



	Morning	After	
Unemployed	59,567	55.2	15,749
Not Employed or Seeking Work	27,495	60.2	8,116

Research on Adult Numeracy Practice

Research on adult numeracy typically is concerned with how adults use mathematics in specific contexts (e.g., work, school, the home), and how these contexts affect adults' mathematical behavior. By looking at the use of mathematics inside and outside of school, researchers can help teachers and adult education programs build on what adult learners already know and value. Rather than treating mathematics as a decontextualized skill, researchers and teachers working within the adult numeracy framework see mathematics as a social practice grounded in larger social and cultural contexts. This annotated bibliography highlights studies that focus on adult numeracy practice and pedagogy, including studies of specific classroom strategies.

Arriola, L. (2000). Learning to learn: Mathematics as problem solving. In I. Gal (Ed.), *Adult numeracy development: Theory, research, practice* (pp. 225-237). Cresskill, NJ: Hampton Press.

This practitioner research project focused on the development of learning-to-learn skills in an Adult Basic Education (ABE) math class based on the National Council of Teachers of Mathematics (NCTM) standards. The instructor investigated ways to change learners' beliefs about math knowledge and help them develop independence and self-monitoring skills. Students in the class explored fractions using several approaches and a variety of contexts. Working in pairs and groups, students made manipulatives, invented games, made charts, drew diagrams, constructed word problems, and compared solutions. Over the course of the project, the instructor learned to reframe questions in ways that were less directive to allow for problem-solving by students. The teacher believes that working without the pressure of time and tests freed students to explore but that, at the end of the project, they remained somewhat teacher-dependent. The teacher suggests that development of abstract mathematical thinking is a long, slow process, even for learners who are able to think abstractly in other contexts.

Coben, D., Colwell, D., Macrae, S., Boaler, J., Brown, M., & Rhodes, V. (2003). *Adult numeracy: Review of the research and related literature*. London, England: National Research and Development Centre. Retrieved November 27, 2005, from http://www.nrdc.org.uk/uploads/documents/doc_2802.pdf.

This is an overview of current thinking about adult development and adult numeracy pedagogy. The authors conducted an analysis of adult

numeracy research from around the world. Key findings include: (1) adult numeracy is fast-developing but remains under-researched and under-theorized; (2) teachers' inadequate subject knowledge is a continuing concern; and (3) teaching that connects math topics with the world beyond the classroom is associated with improvements in students' attitudes and skill attainment. The introduction highlights the conceptual issues involved in defining numeracy and the relationship between numeracy and mathematics. In addition to a broad overview of the field, the review contains individual chapters that focus on numeracy in context, teaching and learning numeracy, factors affecting learning, and methodological issues associated with numeracy research. An extensive bibliography contains hundreds of references to academic literature, professional literature, and government/official reports.

Costanzo, M. (2001). Adult multiple intelligences and math. In M.J. Schmitt & K. Safford-Ramus (Eds.), *A conversation between researchers and practitioners: Proceedings of the Seventh Annual Conference on Adults Learning Mathematics* (pp. 104-108). Cambridge, MA: National Center for the Study of Adult Learning and Literacy, Harvard Graduate School of Education, in association with Adults Learning Mathematics - A Research Forum (ALM).

The Adult Multiple Intelligences (AMI) study explored ways that multiple intelligences (MI) theory can support instruction and assessment in various adult learning contexts. MI-inspired instruction encourages teachers to analyze their own instructional practice and provide students with a range of learning opportunities based on the students' own strengths and interests. This text reports on the part of the study that deals with numeracy instruction. As part of the study, teachers created AMI profiles to help learners in an adult secondary education class reflect on the best ways to approach math problems or questions using their own intelligences. The teachers also created MI-related activities for the classroom. In "Learning about MI," teachers explained unfamiliar, nontraditional, MI-informed activities. In "Learning about Ourselves," students increased awareness of their own strengths and developed self-efficacy. In "Learning about Our Ways of Learning," students worked on finding learning strategies that fit their strengths and interests. By creating open-ended assignments that took into account the multiple intelligences of groups of students, the researchers were able to teach math skills in a variety of ways that provided authentic learning experiences to adult students.

Curry, D. (2000). Journey into journal jottings: Mathematics as communication. In I. Gal (Ed.), *Adult numeracy development: Theory, research, practice* (pp. 239-258). Cresskill, NJ: Hampton Press.

This practitioner research project focused on journal writing as a way to develop skills for communicating mathematically. The context was a workplace-based preparatory math class in which students wrote journal entries about each day's lesson. Students wrote about what struck them, what they didn't understand, or what new things they learned. They also wrote responses to instructor comments on their journal entries. The journals became a tool for ongoing assessment and provided evidence that students were able to connect math to work and family life. Journals also confirmed the effectiveness of specific techniques (e.g., manipulatives) used in class. The instructor interviewed students individually at the end of the course and compared pre- and post-course assessment data. Results showed that students increased their use of math-related language.

Durgunoglu, A. Y., & Öney, B. (2000). Numeracy needs of adult literacy participants. *Focus on Basics*, 4(B), 18-20. Retrieved November 27, 2005, from <http://www.ncsall.net/?id=315>.

The researchers conducted an in-depth study of 63 participants (predominantly women) in the Functional Adult Literacy Program in Turkey. Thirty-nine expressed a need for mathematics learning, especially in particular situations such as banking, shopping, health care, transportation, and work. Participants exhibited strong emotions associated with the need for numeracy instruction, including shame, worry about being cheated in transactions, the desire to help their families, and the need for independence. The researchers recommend that adult literacy programs focus on teaching real-life applications of skills to address participants' expressed cognitive or emotional needs. Examples of possible classroom activities include identifying prices, using measurements, understanding graphs, interpreting bills, and using the telephone.

FitzSimons, G. E. (2002). *What counts as mathematics? Technologies of power in adult and vocational education*. Mathematics Education Library, Vol. 28. Dordrecht, the Netherlands: Kluwer Academic Publishers.

This case study of work-related math instruction for Australian workers found that learners spent much of their limited time on math skills that are more efficiently performed by machines. In so doing, they did not acquire more useful skills such as estimation, interpretation, evaluation, and problem solving. Math instruction was not contextualized and failed to link practice to the workplace. Despite rhetoric about a learner-centered curriculum, the activities in the work-related math class were only superficially different from those found in traditional math classes. The author believes that the range of possible math activities within the classroom was limited by vocational education policymakers and program managers who had different priorities from those of the learners.

Fortini, B. (2001). What kind of MI instruction and assessment can be developed that will help adult learners deal with math anxiety so that they may reach their stated goals? In S. Kallenbach & J. Viens (Eds.), *Multiple intelligences in practice: Teacher research reports from the Adult Multiple Intelligences Study*, (pp. 89-102). Cambridge, MA: National Center for the Study of Adult Learning and Literacy Retrieved November 27, 2005, from http://www.ncsall.net/fileadmin/resources/research/op_kallen4.pdf.

This classroom-based research conducted by a teacher in Maine focused on the use of Multiple Intelligence (MI) theory to address students' math anxiety. The teacher-researcher asked students to describe what math anxiety felt like using a five-point scale to rate their level of anxiety. The teacher introduced MI theories to the students, and then the students discussed the relevance of MI theory to their own learning styles and difficulties. The teacher suggests that discussing MI theory did not necessarily help alleviate students' math anxiety but that it was a first step in that direction. Discussions of MI theory appeared to help students understand that they have useful strengths. With the teacher's encouragement, the students developed a list of intelligence-related "stress busters" based on their understanding of their own strengths. These included taking a walk in nature, listening to music or soothing sounds, doing Tai Chi or yoga, and talking to a friend.

Ginsburg, L., Gal, I., & Schuh, A. (1995). *What does "100 percent juice" mean? Exploring adult learners' informal knowledge of percent*. Philadelphia, PA: National Center on Adult Literacy, University of Pennsylvania. Retrieved November 27, 2005, from <http://www.literacyonline.org/products/ncal/pdf/TR9506.pdf>.

Researchers conducted interviews with 60 adults studying in seven urban and suburban adult education programs. None of the students had received formal instruction on how to work with percentages. During the interview, researchers asked the participants to complete a series of school-like exercises using percentages and to give their interpretations of percents found in everyday percent-laden stimuli (e.g., newspaper articles, advertising flyers). The researchers found that most of the students interviewed had some informal knowledge and skills involving percentages, but they did not have formal computational skills. Participants appeared to have a patchwork of knowledge of the percent system, with concepts and skills associated with specific contexts (e.g., shopping). Participants had difficulty transferring percent knowledge from one real-life situation to another. The researchers recommend that when interacting with students and planning activities, teachers take into account students' informal knowledge of percents. Teachers need to help students build on their strengths, integrate new concepts into their existing understanding of the percent system, and learn to compute percentages in a variety of situations.

Harris, M. (2000). Mathematics and the traditional work of women. In I. Gal (Ed.), *Adult numeracy development: Theory, research, practice* (pp. 269-302). Cresskill, NJ: Hampton Press.

This study examined the development of mathematical understanding outside of formal instructional settings. It is a qualitative study of three women engaged in knitting or quilting. Observations, interviews, and

mathematical analysis revealed the arithmetic, geometry, and problem-solving behaviors involved in their crafts. The women's understanding and use of math emerged within contexts that were meaningful and pleasurable. The researcher views math as a social construction emerging from authentic activity and critiques mainstream math education for treating math as an abstract body of knowledge to be acquired. The researcher also suggests that framing math in abstract terms ignores the kind of mathematical activity in the women's work.

Marr, B. (2001). How can they belong if they cannot speak the language? Enhancing students' language use in the adult mathematics classroom. In M.J. Schmitt & K. Safford-Ramus (Eds.), *A conversation between researchers and practitioners: Proceedings of the Seventh Annual Conference on Adults Learning Mathematics* (pp. 132-140). Cambridge, MA: National Center for the Study of Adult Learning and Literacy, Harvard Graduate School of Education, in association with Adults Learning Mathematics - A Research Forum (ALM).

This study focused on the use of language in an Australian adult numeracy class. Nineteen students participated, including seven who spoke English as a second language. The researcher used audio- and videotapes to record the speech of students as they participated in a range of mathematical learning activities. Activities included written assignments with prompts such as "use math language about shape to write three sentences describing a container." Students also engaged in reflection and discussion in groups or pairs. The ongoing, grounded analysis revealed two distinct aspects of language use in the mathematics classroom: "opportunity to speak" (space to articulate and modify thoughts about mathematical tasks) and "means to speak" (understanding of mathematical concepts and ability to use mathematical terminology). In traditional classroom discourse, students often have limited opportunity to speak because the instructor controls dialogue. The activities in the study class increased the number of opportunities students had to speak, but students still appeared to lack some of the concepts and terminology needed to fully express themselves. The researcher recommends that teachers supplement conceptual tasks with activities involving written and oral use of mathematics terminology.

Meador, P. (2000). The effects of continuing goal-setting on persistence in a math classroom. *Focus on Basics*, 4(A), 7-10. Retrieved November 27, 2005, from <http://www.ncsall.gse.harvard.edu/fob/2000/meador.html>.

This practitioner research project tested the effect of goal-setting techniques on learners' participation and success rates in an adult math class. Students completed a goal-setting questionnaire on the positive and negative forces that might affect their pursuit of stated goals. Students identified math difficulties (including fear of math) as the primary barrier to completion, rather than factors outside the classroom (such as conflicts with work or daycare schedules). The teacher then asked students to list action steps they could take to help reach their goals. During the fourth class, students revisited their goals, the positive and negative forces they had identified, and the action steps they were taking. At the end of the course, the students who remained in the class rated factors that kept them attending, kept them connected, or made it

difficult for them to continue in the course. The goal-setting activity had a positive impact on rates of continued participation for some students, particularly men. Retention rates for goal-setting classes were better than for a comparison group. Those who persisted reported improved attitudes about math.

Tomlin, A. (2000). *A 'democratic classroom,' but who speaks loudest? Research with basic mathematics students*. Paper presented at the 2nd Mathematics, Education and Society Conference (MES2), Lisbon, Portugal. (ERIC Document Reproduction Service No. ED473856).

Students in an adult basic math class acted as co-researchers in a project to investigate the discourse within an adult basic math classroom. Four groups of six to ten students participated over two years. Learner activities included the following: (1) drawing line graphs of their math life histories; (2) interviewing each other; (3) convening student meetings about math; (4) producing a student magazine that reported on the meetings and their life experiences with math; and (5) observing classes. Although the class was advertised as being learner-centered, it was clear from the student research that student experiences and needs were not reflected in the classroom. The peer interviews and meetings indicated that students felt tutors tended to control the curriculum development process. The author calls for more student involvement in studies that focus on adult education classrooms. The author also suggests that classrooms striving to model democratic dialogues between teachers and students need to examine the asymmetric power relations (in the classroom and outside of school) that make the reality of classroom dialogues less than democratic.

Tout, D., & Schmitt, M. J. (2002). The inclusion of numeracy in adult basic education. In J. Comings, B. Garner, & C. Smith (Eds.), *Annual Review of Adult Learning and Literacy*, vol. 3 (pp. 152-202). San Francisco: Jossey-Bass. Retrieved November 27, 2005, from http://gseweb.harvard.edu/~ncsall/ann_rev/vol3_5.html.

The authors examined two bodies of literature: the general literature on adult basic education (ABE) and literacy, and the literature that directly addresses adult numeracy or mathematics in ABE. The review included federal and state government policy documents, reference documents, and research reports. The literature search confirmed the findings of researchers in the mid-1990s that scant reference is made to numeracy or mathematics in such sources. However, the authors identified a small body of research that focuses on adults' use of everyday math. Several implications emerge from this research: (1) formal or school-based math is not the only type of math that people practice; (2) informal learning is as valuable as formal, school-based learning; and (3) teachers should encourage students to build on a range of real-life mathematical experiences while also learning formal math. The authors suggest that challenging and engaging curricula are needed that emphasize the relevance of math and the connection of math concepts to real-life situations. Students can develop their number sense and their ability to communicate mathematical ideas by working with curricula that promote problem solving, reasoning, and decision making. The authors suggest that assessment in adult numeracy education should be aligned with and support these new types of curricula and instruction.

van Groenestijn, M. (2001). Assessment of math skills in ABE: A challenge. In M.J. Schmitt & K. Safford-Ramus (Eds.), *A conversation between researchers and practitioners: Proceedings of the Seventh Annual Conference on Adults Learning Mathematics* (pp. 66-71). Cambridge, MA: National Center for the Study of Adult Learning and Literacy, Harvard Graduate School of Education, in association with Adults Learning Mathematics - A Research Forum (ALM).

The author conducted a qualitative study of the mathematical knowledge and skills of adults from 12 countries who were enrolled in adult basic education (ABE) in the Netherlands. The author completed a content analysis of the students' results on a placement test to determine whether the test was successful in capturing information, and whether the test was an effective way of testing non-native speakers. Based on results of the research, the author suggests the following criteria for designing placement tests for assessing the math skills of ABE students: (1) language in a placement test should not hamper learners from taking the test; (2) adults, in particular second language learners, should have a chance to apply the mathematical procedures and the algorithms that they are used to; and (3) the test should yield qualitative information about learners' mathematical skills to enable teachers and program developers to design effective ABE programs. The author suggests that teachers can collect qualitative information about the mathematical procedures learners use by avoiding questions that have simple "right" or "wrong" answers.

Related Resources

Research Digests, Research Summaries, and Research Bibliographies

As part of its research-to-practice initiative to make research accessible to adult literacy educators, the California Department of Education produces research digests, research summaries, and research bibliographies on topics that are both timely and important to the practice of adult literacy education. All research publications are available online at <http://www.calpro-online.org/pubs.asp>. Publications currently available are the following:

Applying Adult Learning Theory:

Self-directed Learning and Transformational Learning in the Classroom

How Teachers Change:

A Study of Professional Development in Adult Education

Learner Persistence in Adult Basic Education

Research on Participatory Approaches to Adult Basic and Literacy Education

Guidelines for Facilitating Discussion Groups

The California Adult Literacy Professional Development Project (CALPRO) has developed suggested guidelines for initiating and conducting discussion groups using the research digests, summaries, and bibliographies. A discussion group provides participants an opportunity to engage in a focused conversation about an important topic. With a research publication as the stimulus for discussion, participants can look at relevant research in depth and from multiple perspectives, identify aspects of the publication that are most relevant to their own practice, and brainstorm implications for practice in their own agency or program. Used in this way, a discussion group is designed to disseminate knowledge, encourage reflection among participants, and provide participants a forum for considering and implementing change in their practice. It offers a good opportunity to involve staff members in the decision-making process and get their input on changes that ultimately will affect their practice. Guidelines for research publication discussion groups can be downloaded at <http://www.calpro-online.org/pubs/DiscussionGuidelineforResearchPublications.pdf>.

Workshop: Algebra Instructional Strategies for Adult Educators

This workshop provides an overview of the California content standards for algebra along with sample questions and teaching strategies. It also provides test-taking strategies and techniques for helping learners overcome "algebra anxiety." Visit the CALPRO calendar at <http://www.calpro-online.org> to see when this workshop is being offered in your area.

Developed by the California Adult Literacy Professional Development Project (CALPRO), under contract with the California Department of Education.

Bibliography Authors: Sandra Kerka, The Ohio State University
Erik Jacobson, CALPRO

Bibliography Editor: Mary Ann Corley, CALPRO
