL measure numeracy by asking respondents to demonstrate ability on specific tasks.

Interpreting Results (Adapted from the AIR report)

The average scores and percentages reported are estimates based on a sample of Massachusetts's adults. Like all samples, the results are subject to a measure of uncertainty (i.e., sampling error), reflected in the standard errors of the estimates.

Numeracy Level	Score on NAAL/SAAL	Level Description
Below Basic	0-234	locating numbers and using them to perform simple quantitative operations (primarily addition): adding the amounts on a bank deposit slip when the mathematical information is very concrete and familiar
Basic	235-289	locating easily identifiable quantitative information and using it to solve simple, one-step problems when events the arithmetic operation is specified or easily inferred: comparing the ticket prices for two events
Intermediate	290-349	locating less familiar quantitative information and using it to solve problems when the arithmetic operation is not specified or easily inferred: calculating the total cost of ordering specific office supplies from a catalog
Proficient	350-500	locating more abstract quantitative information and using it to solve multi-step problems when the arithmetic operations are not easily inferred and the problems are more complex: computing and comparing the cost per ounce of food items

Quantitative Literacy Scores (average out of 500 points)

US 283

Mass 297

Finding: Massachusetts adults scored significantly higher than the overall US population.

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Massachusetts Numeracy...

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Quantitative Literacy Level Percentages

Mass	15*	31	34	20*
Nation	21	33	33	14

Finding: Massachusetts had a significantly higher percentage of people scored as quantitatively proficient and a significantly lower percentage of people scored as quantitatively below basic in skills.

Prose, Document and Quantitative Level Percentages Compared in Massachusetts

Mass Prose	9	23	49	19
Mass Doc.	8	18	57	17
Mass Quantitative	15	31	34	20

Findings: Massachusetts is stronger in Document and Prose Literacy than in Quantitative Literacy. The percentage scored as Below Basic in Quantitative Literacy is nearly double Below Basic percentage scored in Document literacy, and the Basic and Below Basic Quantitative percentage is nearly half of all survey takers, while document literacy at these levels represents slightly more than 1/4 and Prose at these levels is less than 1/3.

Ethnicity: Average Quantitative Literacy Scores (2003) by Race

Findings: Similar to the nation, the average quantitative literacy of Whites in Massachusetts was higher than the average quantitative literacy of Blacks and Hispanics. The gap between Whites and Blacks in Massachusetts is slightly larger than in the nation, while the gap between Whites and Hispanics in Massachusetts is significantly larger than in the nation.

Quantitative Literacy Scores by Gender

	Men	Women
Mass	309	286
Nation	287	279

Whites

Mass 304
Nation 297

Blacks

Mass 244
Nation 238

Hispanics

Mass 217
Nation 233

Findings: Massachusetts men scored significantly higher than men in the nation at large and they scored significantly higher than women in the state. The gap between men and women's scores was much smaller at the national level.

Quantitative Literacy Percentages by Gender and Level

Findings: Far fewer Massachusetts men than men across the nation are scored as below basic in quantitative literacy, and for more Massachusetts men than men across the nation are scored as proficient. Percentages for Massachusetts women in each category parallel the national percentages for both men and women, with Massachusetts women scoring slightly better than women across the nation.

Men	Below Basic	Basic	Intermediate	Proficient
Mass.	11	28	36	25
Nation	21	31	33	16

Women	Below Basic	Basic	Intermediate	Proficient
Mass.	20	33	33	15
Nation	22	35	32	11

Massachusetts is stronger in document and prose literacy than in quantitative literacy.

Improve Math Instruction

Excerpt from Ginsburg, Lynda, and Gal, Iddo, 2000, Instructional strategies for adult numeracy education, *Adult numeracy development: Theory, research, practice*, Hampton Press, Inc., Cresskill, NJ, pp. 90-91)

...During the past 20 years, the field of mathematics education has been enriched by extensive research into the nature of the cognitive processes involved as people learn mathematics (e.g. see Siegler, 1991; Wearne & Hiebert, 1988) and teaching techniques that are particularly effective in helping students learn mathematics (Ball, 1993; Lampert, 1986). The National Council of Teachers of mathematics has drawn implications from this research, as well as from teachers' experiences, and produced the Curriculum and Evaluation Standards for School Mathematics (1989), a vision of math education that is revitalizing and revolutionizing the teaching of math in the United States.

Although the focus in the Standards is on the K-12 curriculum, adult numeracy educators can certainly identify with and learn from NCTM's articulation of the broad goals of math education and the descriptions of instructional practices aimed at achieving those goals.

...Theories of adults' learning processes (e.g. Knowles, 1990) tend to be general in nature and do not address learning in specific content domains. (We) suggest specific instructional practices and strategies that are aimed at improving numeracy education for adults. The suggestions reflect what we have learned about how adults learn, how children and adults learn math, and what is important math learning (important both in the sense of building a foundation on which further math learning can be constructed and in the sense of real-world utility....

1. **Address and evaluate** attitudes and beliefs regarding both learning math and using math.

2. **Determine** what students about a topic before instruction.

3. **Develop** understanding by providing opportunities to explore mathematical ideas with concrete or visual representations and hands-on activities.

4. **Encourage** the development and practice of estimation skills.

5. **Emphasize** the use of 'mental math' as a legitimate alternative computational strategy and encourage development of mental math skill by making connections between different mathematical procedures and concepts.

6. **View** computation as a tool for problem solving, not an end in itself.

7. **Encourage** use of multiple solution strategies.

8. **Develop** students' calculator skills and foster familiarity with computer technology.

9. **Provide** opportunities for group work.

10. **Link** numeracy and literacy instruction by providing opportunities for students to communicate about mathematical issues.

11. **Situate** problem-solving tasks within meaningful, realistic contexts in order to facilitate transfer of learning.

12. **Develop** students' skills in interpreting numerical or graphical information appearing within documents and text.

13. **Assess** a broad range of skills, reasoning processes, and dispositions, using a range of methods.



Research Terms and Definitions

Research

"Systematic investigation toward increasing the sum of knowledge." *Chambers 20th Century Dictionary*.

"An endeavor to discover new or collate old facts, etc. by the scientific study of a subject or by a course of critical investigation." *The Concise Oxford Dictionary*

Quantitative Research

In lay people's terms, quantitative research generally involves reporting numerical data, especially as they refer to variables within an experiment or observation. It is generally judged on its validity (whether it tests what it purports to test) and its reliability (whether it is replicable).

Below are listed some quantitative research methodologies as taken from Powell, R. R.

(1999) Recent trends in research: a methodological essay. *Library & Information Science Research*. 21. 91-119.

Descriptive studies Survey or observational studies generally designed to describe current status of phenomena in terms of specific set of variables or conditions; not designed to test hypothesized relationships between variables. (p.96)

Predictive/explanatory studies non-experimental studies designed to test for hypothesized relationships among variables for purposes of explanation of prediction; may include survey, ex post facto, causal-comparative designs. (p.96)

Experimental studies true, quasi, and pre-experimental studies conducted in controlled lab or field settings. (p.96)

Bibliometric studies includes citation analysis; studies

of literature scatter, growth, obsolescence; author or institutional productivity, patterns of authorship and institutional affiliation etc. (p.96)

Content analysis objective, quantitative studies of documents or other forms of communication that examine frequency/patterns of words, phrases, concepts, images, themes, characters, roles, etc.; includes readability research. (p.96)

Operations research studies employing management science, system analysis, and mathematical modeling techniques to support managerial decision making. (p.96)

Transaction Log Analysis the study of electronically recorded interactions between online information retrieval systems and the persons who search for the information found in those systems. (p.110)

systematic
investigation

Qualitative Research

In lay people's terms, qualitative research generally reports data in verbal form, with dense descriptions. It is generally judged on its believability, its accuracy in recounting experiences, situations, or individuals in ways that correspond to others' perceptions and that make sense given the evidence presented. Below are listed some qualitative research methodologies as taken from Powell, R. R. (1999) Recent trends in research: a methodological essay. *Library & Information Science Research*. 21. 91-119.

Case study explores a single entity or phenomena (the case) bounded by time and activity (a program, event, process, institution or social group) and collects detailed information by using a variety of data collection procedures during a sustained period of time. (p.102)

Ethnography a type of qualitative inquiry in which the researcher studies an intact cultural group in a natural setting during a prolonged period of time by collecting,

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Research Terms ...

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primarily observational data. As cultures are now defined in terms of smaller units than they once were, an ethnographic methodology might be quite appropriate for studying, for example, the patterns of information use by research scientists in a single organization. (p.102)

Phenomenology a research method that attempts to understand participants' perspectives and views of social realities. As phenomenologists attempt to understand what a specific experience describing it as it is found in concrete situations and as it appears to the people who are living it. (p.102)

Hermeneutical phenomenology is a research method that seeks understanding through the description of the lived experience but in addition an interpretive (hermeneutical) aspect is applied to the phenomena described.

Grounded theory is a general research methodology, a way of thinking about and conceptualizing data. It is a set of procedures for analyzing data that will lead to the development of a theory useful to the discipline. (p.103)

Special *Field Notes* Issue on ABE Math

The fall/winter issue of *Field Notes* will focus on ABE Math. Watch for it in December on <www.sabes.org> or request a hard copy from Leah Peterson at <lpeterson@worlded.org>.

We have heard much about the poetry of mathematics, but very little of it has as yet been sung. The ancients had a juster notion of their poetic value than we. The most distinct and beautiful statements of any truth must take at last the mathematical form. We might so simplify the rules of moral philosophy, as well as of arithmetic, that one formula would express them both.

—H.D. Thoreau