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### An Environmental Scan of Adult Numeracy Professional Development Initiatives

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RESEARCH<sup>®</sup>

# **An Environmental Scan of Adult Numeracy Professional Development Initiatives and Practices**

*Prepared for:*

U.S. Department of Education  
Office of Vocational and Adult Education  
Division of Adult Education and Literacy

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## **I. INTRODUCTION**

### **A. Instruction and Professional Development in Adult Numeracy**

Numeracy skills are essential for the United States to be competitive in a global economy and for adults to function successfully in the workforce, in training programs, and in the home and community. The growing emphasis on quality mathematics instruction in Grades K–12 is mirrored in adult education as a means of helping all learners achieve the mathematical knowledge and skills necessary to assume a productive role in society. As adult learners are encouraged to move beyond the General Educational Development (GED) and into postsecondary education, the development of numeracy skills becomes more critical. Many states have recognized the need for learners to improve their numeracy skills and have identified mathematics as a core academic area for the development of rigorous content standards.

Numeracy practice in adult education is a relatively unexplored and underdeveloped area of inquiry. The scant research used to guide adult numeracy practice comes, to a large extent, from K–12 and international research. Such research is limited in scope and consequently offers little insight into effective instruction and professional development to help instructors improve mathematics instruction. Indeed, a review of the research by Condelli et al. (2006) confirmed the paucity of rigorous research on instructional approaches and interventions, assessment, and professional development in adult numeracy. However, the research does make clear that there is a lack of qualified instructors with knowledge of mathematics content and instructional strategies for teaching mathematics to adults. Many adult numeracy instructors come from Grades K–12, an arena already experiencing a shortage of qualified teachers (Darling-Hammond, 2000). A large number of these teachers learned to teach using a model of instruction that focuses on memorizing facts (Darling-Hammond & McLaughlin, 1995; Porter & Brophy, 1988) without integrating procedural and conceptual instruction (Desimone, Smith, Baker, & Ueno, 2005).

Adult mathematics teaching is often decontextualized (Leonelli, 1999) and may focus more on manipulation of numbers than on the critical thinking and problem-solving skills that comprise the standards and frameworks developed by such organizations as the National Council of Teachers of Mathematics (NCTM), the Adult Numeracy Network (ANN), the National Institute for Literacy (NIFL), and the American Mathematical Association of Two-Year Colleges' (AMATYC). Instructors who have limited mathematical content and pedagogical knowledge for teaching adults will be unable to effectively assess learners' abilities, plan and deliver mathematics instruction, and respond to students in ways that support learner growth and achievement in numeracy.

A review of teacher training practices in the United States (Gal, 2002) found little evidence of mathematics training among adult education instructors, with fewer than 10% of instructors reporting that they were certified in mathematics. Yet research done on children (Rice, 2003) clearly indicates that teacher preparation has the strongest correlation to student achievement in reading and mathematics. For a variety of reasons, there have been limited adult numeracy professional development initiatives. Contributing factors include the part-time nature of the adult education field, limited resources for competing professional development



initiatives, and the fact that numeracy education is often included as part of adult basic education (ABE), “literacy education,” workplace education, and the like and, therefore, is often not discussed as a stand-alone topic (Condelli et al., 2006).

## **B. Role of Professional Development for Numeracy Instructors**

The principal way to improve teaching and foster change in educational practice is through professional development. Advocates for improving numeracy instruction argue for focusing on practitioner development that will “encourage the learning and teaching of mathematics in a manner which is interesting and appropriate to adults” (Massachusetts ABE Math Team, 1994, p. 3) so that “educators can refocus the adult numeracy curriculum in a meaningful way” (Curry, Schmitt, & Waldron, 1996, p. 2) in an effort to “change the way math is actually taught and learned in an adult literacy community” (Brover, Deagan, & Farina, 2000, ¶ 1). Teachers need to know about adult learning theory and adult numeracy learning.

The National Research Council’s Mathematics Learning Study Committee identified the kinds of knowledge K–8 mathematics teachers need to teach mathematics proficiently (National Research Council, 2001). Teachers need to be aware of the individual needs of their students, need to know how to manage their classrooms, and should have an “elaborated integrated knowledge of mathematics” so they can anticipate and understand students’ different interpretations of concepts (p. 381). According to the committee, for proficient mathematics instruction, teachers must:

- Possess a deep understanding of core mathematical concepts and the ways in which students’ understanding matures
- Possess a repertoire of instructional and classroom management routines that they can implement fluently
- Possess a strategic competence in mathematics to respond, on the fly, to students’ questions or statements
- Exercise adaptive reasoning
- View their own knowledge, practice, and learning as valuable
- Feel confident in their own ability to learn from their students

These principles can easily apply to adult education. Adult numeracy instructors must be able to design lessons, manage numeracy classrooms, create an environment that fosters quality numeracy teaching, and teach mathematics to adults who will need to apply such knowledge to multiple aspects of their lives. As Gal and Schmitt (1994) noted, professional development that increases an instructor’s knowledge and skills to teach the mathematical content and processes reflected in the standards is necessary in the area of adult numeracy education.

## **C. Purpose and Scope of the Environmental Scan**

As a step toward improving instruction and professional development in mathematics instruction, the Office of Vocational and Adult Education (OVAE) launched the Adult Numeracy Initiative and awarded the contract to the American Institutes for Research® (AIR). The project is designed to (a) gain a more thorough understanding of the current state of the field of adult numeracy, (b) identify critical issues in instruction, assessment, and professional development, and (c) assist OVAE in developing a research agenda in adult numeracy. A key component of the initiative is a review of professional development activities in adult education through an environmental scan (EScan)—a process for obtaining information, thoughts, and opinions from a wide range of people and programs via individual and group interviews and reviews of data and documents in the field. Other study components include a literature review with a focus on definitions of numeracy, adult learning theory, mathematics instructional strategies, assessment, and professional development; and commissioned papers on various research topics. The project is guided by a technical work group (TWG). This report describes the findings from the EScan.

The purpose of the EScan is to examine recent and current adult numeracy professional development initiatives in the United States and inform future numeracy research and other initiatives at the state and federal levels. The EScan focused on the following research questions:

- What types of professional development initiatives have been implemented at the state and local levels through federal funding that incorporate or focus on adult mathematics instruction?
- What types of programs have been implemented at the state and local levels through federal funding that focus on adult mathematics instruction related to adult English language acquisition learners?
- What instructional practices exist in mathematics education for adult learners that are worthy of replication? How should instructional strategies and programs differ across adult learner populations?
- What practices exist in professional development and certification requirements for instructors of adult mathematics education that are worthy of replication?

Researchers used qualitative research to address these questions and examine current and recent adult numeracy professional development initiatives conducted over the past 10 years. Initiatives ranged from “one-shot” workshops to informal networking sessions to ongoing professional development. To select initiatives to include in the EScan, project staff used a set of criteria based on a review of literature on professional development, numeracy, content standards, and pedagogy. The TWG provided guidance on the selection criteria, initiative selection, and areas for investigation for the initiatives.

For each identified initiative, research staff examined extant materials and spoke with initiative directors, developers, trainers, and participants. Our review examined the following areas:

- Professional development delivery models
- Implementing agencies
- Funding sources
- Professional development participants
- Content of the professional development
- Instructional strategies for numeracy
- Strategies for assessing the professional development
- Strengths and weaknesses of the initiatives from the perspective of initiative directors, developers, and trainers
- Recommendations for sustaining initiatives

The methodology AIR used to select and analyze data is discussed in chapter II. To provide a framework through which to evaluate professional development activities, we reviewed the research and literature on the characteristics of effective professional development. The main works consulted were the following:

- *Effective Professional Development in Mathematics and Science: Lessons From Evaluation of the Eisenhower Program* (Porter, Birman, Garet, Desimone, & Yoon, 2004; henceforth referred to as the Eisenhower study)
- *How Teachers Change: Study of Professional Development in Adult Education* (Smith, Hofer, Gillespie, Solomon, & Rowe, 2003)
- *McREL Insights: Professional Development Analysis* (Mid-continent Research for Education and Learning, 2005)
- *Professional Development Principles* (Adult Numeracy Network, 2005)
- Professional development models identified by the Mathematics Learning Study Committee (National Research Council, 2001)

In addition, researchers reviewed publications from NCTM, AMATYC, and the Mathematical Association of America. We applied the principles derived from this review, as discussed in chapter II, to assess individual adult numeracy professional development initiatives and to draw general conclusions and make recommendations about the initiatives.

## **D. Organization of the Report**

This EScan report is organized into five chapters and includes several appendixes that provide additional information.

### **Chapters**

- Chapter I, **Introduction**, describes the status of adult numeracy instructors and the need for professional development. It includes the scope and purpose of the EScan.
- Chapter II, **Methodology**, describes the procedures for selecting adult numeracy professional development initiatives to include in the EScan, including data collection and the qualitative data analyses procedures employed to maximize the quality of our interpretation, given the uniqueness of the task and of the field of adult numeracy. This section also describes potential limitations.
- Chapter III, **Findings**, describes the results of our investigation and includes information about the professional development deliverers, funding sources, participant characteristics, delivery approaches, content, instructional strategies, and assessment types.
- Chapter IV, **Implications**, examines the relationship of the findings to the findings in the literature and in light of the research questions.
- Chapter V, **Recommendations**, suggests initiative features worthy of replication and further examination and offers suggestions for continued research.

### **Appendixes**

- Appendix A provides general information on initiatives not included in the EScan.
- Appendix B summarizes each of the adult numeracy professional development initiatives included in the EScan.
- Appendix C provides guided questions that were used to gather information in the study.
- Appendix D provides an excerpt of the data codes used to analyze the information collected.
- Appendix E displays data collected from interviews with initiative participants.

Each section, including the appendixes, interweaves the findings from this research with extant research on professional development and adult numeracy to address the research questions fully and to provide recommendations that are meaningful to the field of adult numeracy.

## II. METHODOLOGY

### A. Introduction

The EScan is the first systematic effort by OVAE to examine the nature of professional development in numeracy for adult education programs. The wide differences among adult mathematics instruction, professional development models, and the nature of adult education required a methodology that was flexible enough to accomplish the following:

- Help reveal important nuances about how professional development is practiced in the field of adult numeracy
- Complement efforts to understand the potentially complex and unique nature of the field of adult numeracy
- Enable descriptions of nonquantifiable information, situations, and dynamics in the field
- Facilitate understanding of a topic on which little is known, given the paucity of research
- Help identify important variables and presumptions in adult numeracy that might later be tested quantitatively
- Yield enough data of sufficient depth to answer the research questions meaningfully and to generate theory about adult numeracy professional development

Answering the research questions for the EScan required a research design that produces more than just the collection and quantification of data, but instead generates adequate descriptions of adult numeracy professional development, informs future steps in adult numeracy research, and helps advance the field. To achieve these goals, AIR utilized a qualitative research design, with procedures in *grounded theory* and other complementing research techniques that would help establish trustworthiness of the findings.

Grounded theory involves a very rigorous iterative process with systematic steps designed to “ground” propositions made about the data *in* the data. For the EScan, data collection was guided by the underlying assumption that “research is a flow of work that evolves over the entire course of any investigative project” (Strauss & Corbin, 1998, p. 29), and data triangulation was used to substantiate the veracity of all information collected and to increase credibility of the research. This approach allowed researchers to concentrate on the distinctive nature of each adult numeracy professional development initiative discovered.

The research process involved five phases:

- Collection and review of extant materials
- Selection of adult numeracy professional development initiatives
- Preparation of instrumentation, including guiding questions
- Data collection from selected initiatives
- Data analysis

Within each of these phases, we took several measures to ensure that the research findings met criteria for research trustworthiness, as discussed later in this chapter.

## **B. Collection and Review of Extant Materials**

To identify all possible professional development initiatives that focused on adult numeracy, AIR researchers searched government Web sites for recent grants for adult numeracy professional development initiatives; requested information from adult education state administrators and professional development staff; posted requests for information on numeracy and professional development e-mail discussion groups; gathered information from ANN members and other adult numeracy experts; reviewed agendas of national adult education conferences, such as the Commission on Adult Basic Education (COABE), Equipped for the Future (EFF), and the American Association of Adult Continuing Education (AAACE); and held conversations with presenters and participants at the conferences. The collected information was captured in a matrix to facilitate data management and sorting and to aid the analysis process.

Once identified, we examined information on each initiative to determine whether it met both the Adult Numeracy Initiative request for proposals (RFP) specifications and the criteria for selection that AIR developed. These criteria were developed based on the research literature on numeracy, content standards, pedagogy, and professional development and were reviewed by members of the project's TWG. The criteria were divided into categories of essential and desirable features. The *essentials* contained elements that would be crucial for inclusion in the EScan; the *desirables* contained elements that would be advantageous in answering the research questions.

### **Essential Features**

- The professional development occurs over time and is not a “one-shot” activity.
- The professional development is built upon activities that help instructors advance their own conceptual understanding of mathematics and the way adults learn so that instructors use this knowledge in planning instruction for learners.

- The professional development helps instructors connect content and materials to authentic, real-world numeracy/mathematics situations.
- The professional development reflects the research on how adults learn (e.g., multiple problem-solving strategies, collaborative learning, access to prior knowledge, and/or misunderstanding).
- Mathematical content within the professional development reflects national (e.g., NCTM, AMATYC, EFF) or state standards.
- Participants are from adult education programs, such as ABE, adult secondary education (ASE), or GED, in any delivery setting.
- Program materials are available, and the materials accommodate dissimilar mathematical backgrounds of participants.

### **Desirable Features**

- Evidence exists of an evaluation component to appraise change in instructor knowledge and practice after program completion.
- The program incorporates an explicit affective factor intervention (e.g., study skills, time management, reduction in anxiety).
- Technology is used to prepare and support the participants before, during, and after the intervention (e.g., materials are distributed to participants prior to the professional development event; if technology is to be used for classroom instruction, it is to be incorporated within the professional development).

The information retrieved from the Internet was often so limited that it was impossible to assess programs with respect to all of the essential criteria. AIR staff contacted state directors, adult education program directors, and TWG members to seek additional information, but the problem remained. As a result, we worked with the TWG to limit the criteria to those that could be applied, given the information obtained through the search. With TWG approval, researchers selected two of the essential selection criteria: (a) the professional development occurs over time and is not a “one-shot” activity, and (b) the professional development is delivered to participants in adult education programs. Additionally, we only considered initiatives implemented within the past 10 years (1996–2006).

## C. Selection of Adult Numeracy Professional Development Initiatives

General searches generated 30 initiatives in adult numeracy professional development.<sup>1</sup> Only 20 of them met the study’s selection criteria for further consideration.<sup>2</sup> The initiatives covered a wide range of topics and activities. Exhibit II–1 identifies and briefly summarizes the initiatives selected for inclusion in the EScan. Appendix B includes detailed summaries of each of these 20 initiatives.

**Exhibit II–1. Overview of Selected Initiatives**

	Initiative Name	Overview
<b>State-Level Initiatives</b>		
1.	Arkansas Adult Learning Resource Center (ALRC) Numeracy Project	A series of workshops on NCTM standards and strategies for instructors to help students pass the GED test.
2.	Arkansas Adult Numeracy Campaign	A series of workshops over the course of 8 months on strategies based on NCTM and the Massachusetts ABE Curriculum Framework for Mathematics and Numeracy.
3.	California: CALPRO’s Algebra Training-of-Trainers (TOT) Workshop and Instructor Workshops	Development of a training-of-trainers workshop and instructor workshops on strategies for teaching algebra.
4.	Illinois Adult Learning Resource Center (ALRC) Professional Development in Numeracy	A variety of delivery models implemented by a state literacy resource center on a variety of numeracy topics.
5.	Maine: Annenberg’s Learning Math Series	An online course and periodic workshop sessions on numeracy strategies aligned with NCTM standards, adapted from Annenberg’s series of K–8 mathematics materials.
6.	Maine Center for Adult Learning and Literacy (CALL) Professional Development in Numeracy	A variety of delivery models on a variety of numeracy topics.
7.	Massachusetts SABES ABE Math Initiative	Training of practitioner leaders to deliver professional development on data, algebra, geometry, and numbers, which are the strands of the Massachusetts ABE Curriculum Framework for Mathematics and Numeracy.
8.	New York: Math Exchange Group (MEG)	Monthly study circles that help instructors develop their mathematics content and pedagogical knowledge.
9.	Oregon Ocean Sciences and Math Collaborative Project	Institutes on the integration of ocean sciences content with mathematics instruction. Instructors participate in research expeditions, where they collaborate with oceanographers to design activities related to their experiences.
10.	Oregon and Washington: Visual Math	Multiple-day workshops and a one-time online course on the use of visual thinking in the teaching and learning of mathematics.

<sup>1</sup> Some state-level initiatives, such as the Illinois ALRC, comprise multiple professional development activities, but we count them as single initiatives because they are all funded and implemented through resource centers and because we received little information on each activity. Other state-level initiatives, such as the Arkansas ALRC Numeracy Project and Arkansas Adult Numeracy Campaign, are implemented by the same agency, but we count them as separate initiatives because they are of longer duration than a single workshop. Some national initiatives, such as EFF, we count as single initiatives even though activities occurred in multiple states.

<sup>2</sup> Appendix A includes general information on initiatives that did not meet selection criteria.



## Exhibit II–1. Overview of Selected Initiatives (Continued)

	Initiative Name	Overview
<b>State-Level Initiatives</b>		
11.	Pennsylvania: Making Math Real	Multiple-day institutes with reunion meetings and parallel institutes for returning participants.
12.	Virginia: GED as Project	Workshops on the online curriculum guide, <i>GED as Project</i> , which uses discovery learning to build higher order thinking and problem-solving skills for GED mathematics.
13.	Virginia: Making Math Meaningful	Workshops to strengthen instructors' mathematics skills and methods for teaching GED mathematics.
14.	Virginia Numeracy Project	Training for instructors to deliver workshops and optional study circles on a conceptual approach to numeracy using numbers and number sense, patterns and algebra, measurement and geometry, and data and statistics.
<b>National Initiatives</b>		
15.	EFF Math	Workshops with an optional online course on how to implement the Use Math to Solve Problems and Communicate standard and performance continuum.
16.	EMPower Curriculum	Workshops and institute to develop a curriculum based on mathematical reasoning, communication, and problem-solving and to provide training and support for pilot and field-test instructors.
17.	EMPower Professional Development Workshops	One- to 2-day workshops on the EMPower curriculum.
18.	GED Mathematics Training Institute	National institute that provided state participants with information and tools to help GED instructors recognize students' areas of difficulty on the GED test and provide remediation.
19.	Professional Development Kit (PDK)	Multimedia and optional face-to-face professional development to help instructors examine their classroom practices and develop action research projects.
20.	Teachers Investigating Adult Numeracy (TIAN)	A research and development initiative offering multiple-day workshops over 1 year with regional meetings between workshops on data analysis, algebraic thinking, and proportional reasoning and measurement.

We collected additional information about each of these initiatives through online search mechanisms, a review of extant materials, and semi structured discussions with initiative directors, developers, and/or trainers.

### D. Preparation of Instrumentation, Including Guiding Questions

We developed guiding questions for these discussions that were tailored to address gaps in information for each adult numeracy professional development initiative for which information was not available in extant materials. These guiding questions helped ensure that the extant information was accurate and helped prevent the interview process from being overly time-consuming and burdensome for respondents. We organized all information on the initiatives in a matrix that we shared with respondents prior to interviews. The guiding questions covered the following topics, many of which we identified from the Eisenhower study on professional development of mathematics teachers and from TWG members:

- Program background information
- Cost of initiative's implementation, including funding source
- Number and types of participants and participant incentives
- Types and duration of professional development
- Instructional content and materials, including assessment strategies
- Teaching and learning strategies
- Program assessments and findings
- Sustainability of initiatives

Appendix C provides the protocols used in discussions with initiative directors, developers, trainers, and participants.

Preliminary findings from the collection of data showed that many initiatives had conducted no formal evaluations regarding the impact of the training on instructors, and respondents were able to provide only anecdotal information about the impact of the training on instructors. Lacking this necessary information limited our ability to understand the full context of these initiatives. To obtain some evaluative information, we also spoke with training participants using questions designed to gain a sense of how the training may have affected participants' knowledge and instructional practice. The questions inquired about participants' prior knowledge in mathematics, their background, new knowledge they gained from the training, prior training in mathematics they may have received, other forms of professional development they were receiving at the same time they partook in the adult numeracy professional development, and their plans to continue participation in adult numeracy professional development. Insight into this information also helped confirm certain aspects of the trainer/director discussions.

## **E. Data Collection From Selected Initiatives**

AIR researchers interviewed the directors, developers, and/or trainers of all the initiatives selected for the study and used the guiding questions to focus the discussion. The goal was to not only gather enough data to represent all variations of the adult numeracy professional development initiatives already collected, but also to achieve a sufficient depth of information to facilitate meaningful data coding, data reduction, identification of emerging themes, and ultimately identification of emerging hypotheses or propositions about adult numeracy professional development in the United States.

For each initiative, we collected information first by reviewing extant information and then by interviewing directors, developers, and/or trainers to fill in any information gaps. As part of the discussion, we asked the respondent to refer us to other project staff members involved in

the professional development activities whom we could interview for additional information. Our researchers used the protocol of guiding questions, specifically tailored to individual initiatives, to guide the discussions, facilitate a natural flow of information, and help respondents volunteer information not captured in the protocol.

Also, we wanted to review an evaluation of the effects or outcomes of the professional development activity, but most of the adult numeracy professional development initiatives had not conducted formal evaluations related to the impact of the training on participants. Upon our request, some respondents provided referral lists to AIR, containing the names and contact information of participants who would not mind discussing their training experiences. Other respondents opted to contact participants for permission to share their names and contact information with AIR, to which a minute number of participants responded. AIR received contact information for a total of 369 participants, only some of which included e-mail information.

AIR e-mailed 226 participants from the referral lists, and researchers spoke briefly with 36 participants who were interested in sharing their experiences in their respective adult numeracy professional development. The questions asked of each participant were not the same; the research team asked different questions, depending on what information had been previously gathered from interviews with initiative staff. Participants filled in information gaps and spoke freely about their experiences during and after participation. Data collected through interviews and from online sources were used as primary data for analysis. Participant interview data were used to a limited extent to help the researchers gain a sense of any impact the training may have had on their practices.

AIR verified the accuracy of all information collected through a crosschecking process that encouraged initiative directors, developers, and/or trainers to add to or delete from the information collected. Matrixes were shared with the respondents for an accuracy check before and after the semi structured interviews. During the interviews, respondents advanced the discussion in light of the guiding questions and the information gaps on the matrix. AIR then extracted critical information<sup>3</sup> from the notes to complete matrixes for each initiative. The technique of purposefully composing the data in a matrix facilitated data management and made key information more accessible for analysis.

## **F. Analysis Plan**

AIR utilized techniques in grounded theory to analyze the data for the EScan. Researchers began data analysis by coding the data collected for each adult numeracy professional development initiative. Such coding enabled us to “reduce” a vast amount of textual data into a manageable amount useful enough for analysis. After coding and organizing the data, we conducted case orientations by examining all initiatives individually and then in relation to one another to make comparisons and determine trends.

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<sup>3</sup> *Critical information* is information that was used to fill information gaps in the matrixes and/or extend the view of previous information collected from extant sources.

## **Data Coding and Management**

The EScan data comprised mostly dense textual information from interview transcripts and extant materials, so coding was important to reduce data to a manageable amount and to identify important patterns and themes. The coding process involved three steps: case orientations, identification of emerging themes and categories, and narrowing emerging themes and categories into core categories for analysis.

1. **Case orientations.** In this step, AIR researchers reviewed all of the adult numeracy professional development initiatives (the “cases”) and engaged in a formal process of constant comparison. The case orientation enabled researchers to compare information across cases. The researchers used “memoing,” a technique to help manage the information coherently. As they reviewed the cases, researchers wrote memos about themes and categories that they noticed in the data.
2. **Identification of emerging themes and categories.** Each researcher was required to code the themes by using pattern, inductive, or ontological coding.
  - a. Pattern coding involves searching the data to identify explicit emerging themes, categories, or trends, namely regularities, or recurrent pieces of information; variations, or deviations and differences; and singularities, or pieces of information that seem unique or exceptional. See Appendix D for a sample of the pattern codes.
  - b. Inductive coding requires the use of prior knowledge of areas related to the current research to identify implicit emerging themes or themes that require knowledge of the context of adult numeracy.
  - c. Ontological coding involves examining the data through several fundamental a priori categories or perspectives from which meaning can exist. In this case, researchers searched the data for information related to the contexts/situations in which adult numeracy takes place; definitions that adult numeracy initiative directors, developers, and trainers have for adult numeracy professional development; processes and activities mentioned or described in adult numeracy professional development; and strategies, techniques, ways, methods, or processes that respondents have for implementing initiatives.
3. **Narrowing of emerging themes and categories into core categories for analysis.** Data coding enabled AIR researchers to reduce the data into several large categories, which were further distilled into core categories. After emerging themes and categories were identified and coded, intra- and inter-case comparisons were made, and codes that were similar were combined and recategorized into several meaningful core categories, which were sorted for review.

AIR conducted ongoing, systematic, initiative-by-initiative comparisons in which each initiative was compared with other initiatives<sup>4</sup> to extend or test emerging propositions (Yin, 1989) and to develop a theoretical framework. In doing such activities, a number of concepts emerged. These concepts are the bases for the generation of larger categories, which eventually led to full-fledged propositions or theories inductively derived and verified through the system of constant comparison.

## Data Analysis

The categories of data were studied by AIR researchers, who examined codes that emerged from this process and then further categorized or reduced them into several larger categories. Using a series of matrixes, researchers examined the data both quantitatively and qualitatively across initiatives for possible relationships in and between categories and initiatives to simplify data analysis. (Appendix E contains some of the matrixes used to analyze participant data.) For the analysis, AIR researchers used the same constant comparison techniques in grounded theory to help develop basic propositions relative to answers to the research questions and to identify certain factors that could support conclusions.

Once we identified larger categories and themes, we drew conclusions about their inherent meanings with respect to their relationship to current literature and research questions and in regard to suggested implications for future research. During this process, the researchers also identified critical information that verified the conclusions and found supporting evidence for all conclusions made about the findings from data.

## G. Trustworthiness of Reporting and Research

For qualitative research of this type, researchers must ensure that the collection, description, and interpretation of the data, and the conclusions drawn from the data, are trustworthy<sup>5</sup> for reporting. AIR used criteria consistent with grounded theory to evaluate the descriptive validity, interpretive validity, and theoretical validity of the research data (Johnson, 1997). These criteria are the following:

- Applicability—The findings were transferable to the field of adult numeracy (external validity).
- Consistency—The research procedures were conducted in a way that was dependable enough to yield the same results if the same steps were to be repeated (consistency/reliability).

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<sup>4</sup> This is done for the purpose of making comparisons for specific reasons, such as for the purpose of using information from the initiatives to conduct *literal replication* (yielding similar results to reinforce or extend emerging theory) or *theoretical replication* (yielding converse results to ensure the obvious or expected and/or to reinforce emerging theory).

<sup>5</sup> *Validity* and *reliability* are the terms used in quantitative research.

- **Neutrality**—The findings were generated from the inquiry and not from researcher biases or proclivity toward any particular theory about adult numeracy practice (objectivity).
- **Validity**—The data and findings had credibility and integrity (truth value or internal validity).

## H. Limitations

As with any other research study, the EScan had limitations, and AIR has considered them in the design and reporting of the data. We used data triangulation to mitigate adverse effects, but the following limitations should nonetheless be considered when evaluating findings.

- **Sources of data.** Information on instructional practices used in the adult numeracy professional development initiatives and modeled for participants to use in their own classrooms is based on what respondents reported, not on observations of the professional development or of classroom practice. The scope of the study was to examine what was occurring in professional development, and resources were unavailable for exploring what was actually happening in the classroom.
- **Limited responses.** AIR's initial request for information about additional adult numeracy professional development initiatives that we did not identify through our searches met with limited response. Although e-mail inquiries were sent to organizations, state directors, literacy resource centers, and literacy programs, only a small number of people responded. This may indicate that few initiatives existed, records of such events were not well kept, or state staff was not well informed about local-level initiatives.
- **Limited responses from participants.** Seven initiative directors, developers, and/or trainers did not provide contact information for participants. When they did provide e-mail addresses or phone numbers, the research team randomly selected three people for a short discussion, contacting additional participants if fewer than three responded to initial e-mails or calls. The response rate was still very low, perhaps because contact information was outdated or because the contacts were made in the summer, when many instructors were on vacation.
- **Life of initiatives.** Some adult numeracy professional development initiatives had already been concluded, and respondents were not readily available. Consequently, we may not have captured complete information for some initiatives. As such, the time and duration of the professional development that participants received varied greatly. Some participants received training for a longer period than others.
- **Question variations.** The types of questions that participants were asked varied. The extant information we collected from each initiative generated different types of questions, and AIR focused on those questions that would provide insight into whether participants found the training to be useful to their practice. Some

participants were asked about professional development that they had received on an ongoing basis several years before; other participants were asked about a 1-day workshop that they had attended the previous month. As such, AIR was only able to make very limited use of the participant data.

- **Internet information.** Because the information on the Internet is unedited, much of the information can be unreliable. However, all extant information collected from the Internet was shared with the directors, developers, and/or trainers for verification.
- **Record keeping.** Many of the initiatives kept no record of their training, and some were only able to give us information from memory. Only a few initiatives were able to provide exact numbers of participants; others estimated participant numbers. Participation numbers were not pursued as a major finding.
- **Lack of evaluative data.** In most instances, no evaluative data existed for AIR to examine to help identify initiatives that are worthy of replication. AIR conducted participant interviews to address this issue, but unfortunately, in some instances, participants were not available or were unwilling to participate in interviews, especially those participants in initiatives that had been concluded. As such, AIR depended on extant research, including the study's original criteria, to make determinations about which practices are worthy of replication.

The type of methodology used in this study provides the flexibility to assuage the limitations above and reinforce the findings. Because this is an exploratory study, more research will be needed to fully investigate the hypotheses that the findings seem to imply.

## **III. FINDINGS**

### **A. Introduction**

This chapter presents a descriptive review of the 20 adult numeracy professional development initiatives included in the EScan. The findings address the first two research questions:

- What types of professional development initiatives have been implemented at the state and local levels through federal funding that incorporate or focus on adult mathematics instruction?
- What types of programs have been implemented at the state and local levels through federal funding that focus on adult mathematics instruction related to adult English language acquisition learners?

The review examined nine topic areas:

- Professional development delivery models
- Implementing agencies
- Funding sources
- Professional development participants
- Content of the professional development
- Instructional strategies for numeracy
- Strategies for assessing the professional development
- Strengths and weaknesses of the initiatives from the perspective of initiative directors, developers, and trainers
- Recommendations for sustaining initiatives

The examination of instructional strategies provides insight on the instructional approaches that practitioners are encouraged to implement in their own classroom settings.

### **B. Overview of Findings From the Research on Professional Development**

The information included in the EScan was gathered through a review of extant materials and through interviews with initiative directors, developers, and/or trainers and, to a small extent,



interviews with participants. Findings are presented in narrative form along with supporting exhibits.

## **Professional Development Delivery Models**

The literature in professional development and mathematics identifies a variety of delivery models. Although many focus on professional development for K–12 teachers, some models may be applicable to adult education. Among the models identified are training workshops, individually guided professional development, observations and assessment, product or process development, and other learning embedded in a program (e.g., inquiry research projects, study circles, mentoring/coaching). Some are referred to as traditional models of professional development (e.g., workshops and institutes), whereas others are referred to as reform models, generally embedded within a program and of longer duration. The EScan revealed that initiatives primarily use traditional models but found that reform activities are being integrated within the delivery process in a variety of ways.

We have organized the discussion of delivery models into three subsections: definition of delivery models, interim and follow-up activities, and selection of trainers and facilitators.

### **Definition of Delivery Models**

Delivery models used by the 20 initiatives fell into two broad categories: face-to-face professional development and online or distance learning professional development. These categories are not mutually exclusive, and several initiatives are composed of multiple models. Face-to-face professional development consisted of single workshops, multiple workshops or institutes, study circles, product development, and mentoring/coaching. Online or distance learning consisted of online courses, CD-ROMs, and Web sites, either developed specifically for the professional development initiative or developed for Grades K–12 and then adapted for adult education. Distance learning components often supplemented face-to-face professional development.

#### ***Face-to-Face Professional Development***

- **Single workshops (12)** consist of one workshop ranging from a few hours to a full day of professional development. The Illinois ALRC, for example, offers 1-day workshops for instructors on various ways to teach numeracy.
- **Multiple workshops and institutes (17)** provide at least two full-day sessions delivered either consecutively or over a period of days, months, or years. The GED Mathematics Training Institute is an example of an institute that is a single event, whereas TIAN offers three 2-day institutes over the course of 1 year with several interim activities.
- **Study circles (3)** are meetings that last several hours each and are held over a certain period of time. Typically, a facilitator prepares a set of problems or issues for the participants to discuss. Some study circles last for a few months; others, such as MEG, are ongoing.

- **Product development (1)** models require practitioners to work in a collegial manner to develop curricula or other resources for the field. The initiative that developed the EMPower Curriculum is an example of product development.
- A **mentoring/coaching (4)** model is when a trainer, facilitator, or another participant provides feedback between sessions either in person, by phone, or by e-mail. Initiatives use mentoring/coaching on a very limited basis.

**Online or Distance Learning Professional Development**

Online or distance learning professional development consists of asynchronous online courses, Web sites, or CD-ROMs developed by the initiative.

- **Online courses (4)** range from one 3-hour session (e.g., the Illinois ALRC’s Visual Math course) to an 8- to 16-hour course (e.g., EFF Math). In courses with multiple sessions, a facilitator usually encourages interaction among participants and gives them feedback on their work. Participants may read and discuss articles or try out new strategies in their classrooms and share their experiences. Some online courses are administered between the sessions of multiple workshops.
- **Web sites or CD-ROMS (3)** provide information created or compiled by the initiative and delivered online or through software. A Web site or CD-ROM may provide articles or video clips for users to view and download.

Exhibit III–1 identifies the models for and duration of professional development of each initiative.<sup>6</sup> A bullet in a table cell indicates that the model was offered but the duration was unknown.

**Exhibit III–1. Professional Development Delivery Models \***

	Face-to-Face					Distance Learning	
	Multiple Workshops	Single Workshops	Mentoring/ Coaching	Study Circle	Product Development	Online Course	Web site or CD-ROM
<b>State-Level Initiatives</b>							
AR ALRC Numeracy Project	2 days per month for 2 months						
AR ANC	2 days per month for 3 months or 1 day per month for 5 months						

<sup>6</sup> Some initiatives used different delivery models for different types of participants involved in the training—participants who would become trainers and those who would not. Parentheses indicate any differences.

**Exhibit III–1. Professional Development Delivery Models\* (Continued)**

	FACE-TO-FACE					DISTANCE LEARNING	
	Multiple Workshops	Single Workshops	Mentoring/ Coaching	Study Circle	Product Development	Online Course	Web site or CD-ROM
<b>State-Level Initiatives</b>							
CA: CALPRO's Algebra TOT and Instructor Workshops		4 hours (trainers and instructors) <sup>†</sup>					
IL ALRC Math	On average, 2 days	1 day				1 hour	
ME: Annenberg	2.5 hours per session for 10 sessions						•
ME CALL Math	Ranges from 1 to 2 days per month for 4 months	1 day				4–6 weeks	
MA SABES ABE Math	4 days over the course of a year (trainers); varies for instructors	1 day		On average, five 3-hour sessions over 7 months (instructors)			
NY: MEG		1 day		1 day per month			
OR Ocean Sciences and Math Project	3-day institute per year		•				
OR & WA: Visual Math	3–5 days					•	
PA: Making Math Real	On average, one 3-day institute per year	1-day reunion					
VA: GED as Project	2–3 days	1 day					•
VA: Making Math Meaningful		1 day					
VA Numeracy Project	2 days (trainers)	4 or 7 hours (instructors)		1.5–2 hours per month for 2–3 months (instructors)			
<b>National Initiatives</b>							
EFF Math	On average, three 2-day workshops over 4–9		• (Feature has just begun)			8–16 hours	

**Exhibit III–1. Professional Development Delivery Models\* (Continued)**

	FACE-TO-FACE					DISTANCE LEARNING	
	Multiple Workshops	Single Workshops	Mentoring/ Coaching	Study Circle	Product Development	Online Course	Web site or CD-ROM
	months						
EMPower Curriculum	•	•			•		
EMPower Workshops	2 days	1 day					
GED Math Institute	2 days						
PDK	On average, 4 days		•				•
TIAN	Three 2-day institutes per year	1-day sub regional meeting	•				
<b>Total</b>	<b>17</b>	<b>12</b>	<b>4</b>	<b>3</b>	<b>1</b>	<b>4</b>	<b>3</b>

\* Duration is represented in both days per month and, when applicable, number of sessions per month or year. The number of sessions per month or year does not specify whether the months are consecutive or nonconsecutive. In the case of the Arkansas ALRC Numeracy Project, professional development was delivered in 2 days per month for 2 months (February and April).

† In 2006, CALPRO’s algebra workshops for instructors will consist of two 4-hour workshops delivered approximately a month apart; during the time between workshops, participants will try out what they have learned in their classrooms.

Seventeen initiatives delivered multiple workshops, 12 delivered single workshops, 4 delivered mentoring/coaching, and 3 delivered study circles. Four initiatives delivered online courses, and 2 delivered Web sites or CD-ROMs. As noted above, many initiatives incorporate multiple delivery approaches, with one model serving as the primary form of professional development and other models serving as interim or follow-up activities.

Duration of initiatives varied from 4 hours for a single workshop (e.g., CALPRO’s algebra training-of-trainers workshop) to several days for multiple workshops, institutes, and online courses. Initiatives implementing multiple workshops or institutes also varied in the commitment they required from participants. TIAN, for example, provided three 2-day institutes over the course of a year and required participants to commit to the entire series. Making Math Real, although it offered multiple sessions, did not require such a commitment. In Making Math Real’s case, duration varied by individual participant.

It is important to note that a few models prominent among K–12 mathematics professional development were noticeably absent from the initiatives in the EScan. One model involves a partnership between university faculty and a school district or region. In such a model, school districts draw on the expertise of mathematicians and mathematics educators to support teacher development. The McREL study (2005) advocates another model in which instructors participate in a summer training institute and then work with onsite coaches during the school year to encourage teacher reflection and facilitate instructional change. A variation of this model is currently being examined by AIR through a study funded by the Institute for Educational Sciences. Models promoted by NRC’s Mathematics Learning Study Committee include a blend of workshops and job-embedded “sharing groups” and a model that mimics the Japanese lesson

study approach (National Research Council, 2001). Each of these models may hold promise within the adult education context; however, each requires a more sustained commitment by participants and by local program administrators to support the professional development.

## **Interim and Follow-Up Activities**

Several initiatives provided interim activities between multiple workshop sessions or online courses. Very few initiatives offered any follow-up activities once funding ended.

### ***Interim Activities***

Interim activities are provided to reinforce what participants have learned and to foster the application and transfer of content and instructional strategies to the participants' own learning environments. Often, participants are required to apply new instructional strategies between sessions and report on their activities at subsequent sessions, between sessions, or both.

Thirteen of the initiatives in the study did not provide interim activities, and seven initiatives offered some type of interim activity for all participants between the workshops or distance learning sessions. Of the seven, only three—Making Math Real, EFF Math, and TIAN—provided more formalized experiences. EFF Math provided an online course that could be used as both an interim professional development opportunity and a stand-alone professional development activity. Making Math Real and TIAN provided “reunions” and sub regional meetings, respectively, that offered opportunities for information sharing and discussion of classroom investigations.

The Making Math Real reunions, however, could not always count on all attendees to participate, partly because of the reluctance of local program directors to provide release time for staff who had already participated in an adult numeracy professional development event. The sub regional meetings offered by TIAN enabled participants to meet within a smaller geographical area or to participate via conference call. Four initiatives used some form of distance communication (e.g., online or via telephone) to provide more informal interim support, which did not involve release time and allowed for flexibility.

Only EFF Math modeled in an actual classroom how to implement adult numeracy instruction. This occurred as part of the EFF Math initiative in New Jersey.

Exhibit III–2 provides an overview of the types of interim and/or follow-up activities that initiatives delivered. It was unusual for any initiative to provide more than one interim activity.

### Exhibit III–2. Interim and Follow-Up Activities

Initiative	Interim Activity				Follow-Up Activity
	Workshop/Meeting	Demonstration/Modeling	Discussion/Communication	Online Course	Workshop/Meeting
<b>State-Level Initiatives</b>					
OR Ocean Sciences and Math Project			•		
PA: Making Math Real	•				•
VA: Making Math Meaningful					•
VA Numeracy Project			•		•
<b>National Initiatives</b>					
EFF Math		•	•	•	
PDK			•		
TIAN	•				

#### *Follow-Up Activities*

Follow-up activities serve the same purpose as interim activities but occur far less frequently. Seventeen initiatives did not offer follow-up activities, either because their funding had ended or because they did not develop additional professional development for returning participants.

Three initiatives offered an additional face-to-face workshop or meeting after the professional development was delivered. During institutes for new participants, Making Math Real offered parallel institutes for returning participants. Making Math Meaningful offered a workshop at a conference for participants who previously had attended a Making Math Meaningful workshop. The Virginia Numeracy Project trainers, on a fee-for-service basis and by program directors’ requests, delivered workshops to instructors and offered the option of follow-up study circles with the same groups of instructors.

The trainer of the Arkansas Adult Numeracy Campaign offered a 1-day follow-up workshop to a group of participants and also observed instructors upon request. Because they were delivered on an ad hoc basis to a small group of instructors, we did not consider these to be follow-up activities.

#### *Selection of Trainers and Facilitators*

Initiatives varied in their approaches to selecting or identifying individuals to provide with adult numeracy professional development. They used external consultants, internal staff, or staff trained by the initiative. Some initiatives used a combination of the three.

- **External consultants (8).** Several state and national initiatives relied on external consultants to provide professional development. One rationale for bringing in

experts is that they are confident in their skills and knowledge of math and can help reduce participants’ mathematics anxiety.

- **Internal staff (18).** Most initiatives used their own staff (e.g., MEG) or drew on expertise within the state.
- **Staff trained by initiative (7).** Some initiatives built capacity in the state by training staff, either as formal train-the-trainer programs (e.g., CALPRO’s algebra training-of-trainers workshop, the Massachusetts SABES ABE Math Initiative, the Virginia Numeracy Project, TIAN) or informally through coaching (e.g., Making Math Real, EFF Math).

Exhibit III–3 provides an overview of the types of trainers used within each initiative. Several initiatives used multiple types of trainers.

### Exhibit III–3. Selection of Trainers

Initiative	External Consultants	Internal Staff	Staff Trained by Initiative
<b>State-Level Initiatives</b>			
AR ALRC Numeracy Project		•	
AR ANC		•	
CA: CALPRO’s Algebra TOT and Instructor Workshops		•	•
IL ALRC Math	•	•	
ME: Annenberg		•	
ME CALL Math	•	•	
MA SABES ABE Math		•	•
NY: MEG		•	
OR Ocean Sciences and Math Project		•	
OR & WA: Visual Math		•	
PA: Making Math Real	•		•
VA: GED as Project		•	
VA: Making Math Meaningful		•	
VA Numeracy Project	•		•
EFF Math	•	•	•
EMPower Curriculum		•	
EMPower Workshops		•	•
GED Math Institute	•	•	
PDK	•	•	
TIAN	•	•	•
<b>Total</b>	<b>8</b>	<b>18</b>	<b>7</b>

## **Implementing Agencies**

Much of the professional development offered in adult education is provided through state professional development systems that are generally supported through federal leadership funds<sup>7</sup> and additional state funds (Tolbert, 2001). Some systems are organized into regional resource centers, which may provide the same content-specific workshops in all regions of the state. Centers also may customize training for practitioners within their regions, but this is much less common. For example, some resource center staff may provide onsite professional development that is targeted to the needs of the program and staff. In such cases there is likely to be “coherence” between programs’ plans for continuous improvement and the professional development offered.

Some agencies provide nationwide professional development. These agencies, often research institutions, may provide fee-for-service programs, in which case the content may be adapted to the needs of the state or program. Such agencies also may provide professional development that stems from research and development projects.

The 20 initiatives reviewed were implemented by several types of agencies and fall into five categories: research organizations, state or regional resource centers, adult education/literacy providers, local foundations, and institutions of higher education. Exhibit III–4 identifies the different types of agencies that implement each initiative.

- **Research organizations (9)** conduct research, development, training, technical assistance, and/or evaluation. Several of these organizations implement multiple initiatives. For example, the EFF Center for Training and Technical Assistance at the University of Tennessee’s Center for Literacy Studies serves as the implementing agency for both EFF Math and TIAN, and TERC serves as the implementing agency for TIAN and the two EMPower initiatives. Five national initiatives that are implemented by research organizations contract with states.
- **State or regional resource centers (8)**, supported by state leadership funds, provide professional development and technical assistance to adult education programs in their states. Eight initiatives are implemented by resource centers, and all of the initiatives serve states or regions. Several regional resource centers offer a variety of adult numeracy professional development activities or initiatives.
- **Adult education/literacy providers (3)** offer a wide range of classes to adult learners in the local community. For example, MEG originally was implemented by an adult education literacy provider, but it is currently not implemented by any specific agency or literacy provider.

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<sup>7</sup> The Adult Education and Family Literacy Act (AEFLA) of the Workforce Investment Act (WIA) of 1998 allows states to spend a maximum of 12.5% of their federal adult education grants on professional development activities and other state leadership activities.



- **Local foundations (1)** provide grants and technical support to local programs within the state. One initiative, GED as Project, was implemented by the Virginia Literacy Foundation, in partnership with several other organizations.
- **Institutions of higher education (1)** refer to departments at colleges or universities. Only the Oregon Ocean Sciences and Math Collaborative Project was implemented by a university.

### Exhibit III–4. Implementing Agencies

Initiative	Research Organization	Resource Center	Adult Education /Literacy Provider	Local Foundation	Institution of Higher Education
<b>State-Level Initiatives</b>					
AR ALRC Numeracy Project		•			
AR ANC		•			
CA: CALPRO's Algebra TOT and Instructor Workshops		•			
IL ALRC Math		•			
ME: Annenberg			•		
ME CALL Math		•			
MA SABES ABE Math		•			
NY: MEG			•		
OR Ocean Sciences and Math Project	•				•
OR & WA: Visual Math	•				
PA: Making Math Real			•		
VA: GED as Project	•			•	
VA: Making Math Meaningful		•			
VA Numeracy Project		•			
<b>National Initiatives</b>					
EFF Math	•				
EMPower Curriculum	•				
EMPower Workshops	•				
GED Math Institute	•				
PDK	•				
TIAN	•				
<b>Total</b>	<b>9</b>	<b>8</b>	<b>3</b>	<b>1</b>	<b>1</b>

A single agency implemented 15 initiatives. Five initiatives were implemented through consortium organizations/agency partnerships:

- GED as Project was implemented by Virginia's Workforce Improvement Network and the Virginia Literacy Foundation.
- The National Center on Adult Learning and SRI International implemented PDK.
- TERC and the EFF Center for Training and Technical Assistance implemented TIAN.
- A literacy provider that partnered with a consultant implemented Making Math Real.
- To implement the Oregon Ocean Sciences and Math Collaborative Project, the Oregon Department of Community Colleges and Workforce Development partnered with the Hatfield Marine Science Center, the Oregon Sea Grant, and the Oregon State University College of Oceanic and Atmospheric Sciences.

## **Funding Sources**

The EScan found that adult numeracy professional development initiatives are funded through four primary sources: foundation grants and local, state, and federal allocations. Two initiatives were provided as fee-for-service, with delivery and content adapted to meet the needs of the state or program contracting the initiative's services, although these initiatives had received initial development funds from federal sources. One initiative, Visual Math in Oregon, required participants to pay registration fees. Several initiatives had one funding stream, while others had multiple funding sources. Exhibit III-5 provides an overview of the various funding sources for each initiative.

- **Foundation grants (3).** The Arkansas ALRC Numeracy Project and the Arkansas Adult Numeracy Campaign were both funded through a grant from the Rockefeller Foundation, and Visual Math received partial funding from the Murdock Charitable Trust.
- **Local funding sources (5).** Two initiatives received either full or partial funding for their professional development activities through local sources: MEG<sup>8</sup> (New York Community Development Agency, New York City Board of Education, Begin Employment Gain Independence Now (BEGIN), a social service arm of the New York City Human Resources Administration); and the Oregon Ocean Sciences and Math Collaborative Project (Oregon College of Ocean Sciences, Oregon Sea Grant). Annenberg's Learning Math Series, implemented by the adult education division of the Portland, Maine, public school system, was funded by local and state taxes. The Illinois ALRC was funded partially by the Illinois Community College Board.
- **State funding sources (12).** State resources, many coming from literacy resource centers, either fully or partially funded nine initiatives: Arkansas Adult Numeracy

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<sup>8</sup> MEG is no longer funded.

Campaign, CALPRO’s algebra training-of-trainers workshop and instructor workshops, Illinois ALRC, Annenberg’s Learning Math Series, the Massachusetts SABES ABE Math Initiative, Making Math Real, GED as Project, Making Math Meaningful, and the Virginia Numeracy Project.

- **Federal funding sources (7).** Federal sources either fully or partially supported seven initiatives: EFF Math (NIFL), GED Training Institute (OVAE), PDK (OVAE), Visual Math<sup>9</sup> (NSF and U.S. Department of Energy), EMPower Curriculum (NSF), and TIAN (NSF).<sup>10</sup>
- **Fee-for-service (3).** Two initiatives, EFF Math and EMPower Professional Development Workshops, were supported through fee-for-service contracts. Visual Math contracted with programs or school districts to deliver professional development.

### Exhibit III–5. Funding Sources

	Foundation	Local	State	Federal	Fee-for-Service
<b>State-Level Initiatives</b>					
AR ALRC Numeracy Project	•		•		
AR ANC	•		•		
CA: CALPRO's Algebra TOT and Instructor Workshops			•		
IL ALRC Math		•	•		
ME: Annenberg		•	•		
ME CALL Math			•		
MA SABES ABE Math			•		
NY: MEG		•		•	
OR Ocean Sciences and Math Project		•	•		
OR & WA: Visual Math	•			•	•
PA: Making Math Real			•		
VA: GED as Project			•		
VA: Making Math Meaningful			•		
VA Numeracy Project			•		

<sup>9</sup> Visual Math also was funded through NSF for curriculum and instructor development, but additional funds for implementation in middle school programs on reservations came through the U.S. Department of Energy.

<sup>10</sup> TIAN and EMPower Curriculum were funded by NSF as research and development and research and product development projects, respectively.

**Exhibit III–5. Funding Sources (Continued)**

	Foundation	Local	State	Federal	Fee-for-Service
<b>National Initiatives</b>					
EFF Math				•	•
EMPower Curriculum				•	
EMPower Workshops					•
GED Math Institute				•	
PDK				•	
TIAN				•	
<b>Total</b>	<b>3</b>	<b>4</b>	<b>12</b>	<b>7</b>	<b>3</b>

**Professional Development Participants: Characteristics, Recruitment, Selection, and Incentives**

The EScan revealed that participants in the adult numeracy professional development initiatives came from a wide variety of teaching and mathematics backgrounds. Participants came from ABE, ASE, GED, ESL, family literacy, and correctional education programs. They possessed a variety of experiences teaching mathematics classes and a range of comfort levels with mathematics. Some participants felt confident in their mathematics skills, and other participants had anxiety about teaching mathematics.

Initiative developers used different strategies for informing potential candidates about the professional development offerings and for selecting participants. Initiatives also provided a range of incentives for participation, such as a stipend, free meals, and college or district credit. The sections below discuss participant characteristics, recruitment and selection processes, and incentives.

***Participant Characteristics***

Information about participant characteristics was gained through two sources: interviews with initiative directors, developers, and/or trainers and interviews with a small sample of participants. Adult numeracy professional development initiatives had two primary audiences: (a) individuals trained to lead future professional development activities, and (b) classroom instructors.

**Program Area**

Data gathered from interviews with directors, developers, and/or trainers revealed that 15 initiatives delivered professional development to instructors in ABE programs, 7 to instructors in family literacy programs, 6 to instructors in GED programs, 6 to instructors in ESL programs, and 4 initiatives delivered professional development to instructors in correctional education programs. Two initiatives each were reported to deliver professional development to

workplace education instructors and ASE instructors, and one initiative was reported to deliver professional development to high school teachers and adult education program support staff.

Data gathered from the 36 participant interviews revealed that half of the participants taught in more than one program area. Twenty participants taught in GED programs, 19 participants taught in ABE programs, and 4 participants taught in ESL programs. Three participants each taught in family literacy and correctional education programs. The backgrounds of 9 participants were unknown.

### Prior Experience and Training

Participants were asked to describe their prior experiences and training as mathematics instructors. Twenty-eight participants had taught mathematics, either in adult education, Grades K–12, or both, and/or were certified to teach mathematics. Of those 28, 18 had been teaching for 10 or more years, and 7 were highly involved in the field of adult numeracy; that is, they had participated in other numeracy initiatives, had contributed to the development of mathematics content standards, or had delivered professional development themselves. On the other end of the spectrum, 8 participants had little to no experience teaching or receiving professional development in mathematics.

Participant interview data also revealed that prior to attending the professional development initiative, instructors employed a variety of methods and materials, ranging from workbooks to manipulatives and instructor lectures to student inquiry.

### Exhibit III–6. Participants’ Prior Experience and Methods Employed

Number of Participants	Methods and Materials Prior to Training
14	Used traditional materials (e.g., worksheets and textbooks).
13	Maintained a student-directed classroom prior to attending the professional development—that is, instruction acknowledged the everyday mathematics knowledge that students already possessed, and students learned actively and engaged in hands-on activities.
8	Used materials such as manipulatives and realia.
7	Maintained an instructor-directed classroom prior to attending the professional development.
6	Did not offer information on methods and materials.

### Participant Recruitment

Initiatives reported using a variety of strategies to recruit participants, from distributing information at resource centers to making presentations at conferences. Strategies for disseminating information were not collected on four initiatives. Dissemination of information took place through the following sources:

- **Resource centers (10).** Half of the initiatives informed potential candidates by distributing information to state and regional resource centers. Regional resource centers implementing initiatives put advertisements on Web sites, newsletters, and e-mail discussion groups, among other places. The Arkansas ALRC Numeracy

Project, Arkansas Adult Numeracy Campaign, CALPRO's algebra training-of-trainers workshop and instructor workshops, the Illinois ALRC, Maine CALL, Massachusetts SABES ABE Math Initiative, Making Math Real, GED as Project, Making Math Meaningful, and the Virginia Numeracy Project all disseminated information through resource centers.

- **Programs/districts (3).** Three respondents reported that their initiatives notified programs or districts about the professional development opportunity. TIAN, for example, sent letters on TERC and state department of education letterhead to program directors. Annenberg's Learning Math Series and the Oregon Ocean Sciences and Math Collaborative Project also disseminated information through programs and districts.
- **Word of mouth or other means (3).** One initiative, MEG, reported relying on word of mouth at places such as workshops, but we can assume that notice of other initiatives spread by word of mouth. TIAN sent out recruitment letters and posted notices on e-mail lists. Staff of the EMPower Professional Development Workshops distributed postcards to all who were interested, and the publisher also disseminated postcards.
- **Conference presentations (2).** Two respondents noted that they presented at conferences to recruit participants. Making Math Real staff, for example, presented at conferences between institutes to recruit more participants and make sure that everyone was informed. PDK also distributed CD-ROMs at conferences to encourage program directors and instructors to use the materials.
- **State departments of education (1).** PDK sent CD-ROMs to all of the state directors of education.

### ***Participant Selection***

Participation in the initiatives was either open to anyone who signed up or managed, in that participants applied and were selected, were nominated to attend, or were selected in some other way. For some initiatives, the selection process varied according to the group, program, or state with which the initiative staff was working.

- **Open participation (9).** Initiatives with open participation invited anyone who signed up to attend as long as there was room. For CALPRO's algebra training-of-trainers workshop and instructor workshops and the Massachusetts SABES ABE Math Initiative, both of which train staff to deliver professional development, participation was open to the instructors who would receive the professional development, not to the individuals who would be trained to deliver it. Arkansas ALRC Numeracy Project, Arkansas Adult Numeracy Campaign, Maine CALL's professional development in numeracy, Annenberg's Learning Math Series, MEG, GED as Project, and Making Math Meaningful also use open participation.

- **Managed participation: Application (2).** Two initiatives required that participants submit applications to attend initiatives. Making Math Real required that participants describe a typical mathematics class, characteristics of a good mathematics instructor, and their reasons for applying, among other topics. Returning participants had to submit a lesson plan and write about how they had changed their practice since the previous institute and whether they had seen any changes in their students. The Oregon Ocean Sciences and Math Collaborative Project also required applications.
- **Managed participation: Nomination (3).** For CALPRO's algebra training-of-trainers workshop, the GED Mathematics Training Institute, and the Oregon Ocean Sciences and Math Collaborative Project, participants were nominated by staff members of the initiative, program, resource center, or state department of education. For the GED Mathematics Training Institute, the staff of each state's department of education nominated one content expert and one professional development expert to attend. For the Oregon Ocean Sciences and Math Collaborative Project, participants had to submit applications after being nominated.
- **Managed participation: Unknown (2).** Interviews with respondents from the Massachusetts SABES ABE Math Initiative and the Virginia Numeracy Project, both train-the-trainer initiatives, used a selection process for soliciting trainers, but it was unclear whether trainers had to apply before they were selected.
- **Combination of open and managed participation (8).** Selection for participation in Visual Math, Virginia Numeracy Project, EFF Math, EMPOWER Curriculum, EMPOWER Professional Development Workshops, PDK, and TIAN varied according to the group, program, or state with which the initiative staff contracted. The selection process also varied for the Illinois ALRC. The mathematics consultant of the Illinois ALRC delivered professional development workshops that were non-exclusive, but she also selected instructors to participate in other activities, such as the pilot test of a mathematics software program or a position on the state mathematics standards development committee.

### ***Participant Incentives***

Participants were offered a variety of incentives to participate in professional development activities. Many respondents discussed intrinsic incentives, such as the chance for an instructor to improve his or her practice and meet other adult numeracy instructors. All initiatives offered some extrinsic incentives, such as stipends, release time, materials, and reimbursement for mileage, meals, and lodging. Incentives for six initiatives varied, as they were determined by the state or program to which the initiative staffs were contracted.

Respondents from eight initiatives mentioned that the initiatives offered college or district credit, continuing education units (CEUs), participation points, or certification hours: the Arkansas Adult Numeracy Campaign, CALPRO's algebra instructor workshops, the Illinois ALRC, Annenberg's Learning Math Series, the Maine CALL, Visual Math, Making Math Real, and TIAN.

Ten initiatives offered materials to participants that they could take home. Eight initiatives offered stipends to participants for attending. Seven initiatives offered reimbursement to participants to cover their travel costs and mileage. Three initiatives, MEG, Making Math Real, and EFF Math, offered release time or substitute instructors to encourage participants to attend. Exhibit III–7 identifies the types of incentives provided to participants.<sup>11</sup>

**Exhibit III–7. Participant Incentives**

	Materials	Stipends	Credit/ CEUs	Travel/ Mileage	Determined by State/ Program	Meals	Lodging	Release Time	Tuition Reimbursement	Unknown
<b>State-Level Initiatives</b>										
AR ALRC Numeracy Project	•			•		•	•			
AR ANC	•		•	•		•	•		•	
CA: CALPRO's Algebra TOT and Instructor Workshops			•	•		•	•			
IL ALRC Math			•							
ME: Annenberg		•	•							
ME CALL Math			•							
MA SABES ABE Math		•								
NY: MEG*		•						•		
OR Ocean Sciences and Math Project	•	•		•		•	•			
OR & WA: Visual Math	•	•	•		•					
PA: Making Math Real	•		•	•			•	•		
VA: GED as Project					•					
VA: Making Math Meaningful	•			•		•				
VA Numeracy Project					•					

<sup>11</sup> For some initiatives, incentives were different for instructors and for trainers, that is, individuals who were trained to deliver the professional development to others.



**Exhibit III–7. Participant Incentives (Continued)**

	Materials	Stipends	Credit/ CEUs	Travel/ Mileage	Determined by State/ Program	Meals	Lodging	Release Time	Tuition Reimbursement	Unknown
<b>National Initiatives</b>										
EFF Math		•		•	•			•		
EMPower Curriculum	•	•								
EMPower Workshops	•									
GED Math Institute	•				•					
PDK										•
TIAN	•	•	•		•					
<b>Total</b>	<b>10</b>	<b>8</b>	<b>8</b>	<b>7</b>	<b>6</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>1</b>	<b>1</b>

\* MEG no longer provides stipends to teachers.

**Instructional Content and Materials**

Knowledge of mathematical concepts and skills is critical to teaching numeracy to adult learners. Research studies such as the Eisenhower study (previously cited), as well as the NRC’s Mathematics Learning Study Committee, emphasized the importance of content knowledge in the subject area, with the NRC focusing on the need for teachers to possess a deep understanding of core mathematical concepts and the ways their students’ understanding matures (National Research Council, 2001). Although some instructors in adult education have a strong background in mathematics, many others come from a literacy background and lack knowledge of the content areas that are fundamental to adult numeracy development (Gal, 2002).

Exhibit III–8 lists several strategies and factors used to determine instructional content. In the case of initiatives that utilize external training consultants, the content was generally customized by the consultants to suit participants or programmatic needs. Annenberg’s Learning Math Series, for example, modified K–8 materials, and thus content, to suit program needs. Similarly, needs assessments were conducted as per requests from different stakeholders prior to providing training (and in some cases during the training) to determine how to customize content and other training features to client and participant needs or to determine which content was useful. Not all initiatives, however, conducted needs assessments. Needs often were identified by the state or implementing agency based on an overall assessment, or on skills and knowledge needed for the new GED, but needs assessments did not always focus often on the specific needs of individual participants.

**Exhibit III–8. Strategies for Determining Content**

Initiative	Strategies
<b>State-Level Initiatives</b>	
AR ALRC Numeracy Project	Developed through focus groups with instructors, administrators, and adult students.
CA: CALPRO's Algebra TOT and Instructor Workshops	Algebra Task Force of administrators and instructors reviewed California adult education mathematics content standards and developed six core mathematics concepts that students can build on to learn algebra. Content was also informed by a needs assessment, by the requirements of the GED, and by the new requirements of the California High School Exit Examination (CAHSEE).
IL ALRC Math	Program directors request consultations or customized professional development for mathematics topics; otherwise, national initiatives or local needs determine content.
PA: Making Math Real	Needs assessment prior to institutes to all programs in states for Year 1 and to former participants for Years 2–4. Also does a mathematics scavenger hunt as informal needs assessment.
VA: GED as Project	Content determined by new GED test.
<b>National Initiatives</b>	
EFF Math	Based on needs of individual states that contract services.
EMPower Curriculum	Focus groups of adult education and K–12 instructors examined how to best integrate the NCTM standards within the curriculum. Also conducted needs assessments with contracting agencies to help them adapt to agencies' own needs.
EMPower Workshops	Based on client needs.
GED Math Institute	Developed as a result of identified skill deficits of those who did not pass the GED mathematics exam.
PDK	National needs assessment plus focus groups and pilot test.
TIAN	Needs assessment done at site of training. Content based on emphases of GED test.

Several initiatives built their content on the NCTM, EFF or state content standards, or content from the GED tests; from sources adjunct to content standards or mathematics curricula, namely modified extant curricula (i.e., Annenberg’s Learning Math Series); on research-based mathematics curricula or initiatives (e.g., the Arkansas Adult Numeracy Campaign and EMPower Curriculum); and from contained materials such as binders and toolkits. The Oregon Ocean Sciences and Math Collaborative Project was unique in its integration of mathematics with ocean sciences, which served as the underlying basis for the mathematics content.

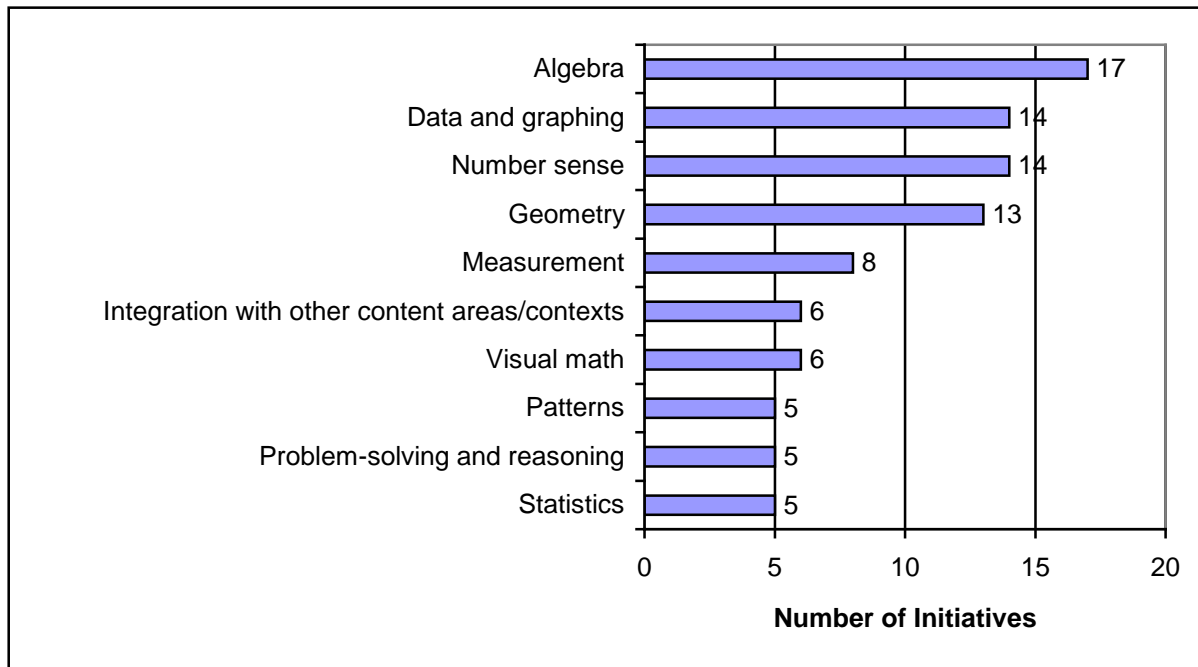
Directors, developers, and trainers identified the following content:

- Algebra
- Analysis of student work
- College/career preparation
- Data and graphing
- Financial literacy
- Geometry
- Integration of mathematics with other content areas/contexts
- Learning disabilities

- Multilevel strategies
- Measurement
- Number sense
- Patterns
- Probability
- Problem-solving and reasoning
- Study skills
- Statistics
- Trigonometry
- Visual math

Of all the content identified by trainers/directors, a few topics were more frequently mentioned. Exhibit III–9 illustrates how common some of the content was among the initiatives.

**Exhibit III–9. Frequency of Content\***



\* Content areas utilized by four or more initiatives are included in this exhibit.

Seventeen directors, developers, and/or trainers identified algebra (which includes algebraic patterns variables, expressions, and sequences) as content used in their respective initiatives. Fourteen directors, developers, and/or trainers identified data and graphing, which includes collecting, analyzing, displaying, and graphing data and developing graphic literacy. Fourteen directors, developers, and/or trainers also identified number sense, which includes integers, ratio, proportion, percentages, fractions, decimals, factors, and prime numbers. Other content (financial literacy, learning disabilities, study skills, and trigonometry) was mentioned once by directors, developers, and/or trainers. See Appendix D, Excerpt of Pattern Codes, for a complete breakdown.

**Materials for Instruction**

Instructional materials used among the initiatives fall into three general types: electronic materials, print materials, and manipulatives. The electronic materials include GED and function calculators, Web sites, audio, compact discs, digital videos, and video clips; print materials include books and book series, facilitator guides, lesson plans, journals, curricula, student action plans, modified K–12 materials, and supplements. Most of the materials were chosen by administrators and/or trainers and were based on projected instructor needs. The data revealed that, overall, instructors had very little input in the development or design of the materials. Exhibit III–10 shows these materials.

**Exhibit III–10. Materials for Instruction**

Electronic Materials	Print Materials	Manipulatives
<ul style="list-style-type: none"> <li>• Audio clips</li> <li>• Compact discs</li> <li>• Function calculators</li> <li>• Graphing calculators</li> <li>• Video clips</li> <li>• Web sites</li> </ul>	<ul style="list-style-type: none"> <li>• Books for instructors and students</li> <li>• Classroom adaptable materials</li> <li>• Critical needs materials</li> <li>• Curricula/curricula frameworks</li> <li>• Facilitator’s guides</li> <li>• Lesson plans</li> <li>• Materials drawn from multiple sources</li> <li>• Modified extant materials</li> <li>• Modified K–12 materials</li> <li>• Instructor-designed materials</li> <li>• Top-down developed materials</li> </ul>	<ul style="list-style-type: none"> <li>• Manipulatives</li> </ul>

In terms of their specific purposes, most of the materials can be described as being audience-specific, authentic, content-focused, technology customized, group work-specific, social variables sensitive, hands-on, and promoting of informal sharing, instructional differentiation, mathematics in context, and modeling. In particular, the content-focused materials also promoted group work, instructional modeling (by trainer), and mathematics in context. Others were flexible enough to enable learner modeling, informal sharing, group work, and hands-on activities. All strategies and materials in the training were intended for classroom use.

**Instructional Strategies**

Instructional strategies are tactics or methods instructors use to achieve specific learning objectives. Adult numeracy instructors have much more than numeracy to consider when determining the instructional strategies best suited for adult numeracy students. Instructional strategies that support the teaching of numeracy knowledge have been instrumental in adult numeracy practice, with numeracy trainers and organizations advocating approaches that promote mathematical problem-solving, collaboration and cooperative learning, discovery learning, critical thinking, and instructional differentiation for diverse learners.

The initiatives utilized multiple instructional strategies that reflect different theories of learning, but no initiative director identified a specific learning theory as key to the initiative's practice. Nonetheless, knowledge of adult learning theories helped the researchers identify the relationship between certain instructional practices and prevailing learning theories. Although the instructional strategies incorporated certain assumptions about adult learning, trainers did not specify particular prevailing assumptions; instead, they talked generally about what they believed adult mathematics learners needed to know, including which instructional strategies would best facilitate their learning.

Initiative directors, developers, and/or trainers indicated that they used the following strategies to train adult numeracy instructors.

- Active problem-based learning
- Classroom demonstration
- Critical thinking
- Current situations and real-world problems
- Direct instruction
- Discussion of pedagogy and research
- Examination of student work
- Facilitative workshops
- Group exercise and dialogue
- Hands-on learning
- Journaling
- Mentoring/coaching
- Modeling
- Multiple solutions
- Ocean science experiences
- Open-ended explorations
- Project-based learning
- Questioning strategies
- Real-life contextual learning
- Student problem-solving
- Instructor inquiry and reflection
- Use of manipulatives
- Videos of classroom actions and of real-world situations
- Visual thinking
- Workshops on authentic materials

Of these strategies, trainers focused mostly on the following six strategies, some of which were used more prevalently than others and most of which promoted active learning as is described in the Eisenhower study:

1. **Use of student work to enhance instructor practice (2).** The use of student work is a teaching strategy utilized by the Massachusetts SABES ABE Math Initiative and TIAN for instructors to gain an understanding of what students know and to build on students' strengths. The Massachusetts SABES ABE Math Initiative training team receives training in the analysis of student work.
2. **Use of real-world situations (11).** Eleven initiatives (Illinois ALRC's professional development in numeracy, Annenberg's Learning Math Series, Maine CALL's professional development in numeracy, MEG, the Oregon Ocean Sciences and Math Collaborative Project, Making Math Real, EFF Math, EMPower Curriculum, EMPower Professional Development Workshops, PDK, and TIAN) utilized instructional strategies that encouraged the use of real-world situations, built on the theory that adults learn experientially. These strategies looked at how adults use mathematics in their everyday lives and move away from situations in which the

- learners have failed. They involved the use of materials such as books, videotapes, and other authentic materials and focused on contemporary world issues such as Hurricane Katrina.
3. **Instructor reflection (10).** Ten initiatives indicated that they used instructor reflection as an instructional strategy, where instructors talk about what and how they are doing to become familiar with different mathematics strategies that can be transferred to their own classrooms. Instructors from MEG reflected on how they solved problems, and Making Math Real instructors reflected on different ways to solve problems; Arkansas Adult Numeracy Campaign instructors used reflection and discussion after mathematics activities and used reflective journals to provide insight into the teaching and learning of concepts. The Illinois ALRC's professional development in numeracy built instructor reflection into all workshops; Annenberg's Learning Math Series prompted online participants to reflect on learning; EFF Math's online course has discussion boards on which instructors shared their experiences; and GED as Project promoted sharing and thinking by encouraging instructors to talk through mathematics problems. The use of *application* seems to be somehow related to this type of strategy. In Arkansas Adult Numeracy Campaign, MEG, the Oregon Ocean Sciences and Math Collaborative Project, PDK, and TIAN, instructors tried out new learning in classes and reflected on their practice.
  4. **Inquiry-based learning (4).** Several initiatives—Arkansas Adult Numeracy Campaign, GED as Project, Virginia Numeracy Project, and TIAN—explicitly identified using contextualized inquiry-based strategies, which are all based on constructivist approaches to learning, though it is likely that many more initiatives have incorporated them. This is a move away from direct instruction, where instructors are considered the arbiter of all mathematics knowledge. Also, GED as Project conducted a 3-day conference on how to use inquiry process and to show instructors how to facilitate discovery learning. The aim of the conference was to help instructors structure learning activities around students' strengths.
  5. **Interactive hands-on (20).** This strategy involves learning by doing. All of the initiatives used this strategy, and CALPRO is currently revising its instructor workshop to include more hands-on/group work and less demonstration. Hands-on activities promoted through the use of manipulatives were very popular among the initiatives. Nine of the 20 initiatives used manipulatives to promote hands-on learning.
  6. **Community of learners (20).** All of the initiatives used different techniques to promote a sense of community among mathematics instructors. Making Math Real built communities within the institute sessions; Illinois ALRC's professional development in numeracy promoted networking at workshops; MEG sometimes involved co teaching; Arkansas Adult Numeracy Campaign and PDK utilized cooperative learning; the Oregon Ocean Sciences and Math Collaborative Project used techniques involving project-based learning, and mentoring/coaching; Annenberg's Learning Math Series used group work; EFF Math's online course encouraged interaction among participants through bulletin boards; CALPRO

encouraged instructors to join networking groups at the professional development centers as follow-up to workshops, and Maine CALL's professional development in numeracy had plans for a future networking component.

### ***Strategies to Reduce Mathematics Anxiety***

Although many of the trainers mentioned that they customized their learning to accommodate the needs of all learners in general, there was no detailed discussion about customization for the specific need of learners who have mathematics anxiety. Instead, the initiatives relied on the use of content experts who were comfortable with mathematics and adult-oriented materials to help reduce anxiety among participants. For example, TIAN used a long-term mathematics instructor trainer and, like the Massachusetts SABES ABE Math Initiative, encouraged the notion that there are multiple ways of solving problems.

The GED Mathematics Training Institute used independent consultants with expertise in both adult education and mathematics, while MEG utilized mathematics leaders with a high interest in mathematics, even if they lacked a strong mathematics background. Content in CALPRO's algebra training-of-trainers workshop and instructor workshops embedded strategies to overcome mathematics anxiety, and Making Math Real and GED as Project promoted group work and sharing to reduce anxiety. In addition, Maine CALL's professional development in numeracy conducted workshops on instructional ideas for college transition instructors, some of which included general strategies for reducing mathematics anxiety.

### ***Strategies for ESL Students***

The findings revealed that the trainers promoted no strategies specifically for instructors of ESL students. Some initiatives and consultants conducted needs assessments to determine instructor need, but no trainer or participant discussed any strategies or techniques that were designed specifically to help ESL students. Of participants interviewed, none claimed to have learned strategies for ESL students, and none discussed having ESL students. Trainer interviews revealed that, for the most part, participation in the training was voluntary. No information was gathered about whether outreach was made to ABE-ESL instructors or whether ABE-ESL instructors chose not to volunteer for the training.

### **Assessment Strategies**

Evaluation of the professional development process has two key purposes—continuous program improvement and accountability. As such, assessment methods are designed to gather (a) data for refining and adjusting professional development activities to ensure that services can be improved on an ongoing basis and/or (b) information on changes in instructional practices as a result of the professional development.

All initiatives, with the exception of MEG, conducted some type of evaluation; and two initiatives, the Arkansas ALRC Numeracy Project and the Arkansas Adult Numeracy Campaign, used an external evaluator. Participant surveys administered at the end of a professional development event were the most common means of collecting data. Of the 20 initiatives, only the PDK respondent commented on conducting a formative assessment of the initiative; nine

assessed changes among instructors (Arkansas Adult Numeracy Campaign, Massachusetts SABES ABE Math Initiative, the Oregon Ocean Sciences and Math Collaborative Project, Making Math Real, GED as Project, Virginia Numeracy Project, EFF Math, EMPower Curriculum, and TIAN). Strategies used to assess change in instructional behaviors included participant interviews with initiative staff, participant interviews with local administrators, observations, delayed surveys, review of student data, and applications. Much of the data were self-reported, and formal reports of findings were generally unavailable, thus making it difficult to gain an understanding of instructor change.

- **Participant surveys (18).** The purpose of such surveys was generally to gather information on how participants viewed the professional development—how useful it was, what they learned, and how they felt about mathematics after participation—rather than to assess changes in participants’ instructional practices. Some initiatives administered variations on the post-training survey. Two initiatives, the Arkansas Adult Numeracy Campaign and Virginia Numeracy Project, administered Web-based surveys. Two initiatives—EFF Math and TIAN—administered pre- and post-training surveys. Additionally, TIAN administered pre- and post-training pedagogical and content knowledge tests, and the Illinois ALRC administered pre- and post-workshop self-evaluations of skills and knowledge for workshops longer than 3 hours. The Virginia Numeracy Project delayed the administration of the survey until instructors had an opportunity to apply the new learning. This delay provided some information on how instructors were using the new learning.
- **Participant interviews (5).** Several initiatives administered interviews to document and assess changes in participants’ instructional practices. These included the Massachusetts SABES ABE Math Initiative, EMPower Curriculum, and TIAN. Making Math Real requested that local program administrators conduct interviews with practitioners who had participated in the initiative and then provide the feedback to the initiative developers. Unfortunately, response rates were very low.
- **Student data (5).** Only five initiatives attempted to gather data from students on either instructor or student change. The Arkansas Adult Numeracy Campaign used an external evaluator to conduct focused interviews of 35 adult students from seven different schools across the state whose instructors had participated in the professional development. All students responded that they had noticed some changes in the way instructors conducted classes, particularly in the use of materials other than textbooks, and all indicated that their grades were either better or had remained at an advanced level (if they were already high at the beginning). EMPower Curriculum used student questionnaires to evaluate implementation in the classroom and also looked at student achievement data. In the Oregon Ocean Sciences and Math Collaborative Project, students provided feedback on instructors’ instructional practices. TIAN plans on collecting student work and looking at students’ achievement on the Test of Adult Basic Education (TABE).

The EFF initiative in Oklahoma collected student data over a 2-year period that focused on attendance and grade-level gains in classrooms with instructors trained in EFF versus classrooms with instructors not trained in EFF. Although this was not a



controlled study, Oklahoma found a 4% increase in the number of students in EFF classes who completed a learning level and a 4% decrease in non-EFF classes; the 4% increase was accomplished in fewer contact hours than the non-EFF classes, which had a 12% increase in contact hours. Also, 38% fewer students dropped out of EFF classes before they had completed a learning level, and EFF classes reported a 25% increase in the number of students who were staying long enough to be appropriately post-tested, compared to an 8% increase in students in non-EFF classes.

- **Monitoring of informal sharing (3).** Some methods, used by Annenberg’s Learning Math Series, Making Math Real, and TIAN, were very informal and involved groups of participants sharing strategies implemented in classrooms between workshops or institutes.
- **Observations (2).** Two initiatives—TIAN and the EMPOWER Curriculum—gathered information about instructor change via observations. TIAN’s efforts were the most extensive, with pre- and post- observations of 10 participants in the two field-test sites and observations scheduled for three participants in each of the four pilot sites. The EMPOWER Curriculum had research associates visit classrooms to collect data.
- **Applications (1).** Only one initiative, Making Math Real, required returning participants to complete an application that included a lesson plan to demonstrate how they have implemented what they learned.

Exhibit III–11 provides an overview of the strategies implemented to assess professional development. Some initiatives used several approaches.

**Exhibit III–11. Evaluation Strategies**

Initiative	Participant Surveys	Participant Interviews	Student Data	Monitoring of Informal Sharing	Observations	Applications
<b>State-Level Initiatives</b>						
AR ALRC Numeracy Project	•					
AR ANC	•		•			
CA: CALPRO’s Algebra TOT and Instructor Workshops	•					
IL ALRC Math	•					
ME: Annenberg	•			•		
ME CALL Math	•					
MA SABES ABE Math	•	•				
NY: MEG						
OR Ocean Sciences and Math Project	•		•			
OR & WA: Visual Math	•					

PA: Making Math Real	•	•		•		•
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**Exhibit III–11. Evaluation Strategies (Continued)**

Initiative	Participant Surveys	Participant Interviews	Student Data	Monitoring of Informal Sharing	Observations	Applications
<b>State-Level Initiatives</b>						
VA: GED as Project	•	•				
VA: Making Math Meaningful	•					
VA Numeracy Project	•					
<b>National Initiatives</b>						
EFF Math	•		•			
EMPower Curriculum		•	•		•	
EMPower Workshops	•					
GED Math Institute	•					
PDK	•					
TIAN	•	•	•	•	•	
<b>Total</b>	<b>18</b>	<b>5</b>	<b>5</b>	<b>3</b>	<b>2</b>	<b>1</b>

For most initiatives, assessment of instructional change was not integrated within the professional development process. Some of the initiatives that were funded partially as research projects, such as the Arkansas ALRC Numeracy Project, the Arkansas Adult Numeracy Campaign, EMPower Curriculum, and TIAN, embedded evaluations into their professional development processes. Without assessments of change, it was difficult to determine whether the initiatives met the goals that were set for the professional development. It is important to note that several of the initiative directors, developers, and trainers reflected on their own initiatives and indicated that assessment of instructional change was an area in which improvement was needed.

**Initiative Strengths and Areas for Improvement**

To gain an understanding of the initiative from the perspective of initiative directors, developers, and trainers, researchers asked them to identify particular strengths and areas for improvement. Several identified strengths reflected findings from the Eisenhower study on characteristics of quality professional development—duration, collective participation, coherence, content knowledge, and active learning. Areas for improvement included the need for conducting impact assessments, providing follow-up activities, and improving communication.

***Strengths Identified by Initiative Directors, Developers, and Trainers***

Although respondents varied in their discussion of initiative strengths, eight areas emerged. These are discussed below.

- **Ongoing nature of the professional development (3).** Respondents from three initiatives—the Illinois ALRC, Making Math Real, and TIAN—indicated the

importance of ongoing professional development. Making Math Real and TIAN offered multiple institutes over a period of years and months, respectively, with interim meetings of participants, while the Illinois ALRC offered a variety of ongoing professional development activities each year. The ongoing nature of the professional development allowed participants to build a knowledge base over time and to apply new learning in a classroom setting. In the case of the Illinois ALRC, the structure allowed participants to absorb new knowledge and then return for additional professional development when they were ready.

- **Community building and creating a collegial environment (6).** In adult education, unlike K–12, collective participation (from a single program, school, or district) in professional development is difficult. Nevertheless, respondents from five initiatives noted their efforts at creating a collegial environment as a key strength. Networking and information sharing were a part of the interim activities provided by Making Math Real and TIAN; and CALPRO and the Illinois ALRC fostered it through regional professional development centers. Community building was a major part of Making Math Real, which introduced each institute with a “Scavenger Hunt” activity to build team spirit and to provide a comfortable way to learn mathematics and validate what participants already knew. A key element of MEG, which implemented a study circle, focused on collaborating on tasks and sharing information.
- **Content (5).** Several respondents indicated that the content was relevant to participant needs and focused on mathematics standards and the GED. The EFF Math and TIAN initiatives focused on both subject matter and pedagogy so that the goal was not just teaching mathematics but also deepening instructors’ knowledge of mathematics. Other respondents commented on the relevance of the mathematics content. GED as Project and the GED Mathematics Training Institute contents were related to the GED test items, while the Arkansas Adult Numeracy Campaign content was based on the NCTM mathematics standards and met participant needs.
- **Materials (7).** Content was supported by the use of a variety of instructional materials that went beyond traditional workbooks and pencil and paper. Several respondents highlighted provision of extensive binders with materials, including manipulatives that participants could use when returning to their own teaching environments (e.g., the Arkansas ALRC Numeracy Project, Arkansas Adult Numeracy Campaign, Making Math Real, and GED Mathematics Training Institute). The GED Mathematics Training Institute also saved all materials on a CD-ROM so participants would be able to replicate the training in their home states. EFF Math respondents discussed the mathematics curriculum frameworks to help design learning and the use of the EFF teaching and learning cycle and performance continuum for planning the delivery of mathematics instruction. Annenberg’s Learning Math Series utilized free Web site materials based on the NCTM standards, and EMPOWER developed a new research-based mathematics curriculum.
- **Instructional and learning strategies (5).** Several respondents specifically focused on the instructional and learning strategies provided. These strategies represented a

constructivist approach and included modeling, hands-on activities, and problem-solving. Both MEG and Visual Math used modeling, and the MEG respondent indicated that helping participants adapt instructional approaches to their own environment was a key strength of the initiative. GED as Project used an inquiry approach, and EFF Math provided mathematics training through a participatory, interactive way, based on adult learning theory, which helped to demystify the teaching of mathematics and reduce mathematics anxiety. Making Math Real provided team building and collaborative activities.

- **Facilitator models (8).** Respondents commented on the use of both an expert consultant model and on training leaders within their own states. Several initiatives used an expert consultant model in which they relied primarily on the services of outside consultants to deliver the training. Respondents from five initiatives—the Illinois ALRC, Making Math Real, Making Math Meaningful, GED Mathematics Training Institute, and TIAN—commented that the use of expert trainers who bring a good understanding of methodology, concepts, and adult learning was key to the quality of the training. The Illinois ALRC brought in external experts for some of its professional activities, while Making Math Real, Making Math Meaningful, and the GED Mathematics Training Institute relied primarily on external consultants. Other initiatives—CALPRO’s algebra training-of-trainers workshop, the Massachusetts SABES ABE Math Initiative, and the Virginia Numeracy Project—relied principally on training state staff to serve as the “leaders of professional development” and build state capacity to provide adult numeracy professional development to instructors.
- **State support (2).** Support by state staff was a key strength of the EFF Math and TIAN initiatives. EFF Math worked particularly well where the state adopted the EFF model and the professional development became part of a coherent state system. TIAN worked with states and professional development centers in supporting and implementing the initiative.
- **Technology (3).** Annenberg’s Learning Math Series and PDK both had a strong technology component. The Annenberg Web site was a key support for learning. For PDK, technology was a way to connect people and to build trust among them as well as to provide opportunities to use videos of classroom instruction, house an online research library, and provide communication through group bulletin boards. In EFF Math, the availability and quality of an online course available between face-to-face professional development sessions provided additional opportunities for learning.
- **Structural design (5).** Additional strengths were cited less frequently and may be associated with the unique characteristics of the initiative. A few were structural, in either the way the professional development was designed or the way it was implemented. The structure of the PDK professional development was flexible. The model was designed to be self-sustaining and did not need to rely on PDK staff to deliver the content. Participants could use online resources, create their own materials, and do their own research, and the model could be used within a program

or state or as a tool for professional developers. Virginia Numeracy Project was also flexible and allowed for customized training.

Other respondents commented on the structure of the partnership. Oregon Ocean Sciences and Math Collaborative Project was a collaborative effort that involved four partners to support funding and delivery of the professional development and was viewed by the director as an excellent way of leveraging funds and meeting all partners' needs. Making Math Real also was a collaborative effort between the professional development consultant and the implementing agency. The GED Mathematics Training Institute was designed so that all states were invited to send two participants and so that states would only have to pay for one participant.

### ***Areas for Improvement Identified by Initiative Directors, Developers, and Trainers***

Several initiative respondents indicated that additional funding would help improve the implementation, assessment, and follow up of the professional development. Other areas for improvement fell into seven primary categories—better allocation of staff resources, better assessments of the impact of the professional development, better follow-up, increased time, increased communication to enhance buy-in, and better use of distance learning, and additional or enhanced content.

- **Allocation of staff resources (2).** Limited staff resources were cited by two respondents as making it more difficult to deliver all services. TIAN respondents raised the point that it would be best to have full-time staff allocated to the initiative to design the training and assessments and to allow for more post-training participant observations. The Massachusetts SABES ABE Math Initiative respondent noted that currently practitioner leaders have too many administrative responsibilities and there is a need to increase the focus on professional development.
- **Assessment of impact (3).** Limited resources were cited by three initiative respondents as hampering efforts to conduct an impact assessment. Visual Math and PDK respondents commented that additional resources were needed for development of assessments and to conduct an implementation study, and TIAN respondents (as noted above) stated the initiative would benefit from additional staff to conduct post-training observations.
- **Follow-up (4).** Respondents from the Illinois ALRC, EFF Math, EMPower Professional Development Workshops, and the GED Mathematics Training Institute indicated that initiatives need strategies for follow-up on the professional development.
- **Time constraints (2).** Respondents from CALPRO's algebra training-of-trainers workshop and instructor workshops and Oregon Ocean Sciences and Math Collaborative Project indicated that they needed more time for the workshop or institutes sessions. CALPRO's algebra training-of-trainers workshop and instructor workshops provided a wealth of content and left little time for more interactive

activities. As a result, CALPRO is redesigning the instructor workshop into a two-session workshop with an interim activity.

- **Communication (3).** Three respondents commented on the need to improve communication with program administrators or state staff to enhance buy-in for the initiative. Making Math Real and TIAN respondents indicated the importance of building relationships with local program directors so that they would better understand the value of the initiatives and to provide support when needed. A GED Mathematics Training Institute respondent would have liked the initiative to more systematically involve state staff in the implementation of the initiatives in individual states.
- **Distance learning (3).** Three respondents cited distance learning as a way to enhance the professional development. The CALPRO respondent mentioned that staff is considering building in time for workshop participants to explore Web sites at computer labs, The Maine CALL respondent thought it could expand its activities through distance learning, and the TIAN respondents indicated that they were thinking of ways to make better use of the Web site.
- **Content (2).** While most respondents did not mention content as an area for improvement, the Arkansas Adult Numeracy Campaign respondent indicated that she would have included more activities and extensions of activities that show the relationship between fractions, decimals, and percentages. Also, the Annenberg's Learning Math Series respondent indicated a need to modify K–12 materials for adults.

Some of the strengths and areas for improvement identified by respondents were also reflected in respondents' recommendations for sustaining a focus on adult numeracy professional development, as discussed below.

## **Recommendations for Sustaining Initiatives**

Among the 20 initiatives studied, 12 are currently providing adult numeracy professional development and 8 ended when funding was exhausted. MEG, PDK, and the literacy resource centers are included in the number of those currently providing professional development, but they present special cases. PDK is no longer funded but its use continues, though there is no mechanism in place for tracking use of the Web site or the materials. MEG also continues, with participants attending study group meetings on a voluntary basis. State literacy resource centers have either continued to offer a variety of adult numeracy professional development experiences or have continued to provide training on a specific professional development module.

Sustaining the adult numeracy professional development initiatives has been challenging for a variety of reasons, including limited resources, lack of commitment at the state and local program levels, and geographical distance for participation. One challenge, the lack of resources, is exacerbated by competing priorities for funding at the state level. Federal and state mandates for implementation of other initiatives make it difficult to sustain the focus on adult numeracy. A lack of full-time staff is another challenge. Respondents from the Massachusetts SABES ABE

Math Initiative and TIAN indicated that when staff members wear multiple hats, it is difficult for them to accomplish all of the initiative's goals and activities.

Interviews with initiative directors, developers, and trainers provided some insight into strategies for sustaining initiatives. Some respondents discussed actions that their initiatives take to sustain themselves; others reflected on general strategies for sustainability that any initiative should consider.

- **Publicize and expand the initiative (9).** Respondents from Annenberg's Learning Math Series, Maine CALL, the Massachusetts SABES ABE Math Initiative, Visual Math, Making Math Real, GED as Project, EMPower Curriculum, and EMPower Professional Development Workshops all discussed the importance of maintaining a level of awareness about the initiative, sharing materials with others, and promoting delivery in other states and programs. Additionally, the Virginia Numeracy Project is developing a training and follow-up project that integrates the state's new content standards.
- **Promote networking and peer mentoring (6).** Respondents noted the importance of networking groups for fostering sustainability, as they are a means for broadening instructors' opportunities to learn from one another. CALPRO's algebra training-of-trainers workshop and instructor workshops, Maine CALL's professional development in numeracy, the Massachusetts SABES ABE Math Initiative, MEG, Oregon Ocean Sciences and Math Collaborative Project, and TIAN have all set up ways for participants to mentor, coach, and network with one another and further develop their mathematics content and pedagogical knowledge. The Maine CALL respondent indicated that Maine is starting a chapter of the Adult Numeracy Network to sustain a focus on adult numeracy professional development.
- **Use a train-the-trainer model (6).** Respondents from the Massachusetts SABES ABE Math Initiative, MEG, Oregon Ocean Sciences and Math Collaborative Project, Making Math Real, EFF Math, and TIAN noted that training participants to expand the training could build capacity beyond the initiative and thus make the initiative more self-sustaining. The initiatives listed have all provided formal or informal training or mentoring to selected participants to support them as they deliver further adult numeracy professional development.
- **Gain commitment from state-level staff (6).** Respondents from the Arkansas ALRC Numeracy Project, Illinois ALRC, Making Math Real, EFF Math, the GED Mathematics Training Institute, and TIAN discussed the importance of gaining commitment from the state and maintaining open lines of communication with the state director and staff. EFF Math, implemented in Oklahoma, exemplifies a strategy for sustainability. The state staff attends every training event, is involved in onsite visits, and has worked with the national trainers from the beginning of the initiative. In addition, the state thought systematically about the big picture from the beginning and wrote goals and objectives for adult learners, instructors, program directors, and state staff, which have guided them throughout.



- **Gain commitment from local program administrators (5).** Commitment and buy-in from local program administrators is essential for providing release time for instructors to attend the professional development as well as for spearheading adult numeracy professional development activities. Respondents from the Arkansas ALRC Numeracy Project, MEG, Making Math Real, EFF Math, and TIAN discussed the importance of maintaining open lines of communication with local program directors and helping them understand the value of the initiatives.
- **Incorporate distance learning (5).** Respondents from Maine CALL, MEG, GED as Project, EMPOWER Curriculum, and PDK commented that implementing distance learning was a way to set up interactive activities for instructors, encourage instructors to communicate with one another, and continue the focus on mathematics. GED as Project and PDK have materials available online for use by individual instructors or by programs. In discussing areas for improvement of their initiatives, several respondents indicated the need to focus more on distance learning. Such learning bridges any geographical divide.
- **Consider the geographical area (2).** MEG respondents noted that it is important to be located in a central geographical area that is a reasonable distance from participants. The MEG model is workable because the professional development is provided within a densely populated area (New York City) and it is easy for participants to attend. This point was also suggested by Making Math Real respondents. In this model, the location of the institutes within the state had some impact on who was able to participate.
- **Promote continuous program improvement (2).** Based on feedback from workshop participants that opportunities for interaction were not sufficient, CALPRO is redesigning its instructor workshop into a two-session workshop that also will incorporate interim activities. EFF Math, as implemented in Oklahoma, listens to what participants say about the professional development and makes changes accordingly. An orientation to EFF was added, as were changes to onsite visits.
- **Engage multiple funders (1).** The Oregon Ocean Sciences and Math Collaborative Project was a collaborative effort among scientists, mathematics and science educators, and adult educators and, according to the respondent, provided a good model for leveraging funds from different sources and meeting all funders' needs for professional development. This partnership helps to sustain the initiative.

**Exhibit IV-1. Elements of Quality Professional Development**

Initiative	Duration <sup>12</sup>	Collective Participation	Coherence <sup>2</sup>	Content Knowledge	Active Learning		
					Engage in Hands-on Activities	Review Student Work	Present Learning to Others
<b>State-Level Initiatives</b>							
AR ALRC Numeracy Project	One 2-day workshop per month for 2 months			•	•		
AR ANC	One 2-day workshop per month for 3 months or one 1-day workshop per month for 5 months			•	•		
CA: CALPRO's Algebra TOT and Instructor Workshops	One 1-day workshop <sup>13</sup> (trainers and instructors)		•	•	•		
IL ALRC Math	On average, one 1- or 2-day workshop			•	•		
ME: Annenberg	2.5 hours per online session for 10 sessions			•	•		
ME CALL Math	Ranges from one 1-day workshop to one 4-day workshop with 4- 6-week online course			•	•		
MA SABES ABE Math	Four 1-day workshops per year (trainers); ranges from one 1-day workshop to five 3-hour workshops over 7 months (instructors)	•		•	•	•	

<sup>12</sup> Duration denotes an extended span of time and involves extended contact hours. While all of the initiatives do not fit this description, we have listed all of them below to demonstrate the range of duration. Initiatives with the greatest contact hours are the Arkansas ANC, Annenberg's Learning Math Series, and TIAN.

<sup>13</sup> CALPRO's algebra workshop for instructors is being revised to consist of two 4-hour workshops delivered approximately a month apart.

NY: MEG	One 1-day study circle per month; occasionally, workshops and 4-week institutes	•	•	•	•			
OR Ocean Sciences and Math Project	One 3-day institute			•	•			
OR & WA: Visual Math	On average, one 3- 5-day workshop			•	•			
PA: Making Math Real	On average, one 3-day institute per year with one 1-day reunion per year		•	•	•		•	
VA: GED as Project	On average, one 2- 3-day institute		•	•	•			
VA: Making Math Meaningful	One 3- 6-hour workshop		•	•	•			
VA Numeracy Project	One 2-day workshop per year (trainers); ranges from one 4-hour workshop to one 2-hour study circle per month for 2-3 months (instructors)		•	•	•			
<b>National Initiatives</b>								
EFF Math	On average, three 2-day workshops over 4-9 months and one 2- 4-hour online session per week for four weeks		•	•	•			
EMPower Curriculum	•			•	•			
EMPower Workshops	One 1- to 2-day workshops			•	•			
GED Math Institute	One 2-day institute			•	•			
PDK	Varies. In Michigan, two 2-day workshops over 2-3 months	•		•	•			

TIAN	Three 2-day institutes per year and four 1-day subregional meetings per year		•	•	•	•	•
Total	-----	3	8	20	20	2	2

### C. Conclusion

The majority of examined initiatives provided adult numeracy professional development through multiple workshops or institutes, generally extending over a period of time, and often were supported by interim activities between workshop sessions. Few of the initiatives provided any follow-up activities. Many of the workshops were facilitated by adult education numeracy experts who were contracted by the implementing agencies. In a small number of initiatives, these experts provided professional development for individuals who would train others within the state, thus helping to build the capacity of the state to deliver adult numeracy professional development.

Funding sources for professional development varied, with state resources supporting more than half of the initiatives in whole or in part. With few exceptions, initiative funding supported the delivery of services, with few funds allocated for an assessment of the impact of those services. The exceptions tended to be those initiatives that were designed as research and development projects. Several of these research projects were funded primarily through federal dollars or foundation grants.

Professional development content tended to be aligned with either state or national mathematics standards or the content from the GED test. The instructional content used had a strong focus on algebraic concepts. Instructional strategies used in the professional development and encouraged for use in participants’ classrooms were based on a constructivist approach to learning. Strategies included inquiry-based learning, instructor reflection, hands-on learning, and the use of real-world situations. All initiatives attempted to build a sense of community among learners.

The following chapter provides an analysis of the findings in light of the research on quality professional development.

## IV. EVALUATION OF FINDINGS

### A. Introduction

To provide a framework for evaluating the findings examined in the EScan, this chapter begins with a brief overview of the research on professional development. Using the framework, we discuss the implications for replication of practices examined, including models of professional development, content, and instructional strategies. We also discuss findings related to the following research questions:

- How should instructional strategies and programs differ across adult learner populations?
- What practices exist in professional development and certification requirements for instructors of adult mathematics education that are worthy of replication?

The chapter closes with a discussion of professional development evaluation practices and reflects on different professional development models for sustaining adult numeracy initiatives.

### B. Research on the Characteristics of Quality Professional Development

To provide a framework for discussing findings from the adult numeracy professional development initiatives identified in the EScan, we examined the literature published by the major organizations that represent mathematics teachers in the United States—NCTM, AMATYC, and the Mathematical Association of America—as well as EFF and ANN, two other organizations that serve adult education mathematics instructors. We also examined documents published by the NRC, NCSALL, and the Association of Adult Literacy Professional Developers. The literature identified models for providing professional development and research that suggested effective methods for providing professional development on the teaching of adult numeracy.

For this EScan, three major research studies, which examined the results of professional development activities, provided us with guidance on characteristics of quality professional development:

- The Eisenhower study, a coordinated set of studies designed to evaluate the effectiveness of the federal government’s professional development program for elementary and secondary school teachers (Porter et al., 2004)
- *How Teachers Change: Study of Professional Development in Adult Education* (Smith et al., 2003)

- *McREL Insights: Professional Development Analysis* (Mid-continent Research for Education and Learning, 2005)

None of the studies was a perfect match for the needs of the EScan tasks, but each offered constructive information that advanced the researchers' ability to conceptualize the notion of *quality professional development*, define the expression *worthy of replication*, and classify program types.

The Eisenhower study (Porter et al., 2004) identified five key features of quality professional development:

- **Duration**—is sustained over time (including the total number of contact hours and the span over which the activity takes place)
- **Collective participation**—emphasizes collective participation of groups of teachers from the same school, department, or grade level
- **Coherence**—forms part of a coherent program for teacher learning and development (e.g., consistent with teachers' goals and aligned with state and district standards and assessments)
- **Content knowledge**—focuses on both content in the subject area and how students learn that content
- **Active learning**—gives teachers opportunities for hands-on work and includes opportunities for teachers to observe expert teachers, link ideas learned in professional development to the teaching context, examine and review student work, and make presentations, lead, and write

As the first large-scale empirical comparison of the effects of different characteristics of professional development on teachers' learning, the Eisenhower study found that to improve professional development, focusing on duration, collective participation, coherence, content, and active learning is more important than focusing on the type of professional development (e.g., mentoring/coaching, teacher networks, individual research project, traditional workshop or conference). The type of delivery has an effect on teacher outcomes only insofar as the activities reflect the key features (Garet et al., 2001). In general, the Eisenhower study showed that effective professional development involves the proper alignment of various program components, including management, funding sources, standards and assessments, and collective participation.

The How Teachers Change Study (Smith et al., 2003) examined how adult education teachers changed after participating in three models of professional development: (a) a multi-session workshop (experiential, active learning activities), (b) a mentor teacher group (study circles, peer coaching, and observation), and (c) a practitioner research group (teachers investigate their classroom practice and collect and analyze data). Findings suggested that most teachers changed, at least minimally, through knowledge and action gains. Factors that led to change were hours of professional development attended, quality of professional development,

and collaborative participation. As in the Eisenhower study, the professional development model was not a factor. Contextual factors that affected change were teacher access to benefits and preparation time, the program’s history in addressing learner persistence, and teacher access to decision-making.

The McREL study (2005) sought to understand the influence of standards-based curriculum, instructional guidelines, and assessment on teacher instruction and student achievement through a synthesis of research about the influence of standards on K–12 teaching and student learning. The findings revealed, “standards-based professional development can have a positive effect on classroom practice, particularly in terms of reform-oriented practices. It can also have a positive effect on student achievement” (McREL, 2005, p. 5) although the research in this regard was mixed. This study, including the corpus of research that it examined, helped in appraising the value of the instructional practices identified in the EScan.

## C. Discussion and Evaluation of Findings

Using the Eisenhower framework, we turn now to an evaluation of the findings from our review of the 20 adult numeracy professional development initiatives. This evaluation looks at the studies in light of what the research identifies as important to the establishment of effective professional development that has the potential to result in improved instructional practice.

### Duration

*Duration* is defined as professional development that is sustained over time and includes the total number of contact hours and the span over which the activity takes place. The McREL study asserts that legitimate change in teacher behavior takes a considerable amount of time. The baseline was 80 professional development hours over a year, with 160 hours needed for “substantive change.”

The time span of professional development in the studied adult numeracy initiatives ranged from 4 hours to several days spread over several years. Although some initiatives spanned several months or years, actual participant contact hours varied by individual. Often the same participants did not enroll for the full span of training. For example, MEG has conducted study circles over several years with practitioners meeting on a monthly basis. However, there was no guarantee that any particular individual attended more than one 2-hour meeting or had contact with the other members outside of the monthly meetings. This was characteristic of almost all initiatives in the EScan, with the exception of the Arkansas Adult Numeracy Campaign, Annenberg’s Learning Math Series, and TIAN.

The majority of initiatives in the EScan conformed to the workshop or institute model—a traditional approach to delivering professional development. Although this model fits well within the context of the adult education delivery system, given the part-time nature and high turnover among instructional staff and the general lack of paid professional development release time and planning time, the model is generally short term. This is exacerbated by the fact that state agencies often provide full or partial funding for the initiatives. Shorter-term workshops are often all that adult education programs can handle, with their competing priorities for professional

development funds and general lack of resources for instructor training. Program schedules, multiple program locations, the nature of the teaching staff, and the willingness of local administrators to support such initiatives often preclude the use of more intensive models.

The limited contact hours for the adult numeracy professional development initiatives studied has implications for “deepening” participants’ knowledge of mathematics and of how students learn—core areas of concentration of professional development identified by the Eisenhower study and the NRC’s Mathematics Learning Study Committee. It may be difficult for instructors, particularly those who have limited mathematics backgrounds and/or mathematics anxiety, to transfer new learning into their classrooms when both contact hours and follow-up are limited.

Little time was available for instructors to collaborate in planning and analyzing their own instructional practices or to participate in professional development activities and reflect on their practices after participation. In fact, nearly one third of the participants recommended that the professional development be of longer duration. See Appendix E for more findings from the participant interviews.

One difficulty in conducting the study was gathering accurate information about participant contact hours in the adult numeracy professional development initiatives. Records of participation were limited, especially for initiatives that had been ongoing for several years or had ended and for which resources were no longer available. This has implications for making any informed future evaluation about instructor change, as it is related to duration when there is limited information about who was enrolled, when, where, and for how long.

## **Collective Nature of Professional Development**

The collective participation of groups of teachers from the same school, department, or grade level was another key feature of quality professional development identified through the Eisenhower study. Given the nature of the delivery system, and because professional development is not easily embedded in adult education, collective participation of instructors is much more difficult in adult education than in Grades K–12. Initiatives in the EScan tended to draw from broad geographical areas. For example, CALPRO’s algebra instructor workshops were offered through regional professional development centers, Making Math Real was offered to instructors across the state, and the GED Mathematics Training Institute brought in mathematics instructors and professional development staff from each state. Participants in all the initiatives came from a variety of programs.

Although several of the professional development initiatives focused on team and community building during the delivery of professional development, once the initiatives ended, the diversity of programs and widespread geographic areas made it difficult to sustain learning communities. Some programs tried to continue network building, generally via distance communication, after the initiatives ended, but no data exists to confirm the extent of these networks.

Geographical proximity is a factor that may contribute to sustaining individual participation in adult numeracy professional development activities and developing a community



of learners. Providing professional development within a small geographical area may help promote collegiality. However, this may have implications for recruitment and selection of participants and for decisions about types of adult numeracy professional development activities funded. Two initiatives—MEG and the Massachusetts SABES ABE Math Initiative—are promising models for promoting collegiality within smaller geographical areas. In fact, one of the MEG participants cited as a strength its small scale and the fact that the study circles are conducted within a densely populated urban area, thus reducing travel time for participants. The Massachusetts SABES ABE Math Initiative also is developing small cadres of practitioner-leaders within the state’s regions to work with instructors in those regions.

If geographical distances cannot be bridged, then another option is to consider more fully the use of online communities. PDK used a CD-ROM with video clips and a Web site as vehicles for professional development. This model provides practitioners with flexibility and “just in time” training—they could refer to the video clips and resources when they needed them and as often as needed to prepare for their own classrooms. Through the use of the Web site’s bulletin boards, such a model appears to have potential for long duration and collective participation. Without an implementation study, however, it was difficult to discern how frequently PDK was used by practitioners, how feasible it would be to implement within the states, and how effective it was in promoting instructor change.

Although other initiatives used the Internet in some form, it did not appear to be used to its full potential for collective participation. This is of particular concern because adult mathematics educators often work in isolation or attend face-to-face workshops with individuals who are geographically dispersed. Assuming the cyclic model of workshop, lesson study, and reflection, electronic communication coupled with scanned or Web-based materials provides opportunities to link individuals across states, regions, or the country in sustained efforts to improve mathematics instruction for adults.

## **Coherence**

The level of connection to either the individual instructor’s professional development goals or those of national, state, or local standards or assessments is another feature of quality professional development cited by the Eisenhower study. Although the current study did not focus on individual or local program goals for professional development, national and state initiatives are supporting standards-based education. OVAE has funded several initiatives to assist states in developing and implementing content standards. At least nine states have developed mathematics content standards, and others are in the process of developing or adapting mathematics content standards.<sup>14</sup>

The initiatives in the EScan offered several good examples of how to link the focus of the professional development to state goals. TIAN, for example, selected states to participate in the pilot and field tests based on whether they had developed or were developing mathematics standards and included training on how mathematics standards were related to standards in other disciplines. CALPRO’s algebra instructor workshops were designed to help adult learners pass

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<sup>14</sup> See the Adult Education Content Standards Warehouse Web site for states and other agencies that have authored mathematics content standards: <http://www.adultedcontentstandards.org>.

the California High School Exit Examination (CAHSEE) or the GED to earn an adult high school diploma. Making Math Real was designed around other key initiatives in the state (e.g., technology, family literacy, EFF) that were incorporated within the training, and EFF Math was part of the overall EFF professional development provided within states. The Virginia Numeracy Project, Making Math Meaningful, and GED as Project were integral parts of Virginia's GED Fast Track initiative.

The implementation of EFF Math in Oklahoma was an example of how initiatives could work with states to promote a coherent professional development program for instructors. State staff collaborated with EFF Center staff on all aspects of the training and developed goals and objectives for key stakeholders within the system. EFF Math is a fee-for-service model in which the professional development is adapted to the needs of the state.

## **Content Knowledge and Materials**

The Eisenhower study found that teacher content knowledge that focused on both the subject area content and how students learn that content is a key feature of quality professional development. Many of the EScan initiatives focused on these aspects. This section discusses how content was determined, how content was differentiated across learner populations, and how instructional materials supported content.

### ***Identification of Content***

Determination of which content to use was based on content standards and on needs identified by stakeholders—states, programs, students, and trainers. Several factors—including pre-tests prior to training, state mathematics content standards, skill deficit among students, and, in one case, findings from a dissertation study—contributed to the determination about which content was useful in the training. In most cases, the content was goal driven and in some cases was promoted through trainer-developed materials (i.e., Annenberg's Learning Math Series, EMPOWER Curriculum, Making Math Meaningful, TIAN).

The extent to which the initiatives conducted a needs assessment to ensure that the content and instructional and learning strategies met the needs of individual participants is unclear, which is curious because the initiatives provided professional development to a diverse group of participants whose knowledge of mathematics concepts and comfort levels with mathematics varied significantly (see chapter III). With many initiatives using an "open enrollment" strategy, developers had no advance knowledge of the specific needs and characteristics of the participants. Without any kind of nominating or application process, workshop directors, developers, and trainers had little knowledge of participants' strengths and areas for improvement. This has implications for differentiating instructional content and strategies to best address individual needs of participants and learners.

### ***Differentiation Across Learner Populations***

If the purpose of the professional development is to deepen mathematics content knowledge and approaches to teaching mathematics, it is important to know how to differentiate instruction to address the knowledge, abilities, and experiences of participants. More seasoned

mathematics instructors, for example, may require more in-depth discussions of content or may focus on more complex issues than those who are relatively new or more anxious about teaching mathematics. Those teaching ESL may have different needs depending on their culture, learning style, and language requirements.

Adult education programs comprise students from diverse linguistic, cultural, socioeconomic, and learning backgrounds. One goal of professional development in education is to ensure that educators acquire the knowledge and skills they need to support the learning needs of diverse students. Unfortunately, it was very difficult to answer the question of how instruction was differentiated, both for the participant in the professional development and also with regard to how that participant was to differentiate learning for his/her adult students. The EScan revealed that, for the most part, instruction was not differentiated in terms of attention to language or cognitive differences (mathematics anxiety, ESL, dyscalculia). In terms of learner populations in adult numeracy, issues surrounding ESL students were the very least discussed. Questions regarding strategies for diverse learner populations offered no information about how best to attend to the needs of ESL learners. Among the examined initiatives, no emphasis was placed on modifying extant content or strategies for ESL learners. Because of the diversity of adult learners, effective professional development needs to both use differentiated learning for the adult learners engaged in the professional development and also impart these skills so that instructors can differentiate among their learners when teaching mathematics.

With only 36 participant interviews conducted, researchers gained limited feedback from initiative participants regarding content. In many cases, instructors were given end-of-training evaluations, but those seemed to focus more on the quality of the training and not on acquired content knowledge or how content was taught to different populations. Initiative directors, developers, and trainers also offered few details during the interviews on how instruction and content were modified for students from diverse backgrounds. For some trainers, the content was flexible enough to allow for adjustment to suit unique program and student needs, although no initiative made modifications specifically for ESL learners.

These findings accentuate the need for more research in ABE-ESL numeracy that will inform effective practice and bolster practitioner interest in this severely neglected area. Such research is critical now that ESL students constitute almost 55% of all ABE students and will increase in importance if numbers continue to grow.

### ***Professional Development Instructional Materials***

Instructional materials vary from initiative to initiative and can be placed into three general categories—electronic materials, print materials, and manipulatives. Electronic materials include GED and function calculators, Web sites, audio, compact discs, digital videos, and video clips; print materials include books and book series, facilitator guides, lesson plans, journals, curricula, student action plans, modified K–12 materials, and supplements. These materials went beyond the traditional workbooks and pencil and paper. Most of the materials were chosen by administrators and/or trainers and were based on projected instructor needs. Two initiatives, Massachusetts SABES ABE Math Initiative and TIAN, included samples of students' work within the materials offered in the training, thus allowing participants to actually analyze the

level of student understanding of the mathematics concepts and procedures. The study revealed that instructors had very little input in the development, design, or use of the materials.

By and large, the materials complemented the training and were consistent with the initiative's goals, content, and instructional strategies. The materials were content-focused and, according to the trainers, promoted group work, instructional modeling, and mathematics in context. Some of them also allowed the flexibility to facilitate teacher modeling, informal sharing, group work, and hands-on activities.

Several initiatives provided extensive materials to workshop participants to help them plan and implement numeracy instruction in their own classroom settings. Based on interviews with participants, instructors seemed to value these materials as they moved away from the traditional workbooks and pencil and paper. Three participants indicated that the materials were a real strength, while other participants indicated that time, students, and other systemic issues affected their ability to use the materials they received in the training. One participant commented about the students' resistance to the use of manipulatives. Another participant, who teaches a GED class in Spanish, said that she appreciated the quality and amount of materials she received but had to spend a lot of time translating the materials. Unfortunately, the interview sample size was small and several of the initiatives ended long before the interviews. Thus, little information is available to determine how useful and effective these materials actually were for instructors. Initiatives need to collect data from instructors to verify whether instructors use the materials and what value, if any, they place on them.

## **Active Learning**

Findings from the Eisenhower study suggest that active learning of participants in professional development is effective in making change. The EScan found that the NCTM standards were instrumental to the content, materials, and strategies trainers used, and that most of the learning activities were based on constructivist principles of learning, which stress collaboration, group work, student centeredness, and discovery. The study did find that some of these learner-based instructional strategies associated with reform-based professional development are being integrated within the traditional workshop delivery approach. For example, many of the initiatives modeled instructional strategies, engaged in problem-solving activities, and promoted reflection—all of which are features of reform-based professional development. These strategies help instructors think about mathematics concepts and how students may learn them. They are designed to reduce mathematics anxiety among participants and to validate for instructors what they already know about mathematics. Also, they are designed to help instructors implement new practices in their own learning environments and provide instruction for diverse learners.

McREL's research on standards-based professional development raised the question, *What is the influence of standards-based professional development on teacher instruction and student achievement?* McREL posits that

Teachers tend to teach in the ways that they are taught . . . To teach in the ways envisioned by standards reformers, teachers need strong content knowledge and the ability to change their pedagogical repertoire as well as their underlying

beliefs and attitudes about it. To do this successfully, teachers need opportunities for deep learning of content, as well as opportunities to learn how to use reform-oriented strategies, practice those strategies in the classroom, and observe their effects on student learning. Therefore, standards-based professional development is the cornerstone of a successful standards-based system. (2005, pp. 2–3)

Reform-based professional development often becomes embedded within the practitioner's own programs and part of the practitioner's daily practice. This study did not find such reform-based professional development initiatives embedded in practice. Few observations of expert teachers in actual classroom settings were conducted. Mentoring/coaching and inquiry research were not regular features of programs. Collaborative problem solving took place in the context of the workshop sessions and institutes, and only a few initiatives provided support for participants to make presentations, another aspect of active learning.

Also, although many of the trainers pointed out that the strategies modeled in the training were for instructor use in the classroom, the responses we received from some instructors seem to suggest that the “realities” of their respective classes and programs preclude their ability to effectively utilize or implement the strategies they learned in the training. Within the context of the adult education delivery system, unlike the K–12 system, it may be difficult to incorporate reform models within instructors' daily lives.

## **C. Certification Practices**

One of the key questions posed is whether certification requirements for instructors of adult mathematics education exist that are worthy of replication. Certification is the requirement of some specific standard of knowledge, training, or education for entry into the field (Shanahan, Meehan, & Mogge, 1994). With only 10% of adult education instructors reporting that they were certified in mathematics (Gal, 2002), the field clearly lacks qualified mathematics instructors. The need for more qualified instructors is heightened with the move toward standards-based education. Certification, then, becomes a mechanism toward professionalizing the field and providing some standards of knowledge and skills for mathematics instructors.

Discussion of certification in the adult education literature is focused more broadly on certification requirements for teaching ABE, rather than on a specific content area. For example, Tolbert (2001) reported that 22 states require instructor certification<sup>15</sup> (p. 11). However, these certification requirements are for adult education instructors more generically. In a similar vein, the EScan found that eight initiatives provide some type of CEUs for participation in mathematics professional development. While these units may apply toward a state's certification or professional development requirements, they are not related to any particular knowledge and skills within a content area. To answer the question of what certification practices are worthy of replication, researchers would have to look at how states certify adult education instructors in general and then determine the feasibility and applicability of these

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<sup>15</sup> Included among the states with certification requirements that are represented in the EScan are: Arkansas, California, Ohio, Oklahoma, Tennessee, and Virginia. Massachusetts has developed licensing procedures for adult education instructors and will begin testing those seeking licenses in content areas, including mathematics.

processes for certification of mathematics instructors. This was beyond the purview of the current study. However, we identified no formal, systematic certification requirements for instructors of adult mathematics education, although some may take some mathematics courses to become certified.

## D. Evaluation and Sustainability

Evaluation of the professional development process is designed to gather data for refining and adjusting professional development activities to ensure that services can be improved on an ongoing basis and to gather information on changes in instructional practices and student learning as a result of the professional development. How to maintain and sustain professional development is a problem confronting all of education. Real change can only occur if mechanisms for providing professional development in adult numeracy continue once funding ends. To conclude this chapter, we examine the strategies used within the adult numeracy initiatives to evaluate whether they achieved their goals with instructors and affected instruction. We also look at models of sustainability that emerged from the study.

### Formative and Impact Evaluations of the Initiatives

To address such questions, such as *What are we doing? How are we doing? and How can we improve?*, formative evaluations may be conducted over the course of the professional development period. Data need to be collected and analyzed on an ongoing basis and used to refine and adjust professional development planning and implementation. PDK was the only initiative that conducted a formative assessment. Most often, adult numeracy professional development providers gained answers to the above questions through post-professional development surveys, typically administered at the end of an event. These surveys may also gather information on what was learned as a result of the professional development.

More challenging to assess is the impact of the professional development on instructors and students. Strategies suited to address such questions as *What levels of use and what degrees of transfer were achieved as a result of the professional development experience? and How long lasting are these changes?* include observations of practice, including videotaping; instructor portfolios (with samples of instructors' work); practitioner journals; and collaborative teams in which groups of instructors work to implement and evaluate their own practices (Kutner, Sherman, Tibbetts, & Condelli, 1997). They also may include surveys administered several months after the professional development experience in which participants are asked to discuss what they have implemented in the interim. "Although standardized, curriculum-based, and program- and teacher-developed tests are the most common method for evaluating students, tests may not be the most satisfactory method" (Kutner et al., p. 34). Alternative assessments of student performance, which may encompass observations and portfolios of student work, may be more appropriate, but these strategies also have drawbacks.

Evaluation of the impact of professional development was the weak link in almost all of the adult numeracy initiatives, with relatively few collecting data beyond self-reported participant data. Respondent interviews supported the fact that assessment was an area needing improvement. Impact evaluations were most systematic among initiatives funded, in part, as

research projects. Some of these studies gathered data to assess instructor change, and a small number gathered data to assess student change.

TIAN and EMPOWER Curriculum, funded by NSF, implemented multiple approaches to gather information about instructor change, including participant interviews and observations (TIAN conducted pre and post observations of 10 participants in the two field-test sites, and EMPOWER Curriculum had staff make visits to classrooms to collect data). EMPOWER Curriculum also administered student questionnaires, and TIAN is collecting samples of student work and achievement data on standardized tests.

The Arkansas Adult Numeracy Campaign, funded by the Rockefeller Foundation, relied on an external evaluator to conduct participant and student interviews related to instructor change. Oklahoma, which implements EFF Math, has collected student data over a 2-year period with a focus on student change related to attendance and grade-level gains.

Initiatives funded primarily through state agencies tended to focus on providing services, rather than collecting data. State professional development resources are spread across numerous activities, and thus, in an effort to collect data, initiative directors implement less demanding and time-consuming approaches. Some initiatives have attempted to gather information by requesting feedback from other adult education stakeholders. Administrators for the Oregon Ocean Sciences and Math Collaborative Project requested student feedback on instructional practices. Making Math Real requested local administrators to assess change through interviews with participants, but this proved unsatisfactory and responses were minimal. Limited feedback implies that local administrators may not appreciate the depth and value of the initiative or view it as a priority among their myriad responsibilities. Several of the initiative directors expressed this concern.

Initiatives also used several other approaches during interim activities to explore changes in instructor practice, such as informal sharing or requiring returning applicants to provide an example of how they have used what they have learned in their classrooms. These less structured approaches appear to be easier to implement but more difficult to gauge the level, depth, and duration of knowledge transfer that occurred as a result of the professional development.

## **Sustaining Professional Development**

The study identified two practices for providing numeracy professional development to adult education instructors that may have some implication for sustaining adult numeracy initiatives. These are the expert model and the train-the-trainer model. Another practice, university partnerships, was not among practices used by the initiatives but may have implications for developing instructor knowledge.

### ***Expert Model***

A common feature of the professional development offered by the studied initiatives was the use of expert consultants to facilitate workshop sessions. Of the 20 initiatives studied, eight relied on the services of outside consultants who were considered experts in mathematics and/or professional development. Using experts who have the appropriate knowledge base for their particular content area and have skills to share with others is an element of effective workshops

or presentations (Jones & Lowe, 1990; Loucks-Horsley et al., 1987). External experts incorporate the research to provide a rich infusion of ideas and insights and strategies within the professional development setting. A respondent from one initiative indicated that interacting with experts helped participants feel more comfortable with mathematics.

Expert facilitators designed and delivered the professional development and provided sessions that offered opportunities for modeling, practice, and reflection; several of these sessions provided strategies for improving instructor skills identified by the research of Joyce and Showers (1988). However, once the experts provided the training, there was little follow-up in the manner of mentoring and coaching—key components for transferring skills from the workshop to the instructors' own classroom environment (Joyce & Showers, 1988). Only five initiatives provided mentoring/coaching to all or a few participants while the initiative was still funded (Making Math Real, Oregon Ocean Sciences and Math Collaborative Project, EFF Math, PDK, and TIAN), with the goal of training others to lead future adult numeracy professional development workshops. Pilot training of TIAN in Massachusetts provided the groundwork for the Massachusetts SABES ABE Math Initiative. SABES regional professional development staff, some of whom had participated in the TIAN training, is extending the focus on mathematics throughout the regions by developing practitioner-leaders to train adult education instructors.

Ohio, the other TIAN pilot state, is, at the time of this report, considering next steps in adult numeracy professional development. EFF Math, as implemented in Oklahoma, is an example of a state's commitment to integrate the initiative within its overall professional development system. State staff worked with the expert trainers from the beginning of the initiative and participated in training events and onsite visits. The state has integrated EFF within their ongoing professional development system. The Illinois ALRC's professional development in adult numeracy also used the expert model and incorporated it within the variety of other mathematics professional development initiatives it has offered, so there was some continuity of learning, although the specific content of other activities may have been different.

The expert model does not generally promote sustainability of a professional development initiative. Unless the state makes a commitment for continuation, the professional development ends once the experts have completed the training. As state agencies often fund the adult numeracy professional development initiatives, they will need to consider the value of more long-term contributions beyond bringing in the experts. Many of the experts invited as facilitators were members of ANN, an organization of dedicated professionals with extensive numeracy backgrounds who have been in the forefront of promoting adult numeracy professional development and changes in the way numeracy is taught in adult education. Although these individuals are the experts in the field, the difficulty lies in relying on the same, relatively small group of individuals and in spreading them too thinly across many initiatives, without growing the next generation of adult numeracy experts within each state.

### ***Train-the-Trainer Model***

Several initiatives sought to build statewide capacity in numeracy through implementation of a train-the-trainer model, in which a selected group of participants were identified and trained to provide adult numeracy professional development throughout the state



or region. These models tended to be funded by state education agencies. This was the case with CALPRO’s algebra training-of-trainers workshop, the Massachusetts SABES ABE Math Initiative’s practitioner-leaders, and the Virginia Numeracy Project. To a smaller extent, other initiatives, such as Making Math Real, selected and mentored participants who had engaged in the initiative to become future trainers; however, this did not appear to be the key element of the initiative. The train-the-trainer model has potential to sustain professional development because it trains and encourages others to take a leadership role in promoting and providing training. It also requires state agencies to think about professional development in the long term, resulting in a continual building of the knowledge base. Finally, to ensure that these trainers are adequately prepared to provide professional development to others, it is imperative that they develop a deep knowledge of the discipline and instructional strategies.

### ***University Partnership Model***

One model not found among the studied initiatives was the university partnership model. University mathematicians or mathematics educators, entrusted with preparing instructor candidates to teach according to the most current thinking of the mathematics community, would seem to be a valuable source, or at least touchstone, for projects aimed at upgrading the conceptual and methodological knowledge of adult mathematics educators. Involvement with university partners opens the door to credit-bearing instruction that can serve as a personal or credentialing incentive. University faculty members possess the strong mathematics background that can help direct “discovering” learners toward valid conclusions. Although the university partnership model is another form of working with an “expert,” the model also has potential for enhanced duration. The credential incentive could foster increased engagement in numeracy learning.

Regardless of the professional development practice, sustainability is closely related to commitment from state and local program staff. States generally provide full or partial funding for the initiatives and must view adult numeracy professional development as a priority that is integrated within the overall professional development system. Similarly, local administrators need to understand the value of adult numeracy professional development to deepen instructors’ mathematical concepts and skills and support them beyond a one-time event. A coherent system in which adult numeracy professional development supports other state priorities, including content standards, may help to sustain these initiatives.

## **D. Conclusion**

Overall, the findings of this study imply that more significant research is needed to shed light on how instructors use the training they receive during adult numeracy professional development. At present, we know very little about changes in instructors’ attitudes about mathematics or about instructional practices. Similarly, we do not know how these initiatives affect adult students or how responsive students are to the new changes. In terms of professional development models, instructional strategies, content, and materials worthy of replication, no one initiative comprised all the elements of quality professional development. However, distinct aspects of all of the initiatives—based on the research literature—are worthy of replication. These are laid out in the following chapter.

## **CHAPTER V. RECOMMENDATIONS**

The EScan provided insight into how federal, state, and local agencies and private entities are preparing adult education instructors to teach numeracy to the adult learner population. The initiatives studied in the EScan had several characteristics in common but also demonstrated some unique features. The findings suggest that no single initiative is replicable itself but that each initiative comprises unique practices or features that are replicable (e.g., delivery models, instructional strategies, content, materials, assessment strategies). This chapter discusses initiative features that are considered worthy of replication based on research on quality professional development and the TWG-approved inclusion criteria. We first present recommendations of program features for designing professional development, then offer recommendations for sustaining such initiatives, and conclude with suggestions for future research, including a prototype for future rigorous investigation.

### **A. Program Features Worthy of Replication**

The goal of professional development is to enhance instructor knowledge, skills, and abilities to improve the quality of teaching for learners and ultimately to support adult learners in meeting their goals and improving learning outcomes. Unfortunately, lack of rigorous research (i.e., providing evidence to support change in instructional or student practice as a result of participation in the adult numeracy professional development initiatives studied) makes it impossible to identify any one initiative as worthy of replication. However, initiatives had individual features that would be worthy of replication. Identification of these features was guided by the research discussed in previous chapters. Particular attention is paid to how well initiative features reflect qualities of professional development, as cited in the Eisenhower study—specifically duration, collective participation, coherence, content knowledge and active learning. In addition, we consulted the initiative inclusion criteria, which were described in chapter II, to inform our decision about potentially replicable practices. We propose the following features for the design of future professional development initiatives.

#### **Provide Multiple-Session Activities Over an Extended Period of Time and With Extended Participant Contact Hours**

Consistent participation, over a period of time, is important to “deepening” knowledge of mathematical concepts. This idea is highlighted in the Eisenhower study and reported in the literature review (Condelli et al., 2006), which indicated that “adult numeracy teachers have relatively little time, limited compensation, and few resources to learn on their own. Many resources put limited emphasis on teacher training and development” (p. 57). Given this reality and given the importance of duration in quality professional development, initiatives that manage to provide longer duration are worthy of replication. Although several initiatives offered multiple sessions, contact hours varied by participant. Only three initiatives (Arkansas Adult Numeracy Campaign, Annenberg’s Learning Math Series, and TIAN) provided professional development over an extended period of time with longer contact hours for participants. These initiatives also had interim activities that supported learning and provided for increased contact hours through follow-up activities.

## Use the Internet and Distance Learning Components

As was identified in this study's literature review, the need for more distance learning in adult numeracy professional development is critical given the nature of the field. The literature review for the Adult Numeracy Initiative suggested that distance learning held some promise for adult numeracy professional development, indicating that "given the limited programmatic resources and time available to adult teachers, the use of technology and distance learning as a professional development mechanism may be a promising area to research" (Condelli et al., 2006, p. 65). Several initiatives provided access to the Internet, although they were not the primary means of delivering services. Four initiatives appeared to make extended use of the Internet and distance learning. Such practices may promote "just in time" learning, provide flexibility for teachers, extend learning opportunities, facilitate access to resources, and promote the development of a learning community that is not centered in a particular program, community, or geographical area. In addition, the growing research base about distance learning can help inform the conduct of an online course to enhance content and instructional knowledge of educators.

Examples of initiatives that provided more extensive professional development through the Internet are Annenberg's Learning Math Series, GED as Project, EFF Math's online course, and PDK. These initiatives also had a face-to-face component to support learning. PDK provided a CD-ROM with video clips for users to view and download teacher demonstrations that provided an opportunity to model instruction in a classroom setting. The initiative also included an online teacher resource in which instructors could read pertinent research, develop and store action plans, keep journals, and log their classroom research. Instructors could also discuss and view the work of others on online bulletin boards. EFF Math's online course could either supplement professional development delivered through workshops or serve as a stand-alone activity. Annenberg's Learning Math Series and GED as Project showed the same potential.

## Use Instructional Modeling and Demonstration

Many of the initiatives modeled instructional strategies during the course of the workshop or institute sessions. Modeling helps participants to understand how to implement practices. However, only two initiatives—EFF Math (New Jersey) and PDK—provided demonstrations within actual classroom settings. Such activities provide opportunities for discussion, focus on both mathematical content and instructional practices, and offer instructors real-life examples of how to provide scaffolding (Vygotsky, 1978) and how to apply instructional principles and concepts in their own classroom. Scaffolding allows students to master skills under the guidance of an expert. According to Wilson, Teslow, and Taylor (1993), a student's observation of the instructor modeling an activity is one of the four basic steps in the process of scaffolding. This, including other types of demonstrations, is very useful in promoting an instructor's growth and adding to an instructor's repertoire of teaching strategies and skills.

## Develop Learning Communities in Small Geographical Areas

Research in effective professional development for K–12 teachers suggests that *collective participation* is among several factors contributing to having an impact on teachers. The nature

of the adult education system often makes it difficult to foster collective participation within a program or district, and initiatives that have been able to accomplish this challenge have features that are worthy of replication. However, offering professional development within smaller, more densely populated areas may be a way of fostering collective participation in urban settings. Massachusetts SABES ABE Math Initiative and MEG appear to be good models. MEG study circles have been implemented for several years, and participants indicate that study circles work well because of their location in a densely populated urban area. Massachusetts SABES ABE Math Initiative practitioner-leaders are providing, within their region, professional development to instructors. This also brings the professional development closer to instructors' programs and may foster more collective participation. TIAN, through a statewide initiative, holds sub regional group meetings between workshops. These meetings, either face-to-face or through telephone conferences, bring individuals together and may promote community building. An initiative feature worthy of replication is the organization of professional development within smaller geographical areas to promote networking, collective participation, and community building.

## **Implement Standards-Based Professional Development**

Mathematics content standards have been one of the major factors in driving the content of the adult numeracy professional development initiatives and are a key feature of many initiatives. As noted in McREL (2005), standards-based professional development is the cornerstone of successful standards-based system. Gal and Schmitt (1994) showed that the vehicle by which states can implement these changes into practice is professional development that improves instructor knowledge and skills to teach the mathematical content and processes reflected in the standards. Other research on standards-based professional development shows that teachers who are not prepared to meet state standards are unable to help students achieve in numeracy (American Council on Education, 1999). Providing standards-based mathematics professional development offers coherent principles for teacher learning and development. As such, a critical practice that is worthy of replication is the provision of extended professional development that is focused on deepening instructors' knowledge of the mathematical concepts articulated in the standards and featured in initiatives, such as CALPRO's algebra training-of-trainers and instructor workshops, Arkansas ALRC Numeracy Project, Arkansas Adult Numeracy Campaign, Massachusetts SABES ABE Math Initiative, Annenberg's Learning Math Series, EFF Math, and TIAN.

## **Integrate With Other State Activities**

A quality professional development program involves more than focusing on content standards. A coherent professional development program reflects other initiatives that are occurring within the state. The EFF Math initiative in Oklahoma provides a good example of how to incorporate mathematics training within a state's adoption of the broader EFF Math framework. Similarly, professional development provided through GED as Project, Making Math Meaningful, and the Virginia Numeracy Project supports the GED Fast Track initiative in Virginia. Making Math Real also aligns professional development with such other state initiatives as EFF Math, technology, and workforce education. Aligning professional development with state initiatives provides a good model for replication, because it promotes systemic coherence. Quality professional development includes professional development that

forms part of a coherent program for teacher learning and development that is consistent with teachers' goals and aligned with state and district standards and assessments (Porter et al., 2004).

### **Use an Expert Model Coupled With the Train-the-Trainer Model**

The expert model coupled with the train-the-trainer model has potential for developing staff who can continue to provide professional development services. The important element is to ensure that these new trainers are well versed in the content and pedagogy before they assume roles as professional development providers. With relatively few “expert” mathematics consultants, the need for growing new experts is clear. Experts from at least three initiatives (Massachusetts SABES ABE Math Initiative, Making Math Real, and Virginia Numeracy Project) provided professional development for practitioners who will become professional development providers. (Note: For Massachusetts SABES ABE Math Initiative, only some of the practitioner leaders participated in the TIAN training.) Although these train-the-trainer initiatives are on a relatively small scale, it may be worthwhile to replicate this model in the future as long as sufficient time and support are provided to grow the next generation of experts. Such a model can help build state and national capacity to deliver adult numeracy professional development. The professional development provided by the experts to future trainers will need to move beyond workshop training and include mentoring/coaching, observations and feedback, and review of student work—all of which are essential to developing a deep understanding of mathematical concepts and instructional strategies.

### **Implement Active Learning**

Opportunities for active learning may include observing expert instructors and being observed, reviewing student work, giving presentations, and writing about and reflecting on one's classroom practice (Porter et al., 2004). Most of the initiatives provided one or more of these opportunities. Participants were engaged in problem solving and reflection and were focused on real-life situations. Two initiatives (Massachusetts SABES ABE Math Initiative and TIAN) provided opportunities for participants to review student work samples and reflect on students' strengths and areas for improvement. Three initiatives (Making Math Real, EFF Math, and TIAN) also mentored a very small number of participants, with the purpose of helping these participants facilitate future training events. These examples of active learning may be worthy of replication. Unfortunately, with limited assessment data, how effective these active learning strategies were in changing instructor practices is unknown.

### **Assess Instructor Change**

The goal of professional development is to deepen instructors' content and pedagogical knowledge, enhance the quality of instruction, and improve student learning. Professional development has its most immediate and direct impact on instructors because they are the recipients of the training (Kutner et al., 1997). For the most part, the initiatives focused on the delivery of services rather than the evaluation of those services, and little is known about changes in instructional behaviors or student outcomes. Such information is valuable for planning and prioritizing future professional development and for making the case for funding agencies to support further professional development. Several initiatives with a research

component did, however, include strategies for conducting impact assessments. The Arkansas Adult Numeracy Campaign, EMPOWER Curriculum, and TIAN fall into this category. Assessment strategies moved beyond self-reported data and included observations, student interviews, pre- and posttests, and student data. Resources were allocated for the purposes of evaluation, and in the case of the Arkansas Adult Numeracy Campaign, an external evaluator conducted the evaluation. Given the paucity of research regarding the impact of professional development initiatives in adult education, the assessment strategies used by these studies may be worthy of replication. EFF Math in Oklahoma is also collecting student data on attendance and grade level gains. Although many of these assessments lack rigor, they provide examples of how to integrate evaluation within the delivery of services.

## **Share Materials to Support Continued Learning**

Follow-up of professional development is designed to reinforce learning, provide opportunities for practice, and help transfer learning to new environments. Unfortunately, most initiatives lacked any systematic follow-up. However, several of the initiatives (e.g., Arkansas ALRC Numeracy Project, Arkansas Adult Numeracy Campaign, Making Math Real, GED Mathematics Training Institute, and TIAN [shared the EMPOWER Curriculum]) provided extensive resources and materials that supported the content of the professional development. Facilitators modeled the use of these materials during the professional development, thus enhancing their use once participants returned to their own learning environments. Sharing and modeling the use of resources with participants is a feature that appears to be worthy of replication.

## **B. Recommendations for Sustaining Professional Development Initiatives**

Based on the findings from a review of extant information, interviews, and the research literature, we provide some recommendations for sustaining, funding, and implementing future adult numeracy professional development initiatives. Several of the recommendations were derived from the discussion in chapter III on practices for sustainability and strengths and areas for improvement.

### **Maintain Good Recordkeeping Systems and Collect Data**

Gathering information about several of the professional development initiatives that had ended was difficult, especially regarding records of participation. Because a goal of professional development is to deepen the content knowledge of instructors, knowing how many individuals participated and for how long is important. The same is true for knowing the characteristics and backgrounds of participants to address their needs during the training. Furthermore, documenting success of the initiative helps to promote instructional change. Initiatives could collect the following types of data:

- Characteristics of participants, including mathematics backgrounds and experiences
- Number of hours of participation

- Content and number of hours of training, including interim and follow-up activities

## **Gain Support From State and Local Administrators**

Administrators and policymakers must recognize the value of providing quality adult numeracy professional development. Respondents from several of the initiatives commented on the lack of commitment on behalf of state and local administrative staff to support the initiative. If learner outcomes are to be improved, state-level staff must make a long-term commitment to support adult numeracy professional development. This involves incorporating a focus on numeracy into state professional development plans, integrating adult numeracy professional development with other state initiatives, and providing resources to support initiatives. Local-level program administrators must support instructors by (a) providing release time and stipends for full participation in the initiatives and (b) supporting instructional processes and strategies that are based on research. Local administrators must also recognize that professional development is more than a “one-shot” workshop and provide instructional leadership. As far as accountability, local staff must evaluate changes in instruction that result from participation in professional development.

Support can be gained in several ways:

- Publicizing the importance of numeracy instruction for professional development by publishing articles in state and regional program newsletters, meeting with state staff, sharing materials with state and local staff, and inviting them to participate in professional development activities
- Disseminating information about quality adult numeracy professional development practices that are based on the research literature
- Obtaining support for the initiative from community and business leaders and college and university staff who can help state and local program staff recognize the importance of the initiatives

## **Create a Community of Learners**

Sustaining a community of learners beyond the timeframe of the initiative will help participants further their content knowledge and skills and stay focused on adult numeracy professional development. Sustaining a community of learners also broadens opportunities for instructors to learn from each other and engages them in a variety of professional development activities, including problem-solving, inquiry research, product and process development, lesson planning, and information sharing. Activities to promote a community of learners may include:

- Setting up networking groups through regional professional development centers
- Providing an online community bulletin board for sharing resources and ideas
- Setting up study circles around specific numeracy topics

- Organizing numeracy presentations at state and local professional development conferences

## **Build Follow-Up Into the Initiatives**

The numeracy backgrounds and experiences of adult education instructors vary widely. Participants in professional development initiatives bring different levels of knowledge and comfort. The learning of new concepts will be more difficult to transfer to an instructor's own settings if the concepts are more complex and more foreign to the instructor's own experience. Instructors may be overwhelmed by the information and uncertain about how and when to implement certain practices or use certain materials. They also may find resistance among students to the new learning strategies and may not know how to respond. Instructors need to be supported when implementing new strategies in their learning environments. Consider the following strategies:

- Making follow-up an integral part of the initiative by setting aside resources for that purpose.
- Offering peer observation and coaching. According to Joyce and Showers (1988), peer observation and coaching appear to be critical to the transfer of new skills and knowledge to instructors' own teaching environments.
- Offering follow-up seminars or group sharing sessions after the professional development has ended.

## **Build an Evaluation Component Into the Initiatives**

A critical component of professional development is ongoing and systematic evaluation procedures that focus on changes in instructional practices that result from participation in the training. The majority of the initiatives conducted evaluations at the end of the professional development that measured how well participants liked the training and how useful it would be for them. Only one initiative (PDK) conducted a formative evaluation, and very few conducted an impact evaluation. Gaining buy-in from state and local policymakers and program directors to support the initiatives is difficult without impact data. Evaluation data should be collected on an ongoing basis in the planning, implementation, and review phases. Building an evaluation component into professional development requires:

- Allocating resources, including time, staff, and funding, to conduct the evaluation
- Gaining support of local administrators to participate in the evaluation
- Choosing a variety of evaluation strategies and understanding the strengths and issues associated with each strategy
- Disseminating results to stakeholders



- Using the findings to improve program practices and strengthen instructors' knowledge, skills, and concepts

A variety of evaluation strategies can be implemented:

- Gaining feedback from local administrators on how the professional development is translated into changed teaching practices
- Conducting pre- and post-observations of instructors' practices
- Having instructors develop and then review instructors' portfolios and practitioner journals to see changes over time
- Using collaborative teams in which instructors plan together how they will monitor implementation of new instructional strategies and how they will determine the effect of such strategies on students

The evaluation strategy chosen should depend on the context of the situation and the specific purpose of the evaluation. Most importantly, however, evaluating professional development should move beyond self-reported data.

## **C.1 Future Research**

Seven questions emerged from the EScan and warrant further research as potential next steps in moving numeracy education forward. The questions focus on diverse learner populations and potential professional development and instructional practices in adult numeracy.

### **What Numeracy Instructional Practices Are Most Effective for Adult Learners?**

NCTM and other influential instructional frameworks suggest content knowledge, skills, and strategies that learners need and suggest ways of delivering this content through instruction. Although adult education has adopted many instructional practices from Grades K–12, we still do not know how effective these practices are in adult education. Limited research exists that evaluates the effects of K–12 instructional approaches on adult education instructor change or on student learning. Initiatives studied had virtually no assessments to determine what types of instructional practices work with adult students. Questions for research may include:

- What numeracy instructional practices has research shown to be effective within the K–12 educational system?
- How congruent are these approaches with the ways adults learn? With diverse characteristics of adult learners (e.g., culture, gender, attitudes about mathematics)?

How effective are these approaches in supporting adult learners as they acquire the content and skills they need?

- What impact, if any, would the K–12 approaches have on adult learners’ mathematical development?
- What factors would facilitate adoption of these practices within the adult education system? What challenges exist? How could these challenges be mitigated?
- How could research be designed to determine the relative efficacy of different instructional practices? What issues need to be considered in designing such research studies (e.g., delivery systems, student characteristics, length of participation, student goals, instructor characteristics, costs)? How could these issues be addressed?

Addressing such questions will help inform the content and strategies used in teaching mathematics and in preparing instructors through professional development.

## **What Numeracy Instructional Practices Are Most Effective for ESL Students?**

This research question went unanswered in the EScan. Initiatives did not focus on ESL learners, and the literature review did not reveal any findings on numeracy instruction in ESL classes. Understanding the needs of this population is essential because ESL students make up a large percentage of ABE students—a percentage that will continue to grow. Questions for research may include:

- What are the cultural, language and literacy issues in teaching numeracy to adult ESL students, and how can these issues be addressed? What can be learned from related fields such as neurolinguistics, psycholinguistics, and sociolinguistics to address these issues?
- What are some of the current instructional strategies used to teach numeracy to adult ESL students? What is the research base supporting these strategies? What strategies are most applicable to a diverse ESL learner population (e.g., learners from non-alphabetic backgrounds, learners who read fluently in their native language)?
- What types of research studies can be designed to identify the most effective instructional strategies for ESL students? What issues need to be considered in designing such studies (e.g., student characteristics, length of participation, student goals, instructor characteristics, costs)? How could these issues be addressed?

## **What Numeracy instructional Practices Are Most Effective for Adults With Learning Disabilities?**

As with the ESL population, the EScan and literature review found little regarding instructional practices that address the needs of adults with learning disabilities. Research questions may include:

- What types of learning disabilities do adults bring to the adult numeracy class that can impede their learning mathematical concepts and procedures?
- What research-based instructional and learning strategies are used in the K–12 system to promote mathematical understanding among students with learning disabilities?
- How effective are these K–12 strategies for teaching numeracy to adults with learning disabilities?
- What types of research studies can be designed to assess the impact of any of these practices on adult learners with disabilities? What issues need to be considered in designing such studies (e.g., student characteristics, length of participation, instructor characteristics, costs)? How could these issues be addressed?
- What are the characteristics of a professional development program designed to train instructors to teach numeracy to adults with learning disabilities?

## **To What Extent Are Collegial Videotaping and Peer Review Effective Professional Development Strategies in Adult Education?**

NCTM has identified collegial videotaping and peer discussion as an effective professional development model. In this approach, an instructor videotapes a lesson and then he/she meets with peers to discuss and improve the lesson and instructional approach. The model involves several elements of “quality” professional development that are identified in the Eisenhower study (e.g., active learning, collaboration, occurs over time). However, the EScan did not identify initiatives with the collegial videotaping and peer discussion approach. The research would test this model in ABE/GED classrooms. Research questions may include:

- What are the strengths and barriers to implementing the collegial videotaping and peer discussion model within the adult education system?
- How can this model be used to extend instructor repertoire of numeracy content and strategies?
- What effect does the model have on the deepening instructor knowledge of mathematical concepts and on teaching practices of mathematics instructors?
- How can a research study be designed to assess the impact of collegial videotaping and peer review on instructor knowledge of mathematical concepts?

## **What Core Numeracy Content and Skills, If Any, Are Essential for Adult Numeracy Instructors?**

The purpose of adult numeracy professional development is to deepen instructors' knowledge and skills about mathematical concepts and practices. Members of the project's TWG raised the issue of conceptual knowledge and emphasized the need for instructors' ability to conceptualize mathematics and make learning mathematics a meaningful endeavor for adult students. The research literature found that less than 10% of the adult education instructors reported that they were certified in mathematics (Gal and Schuh, 1994). Research questions may include:

- What are the core mathematical content knowledge and skills that adult numeracy instructors need in order to provide effective instruction to learners from diverse backgrounds and with different needs? Are there different sets of skills for teaching algebra and higher-level mathematics to adult education students? If so, what are these skills?
- What have we learned from the K–12 system, from workplace education, and from adult numeracy programs in other countries that can help to define these content and skill areas?
- What should be the characteristics of pre-service mathematical training and professional development to support the acquisition of these skills and knowledge areas?
- What other attributes do teachers need to be successful in transferring their mathematical knowledge to adult education students, many of whom come from diverse backgrounds?
- What strategies can be used to recruit and retain adult education teachers who have the disposition and the pedagogical and disciplinary content knowledge and skills to effectively teach numeracy?

## **What Types of Certification Requirements, If Any, Should Exist for Instructors of Adult Numeracy?**

Certification is viewed as a means of providing instructors with a clear set of expectations. States use certification as a quality assurance tool to assist in monitoring the competency levels of those entering and teaching in the field (Sabatini, Ginsburg, & Russell, as cited in Tolbert, 2001). The EScan found no information about practices for certification in mathematics. Several states have certification requirements, but they are focused on certification in ABE rather than any one discipline. Only the Massachusetts Department of Education requires educators in the state to apply for a license to take the Adult Basic Education Subject Matter Test, which includes approximately 25 multiple choice mathematics items. Given the paucity of information on certification in content areas in ABE, further research is needed. Research questions may include:

- What practices exist in K–12 for certification within mathematics that can be beneficial to the adult numeracy setting?
- Given the constraints of the adult education system, would these practices be applicable to adult education? Why? What issues may arise when implementing certification practices in ABE mathematics?
- Should all numeracy teachers meet certification requirements, or should certification be required of instructors who are teaching only higher levels of mathematics (e.g., algebra and higher mathematics) to adults?
- How could certification requirements for mathematics instructors be integrated within the state’s current competencies, licensing, or certification requirements?

### **What Are the Most Effective Ways to Assess Teacher Change as a Result of Numeracy Professional Development?**

As we have noted throughout this report, assessment of instructor change is one of the weakest links in the implementation of adult numeracy professional development initiatives. Because of the nature of the adult education system, conducting impact evaluations on instructors and adult learners is difficult. Assessment of instructor change is complicated because instructors often work part time, usually have other full-time jobs, and often do not receive compensation for planning time or professional development. Furthermore, demonstrating the impact of professional development is difficult because, with the high turnover rate, instructors do not necessarily teach long enough for the professional development to effect instructional change. Assessing the impact of professional development on student outcomes is also challenging because adult learners attend on a voluntary basis, are part time, and may leave the program before gains can be registered due to “open entry” and “open exit” policies. Lastly, professional development initiatives are primarily funded to deliver services but do not have resources to assess the impact of services.

Without data from assessments, we cannot improve programs or determine the effect of professional development on instructors and learners. Research questions may include:

- What can be learned from professional development studies that assess teacher change in numeracy at the K–12 level, in workplace education, and from other adult education systems?
- Given the context of the adult education system, what types of studies would yield the most meaningful information regarding how or whether specific professional development strategies in numeracy result in changes in behavior and instructional practices?
- What issues need to be considered in designing such studies (e.g., programmatic processes, student and teacher characteristics) to test the efficacy of certain assessment measures used to identify instructor change resulting from numeracy

professional development? How can these issues be addressed effectively to avoid constraints on study implementation?

- What are the key variables or domains for characterizing what happens before, during, and after professional development? What methods can be used to collect data before, during, and after professional development?
- What factors affect implementation of new learning in the classroom at the administrative levels? Teacher and classroom level? How can these factors be documented?

## **D. Developing and Evaluating a Research-Based Prototype of Providing Adult Numeracy Professional Development**

As stated earlier in this chapter, the adult numeracy professional development initiatives studied demonstrate several features that reflect the characteristics of quality professional development, as identified in the Eisenhower, NCSALL, and McREL studies. To illustrate a professional development approach that integrates these characteristics, we offer a prototype for professional development. The prototype builds on findings about professional development from the EScan and research literature. A research-based prototype would deepen knowledge of mathematical content and strategies among participants and build a cadre of individuals who would be able to serve as practitioner-leaders for local programs and communities. Results of the evaluation would help inform the delivery of other adult numeracy professional development initiatives. The following discussion highlights six components of a demonstration program.

### **Implementation Sites**

In order to understand how the professional development program could be implemented in a variety of settings, select demonstration sites that vary by learner population, geographical setting, size, instructor characteristics (e.g., full-time and part-time) and program types. Choose a minimum of five sites.

### **Selective Enrollment of Participants**

Gaining commitments from local program administrators and potential candidates to participate in the full extent of the program is important because contact hours would be substantial. An application process that provided background on participants' experiences in teaching mathematics, participants' strengths, and areas in which participants seek improvement would help to tailor the professional development. A minimum of two individuals from each program should participate to foster more collective participation and counter the isolation that adult education instructors typically face. In the application, local program directors should commit to supporting the instructors' participation. Graduate credit and stipends could be provided to all participants to increase interest and participation.

## **Delivery Models**

The demonstration should provide a combination of delivery models to support ongoing learning and to deepen knowledge of mathematical concepts and instructional practices. For example, the delivery model could offer a 2-day summer institute that is facilitated by an experienced numeracy contract provider in partnership with a mathematics educator from an institution of higher education. Candidate pairs would leave the institution with a specific topic for lesson study in the coming month. The pairs could either teach or reciprocally observe each other and provide feedback as the lesson is taught to help situate the professional development within classroom practice. Participants could then follow up with a 1-day workshop over each of the next 9 months and could reconvene to debrief about the lessons presented and to select a topic for the upcoming month. This recursive process could continue over the course of the professional development initiative.

Follow-up sessions should provide opportunities to share new information, discuss student work samples, and undertake problem-solving and reflection. The numeracy provider and the mathematics educator should be available for consultation about both the plan of the lesson and references and materials that would support the effective execution of the lesson. The role of these mentors would be to support instructors' use of the knowledge they gained through the professional development within the context of the instructors' own learning environment (Stein, Smith, & Silver, 1999). Each learning environment would have its own context, and support for instructors would be important so they could transfer learning within that context. An electronic bulletin board should be available for cross-team communication, and if possible, a specific time slot should be reserved each week for whole-class online discussion.

## **Content and Materials**

Content for professional development should be identified through a collaborative effort, with an assessment of needs of all stakeholders: state and local program staff, the instructor, and adult learners. Content should reflect state or national standards and other initiatives that are occurring at the state level, and participants should see the relationship of the professional development to their own learning goals and to the learning goals of their students. Materials should support the learning content, be authentic and hands-on, promote group work and sharing, and be applicable to instructors' learning environments.

## **Instructional and Learning Strategies**

The teaching and learning principles promoted by the ANN provide a good basis for professional development instructional and learning strategies. Instruction should be based on adult learning theory and an understanding of how mathematical knowledge develops in adults. Strategies should include demonstrations, modeling, and hands-on activities. Analysis and discussion of video clips of actual teaching situations could be one aspect of the demonstrations provided, and instructors could use student work and real-world situations to enhance teaching practices. Activities should promote problem-solving and reflection and provide opportunities for large and small group work and sharing. Strategies to reduce anxiety that instructors have

about mathematics could be incorporated within the professional development during the institutes and follow-up seminars and during the coaching that follows.

## **Assessment of Participants**

Formative and impact assessments of participants' learning and implementation of concepts taught should be built into the prototype. Formative assessments should be ongoing to improve the delivery of services over the course of the professional development. Impact assessments could be conducted at multiple points, such as the monthly seminars, to provide an opportunity to learn how strategies are being implemented. Local administrators, who have agreed to the participation of their instructors, could conduct pre- and post-observations, and expert facilitators and mathematics educators could also conduct observations. Instructors could be asked to maintain a journal and reflect on their teaching experiences as a result of the professional development. Participant pairs could also provide feedback on the lesson planning and implementation activities.

The formative and impact assessments could address the following questions related to this prototype.

- How would you design and implement a formative evaluation within the context of the adult education system? What variables or domains would you select? How would you collect and analyze the data? What issues might arise? How would you address these issues?
- How would you design and implement an impact evaluation within the context of the adult education system? What variables or domains would you select? How would you collect and analyze the data? What issues might arise? How would you address these issues?
- What modifications should be made as a result of the evaluation's findings?
- What impact would this model have on different components of the adult education system (e.g., state and local programs, funding streams, professional development delivery systems)?
- How could the model be scaled up within the context of the adult education system and given the current constraints in the field of adult numeracy?



## **E. Summary and Conclusion**

Our charge through the EScan was to examine current and recent adult numeracy professional development initiatives and practices and to recommend programs and practices worthy of replication. Our research identified professional development initiatives for study using a set of criteria that was informed by the research literature on professional development and numeracy and on recommendations by the project's TWG. We identified 30 initiatives based on reviews of state and federal Web sites, requests for information from state offices of adult education and state literacy resource centers, reviews of adult education conference sessions, and requests for information from mathematics experts in adult education, including members of the TWG. Researchers focused on 20 initiatives that met at least two criteria. While it would have been ideal to identify the universe of recent adult numeracy professional development initiatives, doing so would have involved far more resources and time than the project allowed.

Research was conducted on several levels. In addition to identifying and selecting the initiatives, we reviewed extant information on initiatives that were selected for the study; conducted interviews with initiative directors, developers, and trainers using guided questions to complete information gaps from the extant reviews; conducted interviews with a very small sample of participants to gain insight into the impact of the professional development on instructors' teaching practices; and reviewed research studies on professional development and publications of major organizations involved in mathematics education. These reviews provided context for the study and laid the foundation for identifying initiative components that are worthy of replication.

We learned that much good work has been conducted in numeracy professional development over the past several years and that components of many of the initiatives have aligned with principles of the Eisenhower study. In many cases, professional development was coherent with other initiatives within the state, particularly with the implementation of content standards. The focus on content and instructional strategies was a key feature of quality professional development. Much of the content of the professional development was driven by mathematics standards and content on the GED, and the initiatives strongly emphasized algebraic concepts. Materials supported the content and served as a resource for participants once the initiative had ended. Almost all of the initiatives used, to some extent, a constructivist approach to teach mathematics and give participants opportunities for active learning. Facilitators created an environment that was designed to reduce anxiety that participants had about mathematics and to model how to teach mathematical concepts in their own classrooms.

Professional development delivery models were largely multiple-session workshops or institutes. Virtually no professional development was embedded within adult education programs. Duration varied but was primarily short, with several initiatives extending over a period of time. A few initiatives, however, managed to extend participant contact hours. Overall, such limited duration was problematic and contradicted (as discussed in the Eisenhower, How Teachers Change, and McREL studies) the point that "deepening" knowledge is obtained through more extensive contact hours.

Almost half of the initiatives relied on experts to deliver the training, thus ensuring a strong knowledge base in content and in the research supporting that content. One quarter of the

initiatives provided a train-the-trainer model to help build state capacity for teaching numeracy. Despite being a common approach for reaching a large number of instructors, the limited duration of the train-the-trainer models may provide the trainers with fewer opportunities to deepen their knowledge and adequately serve as professional development providers to other instructors. Initiatives had very few, if any, follow-up once funding ended. This raises another question: What strategies were actually transferred to instructors' own learning environments? Several initiatives had interim activities that provided initiative staff with some knowledge of the transfer of learning, but without follow-up, a real understanding of the depth and level of transfer is unknown.

The study left many questions unanswered. Because very few formal evaluations of the impact of the professional development were conducted, we cannot really say what appears to work and what should be replicable. Only a few research and development projects conducted extensive evaluations. We know from the participant interviews that they liked the training and have begun to use some practices, but the sample size was so small that generalizations are difficult to make. This problem was exacerbated further because a number of the instructors who were interviewed were not teaching mathematics classes, for a variety of reasons, after the professional development. Therefore, we have very little information on the extent and depth of transfer of learning. Our recommendations for replicability are based primarily on the relationship of the initiatives' practices to the research on features of quality professional development. This study lays the groundwork for conducting future research in adult numeracy education and professional development and for testing potential models of adult numeracy professional development.

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**APPENDIX A**

**OTHER ADULT NUMERACY  
PROFESSIONAL DEVELOPMENT  
INITIATIVES**

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## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES

Information on the adult numeracy professional development initiatives contained in the table below was acquired through a review of extant information and follow-up e-mails with state staff. As reflected in the table, very little substantive information was found on many of these initiatives. Researchers experienced difficulties obtaining more details about these professional development activities because of Internet search limitations and resource constraints. Researchers identified one national initiative (Adult Literacy Media Alliance) that included a small professional development fee-for-service component. The other initiatives were implemented primarily by states; a few initiatives in Georgia were implemented at the service delivery area (SDA) level. We counted the number of initiatives in the table by the number of implementing agencies, rather than by each professional development activity, because little information was obtained about the individual activities. Information on nine initiatives is presented below. Although this list is not exhaustive, it does capture the types of professional development opportunities being offered within states, with the primary delivery model being single workshops.

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<p><b>Adult Literacy Media Alliance (ALMA)<sup>16</sup></b></p> <p>Professional development component: Organizations contract with ALMA for services of the National Training Director.</p>	<ul style="list-style-type: none"> <li>— Think Math DVD</li> <li>— Financial Literacy Kit</li> </ul> <p>Duration: Each lesson on the Think Math DVD includes a video segment (4–6 minutes), student handout, and teacher’s guide.</p> <p>Each Think Math lesson has a corresponding online lesson and game: <a href="http://www.tv411.org">http://www.tv411.org</a>.</p>	<ul style="list-style-type: none"> <li>— To help adults gain the basic reading, writing, and mathematics skills needed to achieve their educational, career, and personal goals</li> <li>— To create and distribute educational multimedia learning materials through broadcast television, the Internet, and literacy and community-based programs across the country</li> </ul>	<p>Professional development component: The National Training Director conducts workshops with materials, train-the-trainer classes, long-distance or in-person consultation, and evaluation of materials.</p> <p>Content of Think Math curriculum: Fractions, percentages, geometry, perimeter, ratios, rates, two parts on number patterns, and a teacher resource guide</p> <p>Content of accompanying online mathematics games: Patterns in a series of numbers, fractions, part-whole relationships, percentages, perimeters, and ratios. The Web site provides teachers with curriculum support and sample lesson plans and guidelines for correlating TV411 with the educational standards.</p> <p>Content of the Financial Literacy Kit: Understanding a Pay Stub; Reading the Fine Print (on an advertisement); Analyzing a “Rent-to-Own” Deal; Credit Card Offers; Making a Budget; and Reading a Mortgage Chart. Each unit of the Financial Literacy Kit has a video segment, a student workbook/magazine, and a teacher’s guide</p> <p>Content of student guide: Personal finance instruction addresses: What’s on the Stub: Understanding Your Paycheck; Reading the Fine Print: Don’t Be Fooled; Rent-to-Own: Is It Really a Deal?; Wise Decisions: Selecting and Using Credit Cards; Getting on Track: Making a Budget</p>

<sup>16</sup> Evaluation was conducted by an outside agency, KET Enterprise (a subsidiary of Kentucky Educational Television), for the Financial Literacy Kit. Specific follow-up was not done on the Think Math DVD.

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<b>California</b> Adult Literacy Instructor Training	Math Problem-Solving Techniques in the Literacy Classroom (September 1996)	<ul style="list-style-type: none"> <li>— To identify and describe a mathematically rich learning environment for literacy students</li> <li>— To apply mathematics activities using manipulative aids and concrete materials</li> <li>— To apply instructional methods to assist literacy students to use problem-solving and critical thinking to find mathematical solutions</li> <li>— To apply mathematics activities that promote the use of calculators</li> <li>— To identify strategies to facilitate the delivery of mathematics problem-solving techniques with ideas on presenting, implementing, and evaluating training</li> </ul>	Content: Problem-solving and critical thinking Strategies: Using manipulatives, concrete materials, and calculators
<b>Florida</b>	Edutainment for Math: Every Day Math for Every Day Life (May 16, 2006)	<ul style="list-style-type: none"> <li>— To cover the mathematical needs of students in everyday life and the strategies in which to learn them</li> <li>— To answer the popular mathematics question: "When are we ever going to use this?"</li> </ul>	Content: Getting the Basics, Money Matters, Math Around the Home, and Math Out and About
	GED 2000—What Do My Students Need to Know? Enhancing Mathematics Instruction (February 23, 2006)  Skill Level—Intermediate and Advanced	<ul style="list-style-type: none"> <li>— To review data analyzed and presented by the GED Testing Service's (GEDTS's) content experts at the July 2005 national GEDTS conference</li> <li>— To analyze the specific types of questions with which students struggle based on data from students who attained scores at or below the minimum passing score of 410 on mathematics</li> <li>— To explore mathematical procedures and concepts with which students have difficulty and to identify strategies that can enable students to pass 3–6 more questions on the GED test, thus enabling them to earn a passing score</li> </ul>	Content: Latest information from the GEDTS about the types of questions that students most often miss on GED mathematics
<b>Georgia</b>	Workshop at SDA #4 February 10, 2006	N/A <sup>17</sup>	Content: Favorite learning activities for students, including numeracy
	Workshop at SDA #5 February 6, 2006	N/A	Content: Idea-sharing session on mathematics
	Workshop at SDA #25 April 19, 2005	N/A	Content: Simplifying fractions for students and proportional percentages

<sup>17</sup> N/A = Not available



## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
Georgia (Continued)	Workshop on Teaching through Contextualized Learning at SDA #25 January 31, 2005	N/A	N/A
	Workshop on Skills for Math Success at SDA #22 2005	N/A	Content: NCTM content and process standards Materials: List of Web sites with mathematics activities; study tips for students
	Workshop on Math Strategies for GED Teachers at SDA #5 2004	N/A	Materials: Casio scientific calculator
	Annual Literacy Conference: Building a Foundation With Math Resources for the Classroom September 3–5, 2003	N/A	N/A
	Teachers' Academy provided the opportunity to develop Mathematics Lesson Plans July 2003	N/A	N/A
	Spring Training for Teachers offered Setting the Stage for Success—Mathematics March 13–14, 2003	N/A	N/A
	Spring Training for Teachers March 13–15, 2002	N/A	Content: Geometry, ratios, slopes, rectangular coordinates, polygons, quadrilaterals; session on the Casio scientific calculator
	GED 2002 National Training Institute	N/A	N/A
	Workshop on GED Math Preparation for Part-Time Teachers at SDA #33 2002	N/A	N/A
	Workshop for Consortium V (SDA 22–26, 33, 36) 2002	N/A	Content: Learning disabilities with emphasis on GED mathematics
Teachers Academy July 2000	N/A	Content: Development of a teaching strategies notebook for mathematics	

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
Georgia (Continued)	Annual Literacy Conference: Fast Track to GED Math Test March 3–5, 1999	N/A	N/A
	Workshop on Fast Track to GED Math Test at SDA #27 1999	N/A	N/A
	Adult Literacy Conference sessions: — Teaching Mathematics to Adults With Learning Disabilities — Practitioner Research Briefs — Calculators in my Adult Education Classroom and Their Relationship to Math Anxiety February 18–20, 1998	N/A	N/A
	Annual Literacy Conference: Introducing Math Solutions: Problem Solving, Tools, and Application February 28–March 1, 1996	N/A	N/A
Illinois Central Illinois Adult Education Service Center	ABE Math Manipulatives September 23, 2006 (Duration: 3 hours)	N/A	Content: Beginning mathematics topics, fractions, and decimals. Participants receive copies of materials.
	GED Math March 17, 2006 February 10, 2006 November 18, 2005 November 14, 2005 October 14, 2005 (Duration: 3 hours)	— To explore a variety of ways to teach the higher level mathematics skills that students need to pass the GED	Materials: Teachers receive worksheets and other hands-on materials.

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<b>Illinois</b> Central Illinois Adult Education Service Center (Continued)	Reading and 'Riting in 'Rithmetic Class September 1, 2006 October 27, 2006 (Duration: 3 hours)	— To give teachers opportunities to try out teaching and learning activities for ABE mathematics concepts and to explore how language arts can help teach mathematics	Materials: A variety of multicultural materials that will also help develop students' critical thinking skills
	ABE/GED/Family Literacy Provider Group September 1, 2006 May 12, 2006 (Duration: 2.5 hours)	— To discuss problems and resources with other teachers — To decide on topics and date for next meeting	Content: Mathematics in the multilevel classroom, key vocabulary for story problems, and mathematics ideas in the library
	SCORE! Improving Performance on the GED Math Test (online course) August 16, 2006 June 21, 2006 (Duration: 1 hour)	N/A	Content: Based on difficulties that non- and near-passers have encountered on the GED mathematics tests, how they performed in three thematic areas, and teaching tips recommended by GEDTS to help them improve their scores in these areas
	Math on the Internet (online course) October 5, 2006 (Duration: 1 hour)	N/A	Content: Ways that the Internet can support ABE/GED mathematics instruction. Explores some mathematics Web sites and discusses how they can strengthen student learning
	Math Strategies (online course) November 1, 2006 (Duration: 1 hour)	N/A	Content: Strategies that students can use to help remember mathematics skills. Provides opportunities for sharing favorite mathematics strategies.
<b>Illinois</b> Southern Illinois Professional Development Center	Tactile Math for the ABE Classroom 2005–2007 (Duration: Half-day workshop)	— To provide instruction on how to teach ABE mathematics using manipulatives — To explore and create manipulatives for the classroom	Content: Use of manipulatives to bridge the gap from abstract concept to concrete understanding. Materials: Participants will make their own teaching materials.
	Everyday Math 2007 (Duration: Half-day workshop)	N/A	Content: Based on research of the University of Chicago's School Mathematics Project, this workshop provides hands-on ways to help students acquire knowledge and skills and develop an understanding of mathematics from their own experiences.

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<p><b>Illinois</b> Southern Illinois Professional Development Center (Continued)</p>	<p>Southern Illinois Annual Fall Conference Sessions (1 hour each) November 8–9, 2006</p> <ul style="list-style-type: none"> <li>— Celebrate Learning: Teaching Math Creatively</li> <li>— GED Math Initiative: What’s Happening and How Can We Help?</li> <li>— Tic Tac Toe Math</li> </ul>	<p>N/A</p>	<p>N/A</p>
<p><b>Pennsylvania</b> Bureau of Adult Basic Literacy Education, Department of Education</p>	<p>Tic Tac Toe Intermediate Math Training</p>	<ul style="list-style-type: none"> <li>— To provide instruction on how to teach double and multiple digit Tic Tac Toe Math grids for teachers and tutors who have already attended basic training</li> <li>— To learn an alternative technique for completing mathematics operations that involve division, fractions, and percentages</li> <li>— To learn how to teach Tic Tac Toe Math to students who have various learning problems</li> </ul>	<p>Content: Use of Tic Tac Toe Math to complete long division, fractions, and percentage computations. Review basic and multiple digit grids. Materials: Instructional materials for use by adult learners</p>
	<p>Teaching Tricks for Math Learners</p>	<ul style="list-style-type: none"> <li>— To refresh participants’ basic mathematics skills and introduce some different approaches to learning them</li> <li>— To identify where to find mathematics-related teaching materials and how to create them from everyday household items</li> <li>— To transfer mathematics concepts to other subject areas</li> <li>— To use techniques to reach various learning styles</li> <li>— To understand the importance of making connections and using manipulatives</li> </ul>	<p>Content: A discussion of mathematics phobias and ways in which teachers with limited mathematics experience can feel comfortable with helping students to understand mathematics concepts, to review basic mathematics calculations, to create mathematics manipulatives from common items, and to transfer mathematics skills to daily life. Materials: Handouts and homemade manipulatives that can be used with students, a resource packet, and a bibliography of Web sites on mathematics-related material</p>

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<p>Pennsylvania Bureau of Adult Basic Literacy Education, Department of Education (Continued)</p>	<p>Teaching Math for Practitioners</p>	<ul style="list-style-type: none"> <li>— To understand the language of mathematics</li> <li>— To practice ways to encourage and motivate mathematics learners</li> <li>— To practice methods of reducing anxiety about mathematics</li> <li>— To identify different styles of learning mathematics</li> <li>— To identify three reading skills that are required to read mathematical texts</li> <li>— To help learners work from the concrete to the representational to the abstract</li> <li>— To use techniques to teach three critical thinking skills that are important to mathematics instruction</li> <li>— To understand the importance of the relationship between mathematical and memory processes</li> <li>— To practice methods for teaching mathematics</li> </ul>	<p>Content: Instructional techniques for teaching mathematics; lesson planning; mathematical applications; real-life mathematics; mathematics and work; the language of mathematics; motivating mathematics learners; reducing anxiety about mathematics; styles of learning mathematics; reading skills and mathematics instruction; working from the concrete to the representational to the abstract; critical thinking skills and mathematics; mathematics and memory; and teaching mathematics activities for the workplace, GED, and life skills</p> <p>Strategies: Open-ended discussion and group activities</p> <p>Materials: Instructor-made transparencies, instructor-made handouts, and various instructor-supplied materials</p>
	<p>Teaching Adults with Low-Level Literacy and Numeracy Skills</p>	<ul style="list-style-type: none"> <li>— To provide techniques to adult educators and literacy tutors working with adults to set realistic goals for student progress</li> <li>— To learn about the characteristics of low-level literacy students</li> <li>— To learn instructional strategies for teaching reading to low-level students</li> <li>— To learn strategies for working with students in the areas of mathematics computation and problem-solving skills</li> <li>— To learn strategies for setting realistic goals with students</li> </ul>	<p>Content: Overview of auditory perception and processing problems in low-level literacy students, techniques for teaching reading for students with low-level literacy and mathematics computation and problem-solving skills, techniques for teaching mathematics to students with computation and problem-solving skills, and setting realistic goals with students</p>

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<p><b>Pennsylvania</b> Bureau of Adult Basic Literacy Education, Department of Education (Continued)</p>	<p>Rethinking Your Math Practice: If You Are Bored, So Are Your Learners</p>	<ul style="list-style-type: none"> <li>— To give participants an opportunity to rethink what they do in mathematics class and to discover some other ways to deliver instruction and engage learners</li> <li>— To differentiate between teaching mathematics and helping students become numerate</li> <li>— To appreciate the benefits of allowing time to communicate in mathematics class</li> <li>— To incorporate communication activities into every mathematics class</li> <li>— To practice using manipulatives in a range of mathematical topic areas</li> </ul>	<p>Content: Numeracy: More Than Math, Communication in Math Class</p> <p>Strategies: Alternative methods of modeling “other” ways of doing mathematics (i.e., using manipulatives, engaging in conversations and writing, making connections, and building number sense)</p>
<p><b>Texas</b> Coastal Region GREAT Center, Project GREAT (Getting Results Educating Adults in Texas)</p>	<p>Introduction to Literacy and Numeracy: Integrating Numeracy into an Adult Education (ABE/GED/ESOL) Curriculum June 2, 2006 August 1, 2006 (Duration: 3 hours)</p>	<ul style="list-style-type: none"> <li>— To provide adult educators with an awareness and understanding of the relationship among reading, writing, and numeracy</li> </ul>	<p>Strategies: Hands-on activities to use with students</p>
	<p>Introduction to Literacy and Numeracy: Integrating Numeracy Into an Adult Education (ABE/GED/ESOL) Curriculum June 2, 2006 August 1, 2006 (Duration: 3 hours)</p>	<ul style="list-style-type: none"> <li>— To provide adult educators with an awareness and understanding of the relationship among reading, writing, and numeracy</li> </ul>	<p>Strategies: Hands-on activities to use with students</p>
	<p>GED Mathematics (Duration: 3 hours)</p>	<ul style="list-style-type: none"> <li>— To describe the structure and four major content areas of the GED math test</li> <li>— To analyze several types of test problems, with an emphasis on the different levels of thinking skills required</li> <li>— To practice many interactive and relevant activities and lessons that will motivate the GED student</li> </ul>	<p>Content: Overview of the structure of the GED mathematics test; the concepts and content of the test items; strategies for preparing students for the test; and techniques for making lessons relevant, practical, productive, and interactive</p>
	<p>Literacy and Numeracy: Integrating Numeracy Into Adult Education Curricula February 4, 2006 (Duration: 3 hours)</p>	<ul style="list-style-type: none"> <li>— To provide adult educators with an awareness and understanding of the relationship among reading, writing, and numeracy</li> </ul>	<p>Strategies: Hands-on activities to use with students</p>

## OTHER ADULT NUMERACY PROFESSIONAL DEVELOPMENT INITIATIVES (CONTINUED)

Implementing Agency	Professional Development Activity and Duration	Goals/Objectives	Content, Strategies, and Materials
<p><b>Washington</b> State Board for Community and Technical Colleges</p>	<p>Workshop on Visual Math/Teaching Math to Adults Duration: Each workshop lasts 6–8 hours and is generally offered in two sessions, with up to 1 month between sessions.</p>	<ul style="list-style-type: none"> <li>— To help learners gain an understanding of the meaning of key mathematical concepts, using a constructivist approach and a wide variety of visual and concrete models</li> <li>— To help learners develop multiple strategies for approaching and solving both real-life mathematical situations and theoretical mathematical situations, such as those found on the GED and CASAS tests</li> <li>— To help learners develop the skills to explain their own mathematical thinking processes and reasoning</li> <li>— To use conceptual and constructivist approaches to explore topics that include fractions, percentages, and ratio and proportion.</li> </ul>	<p>Content: Averaging, percentages, ratios, and fractions</p>
	<p>Workshop on Math Manipulatives and Strategies Duration: Each workshop lasts 6–8 hours and is generally offered in two sessions, with up to 1 month between sessions.</p>	<ul style="list-style-type: none"> <li>— To experience strategies that create concrete models of basic mathematical principles</li> <li>— To create a bridge from concrete activities to semi-concrete activities to abstract mathematical operations</li> <li>— To understand the direct correlation between certain English words and mathematical operations</li> <li>— To develop strategies that address the major teaching and learning challenges of participants</li> <li>— To explore the use of patterning as an aid to memorizing and/or accessing mathematical facts</li> </ul>	<p>Content: Addition and subtraction, place value, multiplication, division, fractions, decimals, the language of word problems, word problem strategies, algebra, percentages, strategies for memorizing mathematical facts, quadrants, multiplication, grids and multiplication, table extension, Tic Tac Toe Math, and alternative strategies for learners who have difficulties memorizing mathematical facts and/or understanding basic mathematical principles</p>

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# **APPENDIX B**

## **INITIATIVE SUMMARIES**

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## STATE-LEVEL INITIATIVES

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## NATIONAL-LEVEL INITIATIVES

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## **ARKANSAS ADULT LEARNING RESOURCE CENTER NUMERACY PROJECT**

### **A. Background**

The Arkansas Adult Learning Resource Center (ALRC) Numeracy Project was a continuation of the Arkansas Adult Numeracy Campaign (ANC) and was implemented by the resource center. The original ANC grant was awarded in 2001 with funding from the Winthrop Rockefeller Foundation for 3 years. In 2004–05, the project was taken over as an extension of the Rockefeller grant as ongoing leadership and administrative changes were being implemented. Funding for the Arkansas ALRC Numeracy Project was supplemented with funding from state funds and federal leadership funds.

The project was initially developed by Dr. Judy Ward as part of the ANC grant for the Arkansas ALRC, and new adaptations were made as the initiative transitioned into the Arkansas ALRC Numeracy Project. The project consisted of a 4-day workshop. Participants were given up to 24 professional growth hours for attending; the state of Arkansas requires teachers to complete 60 hours of professional growth during each school year. The professional development covered topics that were unique to adult students and problems that teachers were having with adult learners. The professional development focused on providing strategies and skills for teachers to help students pass the GED.

### **B. Goals**

- Encourage teachers to use mathematics standards to improve their instruction
- Help teachers think differently about the delivery of mathematics instruction, understand that mathematics instruction is more than using paper and pencil to practice a particular type of problem, increase teachers' use of group work, learn different strategies for teaching students who have not been successful in mathematics, update teachers' mathematics skills and understanding, and share methods for teaching geometry and algebra with one another

### **C. Participants and Incentives**

- Participants were informed of the project through letters sent by the Arkansas ALRC, advertisements posted on the ALRC's Web site, information in ALRC's newsletter, and mailings from ALRC.
- Eligible participants were adult educators and literacy council tutors in Arkansas who did not attend the ANC training. The goal was to train as many mathematics teachers in the state of Arkansas who had not already attended a similar state-offered workshop.
- All participants received travel, meal, and lodging reimbursement.

- Thirty-five teachers participated in the spring 2005 workshop.

## **D. Delivery Model**

Professional development was offered in sets of 2-day workshops over the course of 2 months.

## **E. Instructional Components**

### **Content**

Content was based on standards of the National Council of Teachers of Mathematics (NCTM) and included visual mathematics.

### **Instructional Materials**

Teachers were provided with materials to use in the classroom, including a set of manipulatives and visual mathematics materials. The manipulatives consisted of Cuisenaire rods, fraction circle kits, Algeblocks with a notebook on usage, Cuisenaire 1-inch wooden color cubes, basic set of base 10 blocks, an NCTM book, and a CD with a manual of activities.

### **Strategies**

- Manipulatives were used to present mathematics in a concrete manner for basic concept acquisition.
- Modeling and practice were an integral part of the workshop.

## **F. Assessment and Findings**

Participants completed a workshop evaluation, which assessed what the participants liked and did not like about the format and content of the workshop. Questions asked about the design of the workshop and the benefits to the participant.

## **G. Strategies for Sustaining the Initiative**

- Obtain buy-in from the local program administration
- Maintain open lines of communication among the staff/trainers and the state directors

## **ARKANSAS ADULT NUMERACY CAMPAIGN**

### **A. Background**

The Arkansas Adult Numeracy Campaign (ANC), a statewide initiative, was implemented by the Arkansas Adult Learning Resource Center (ALRC). The initiative was funded through a 3-year grant (July 1, 2001–June 30, 2004) from the Winthrop Rockefeller Foundation.

Dr. Judy Ward designed the ANC initiative based on her own teaching experience and a K–12 initiative called the Math Crusade, which was funded through the University of Arkansas by the National Science Foundation.

### **B. Goals**

- Re-educate adult educators in alternative mathematics instructional strategies based on standards of the National Council of Teacher of Mathematics (NCTM)
- Help teachers update their mathematics skills, think differently about the delivery of mathematics instruction, understand that mathematics instruction is more than using paper and pencil to practice a particular type of problem, encourage more group work, and learn different strategies for teaching students who have not been successful in mathematics

### **C. Participants and Incentives**

- Participants were informed of the initiative through the Arkansas ALRC.
- Participants came from various backgrounds, including GED, ABE (adult basic education), ESL (English as a second language), and workplace education. Participants were both paid staff and volunteers.
- The Arkansas ALRC, using state/federal monies, reimbursed participants for mileage, lunch, hotel, and travel costs. Participants could request certification hours and graduate credits. Some participants were also given tuition reimbursement if the course counted toward certification. Additionally, participants were provided with manipulatives and other materials.
- The number of participants who registered and completed all the sessions varied, averaging 10 or 15 participants per workshop. All registered participants were expected to attend all sessions of the workshops. If a participant did not complete all sessions, he/she did not receive the box of manipulatives and materials.
- A total of 122 participated in and completed the initiative.

## **D. Delivery Model**

- Multiple-session workshops were delivered over several months. The spring 2002, fall 2002, and spring 2003 workshops lasted 5 months, with 1-day sessions once a month for 5 months. Each season, every workshop was delivered in five regions of the state. In fall 2003 and spring 2004, the workshops lasted 3 months, with 2-day sessions once a month.
- Informal discussions took place at the end of every session and at the end of the workshop, when individual evaluations were written.
- In June 2004, Dr. Ward offered a 1-day follow-up workshop for eight participants in the Ft. Smith area. Although the grant was winding down, money was still available to do this.
- Dr. Ward made onsite visits to participants who requested them. Dr. Ward assisted the instructor in using the manipulatives and materials in an instructional setting with a particular student.

## **E. Instructional Components**

### **Content**

- The content was determined through focus groups of administrators, teachers, and students.
- Content included whole numbers, decimals, fractions, percents, equations, number sense, ratio and proportions, measurements, perimeter, area, problem solving, and gathering and displaying data.
- Content was based on the Massachusetts ABE Mathematics Curriculum Framework for Mathematics and Numeracy and the NCTM standards.

### **Instructional Materials**

Participants used calculators and received a set of manipulatives and visual mathematical materials, which included Cuisenaire rods, fraction circle kits, Algeblocks with an accompanying notebook, Cuisenaire 1-inch wooden color cubes, a basic set of base 10 blocks, an NCTM book, and a CD with a manual of activities.

### **Strategies**

- A constructivist approach, as well as group problem-solving and discussion, helped participants discover the “why’s of mathematics.”

- Most instructional strategies were based on NCTM and Massachusetts ABE Curriculum Framework for Mathematics and Numeracy. All activities first addressed the need for upgrading the skills and knowledge of the participants.
- Participants wrote in reflective journals about (a) situations in and out class that affected their perceptions of mathematics and (b) their use of new strategies. Those receiving graduate credit were required to turn in five journal entries as part of their grade; everyone else was required to turn in one journal entry.

## **F. Assessment and Findings**

- In 2004, the Department of Rehabilitation, Human Resources, and Communication Disorders in the College of Education and Health Professions at the University of Arkansas completed an evaluation of instructors' perceptions and use of AANC methods, the impact of ANC methods on the teaching process, and instructors' perceptions of the impact of the AANC methods on student achievement.
- Eighty-five participants (75% of the total number of participants) completed a Web-based survey on whether the instructional methods positively affected adult learners. Results of the evaluation indicated that the initiative enabled instructors to become more confident in their teaching, create a more positive self-concept about learning mathematics, and have a better understanding of mathematics concepts.
- Thirty-five adult students from seven schools were interviewed about their feelings about mathematics, any changes in their instructors' practices, and strategies they use in class. Several of the students stated that the new methods helped them in their job performance; all students liked the decreased use of the textbook.

## **G. Strategies for Sustaining the Initiative**

Secure steady funding

## **CALIFORNIA: CALPRO'S ALGEBRA TRAINING-OF-TRAINERS WORKSHOP AND INSTRUCTOR WORKSHOPS**

### **A. Background**

*Algebra Instructional Strategies for Adult Education Teachers* is implemented by the California Adult Literacy Professional Development Project (CALPRO), which is funded by the California Department of Education's Adult Education Office. CALPRO's Carole Maken and Erik Jacobson authored the workshop and led the training-of-trainers (TOT) workshop in September 2005. Thirteen trainers began delivering workshops to instructors shortly thereafter, and workshops have been ongoing ever since.

The TOT and instructor workshops were developed in response to a needs assessment of teachers in the state of California and in response to a request by the California Department of Education for students to meet the new requirements of the California High School Exit Examination (CAHSEE) and the GED. The workshop's content and model of delivery is currently being revised.

### **B. Goals**

The TOT and instructor workshops have distinct goals:

- The TOT workshop trains participants to deliver the workshop to instructors.
- The instructor workshops provide participants with information on what adult students need to know to pass the CAHSEE or GED mathematics and to earn an adult school diploma. The instructor workshops also provide participants with strategies for effective instruction.

### **C. Participants and Incentives**

#### **Training-of-Trainers Workshop**

- Participants in the TOT workshop were selected by 10 managers of CALPRO's Professional Development Centers (PDCs). PDC managers nominated eligible trainers who had backgrounds in mathematics and facilitation and presentation skills. Participation in the TOT workshop was voluntary for nominated trainers.
- Thirteen participants attended the TOT workshop on September 9, 2005.
- Participants in the TOT workshop were reimbursed for travel, lodging, and meal expenses.

## **Instructor Workshops**

- Anyone can attend the instructor workshops. Participants come from such program areas as adult basic education, adult secondary education, and GED. Instructor workshops are offered through the state's PDCs.
- On average, 20 participants attend each workshop.
- Participants of the instructor workshops receive certificates of attendance that can be applied toward professional growth hours or for recertification.

## **D. Delivery Model**

- The TOT workshop consisted of a full-day workshop on September 9, 2005. A listserv was set up so trainers could communicate after the training session. Another TOT workshop is scheduled after the revisions to the workshop are approved. Normally, however, a TOT workshop is conducted only when the capacity for trained facilitators has decreased and when new facilitators are needed.
- In 2005, each instructor workshop was presented as a 4-hour session. The workshop is currently being restructured to include two sessions with an interim assignment. Workshops, in the meantime, are still being conducted. Participants in the instructor workshops are encouraged to join national listservs, such as those hosted by the National Institute for Literacy, for support and further information.

## **E. Instructional Components**

### **Content**

- The workshop provides an overview of the California content standards for algebra and includes a sample of CAHSEE questions for each standard; provides test-taking strategies and techniques for helping learners overcome anxiety about mathematics; and reviews six core mathematical concepts that students can build on to learn algebra and nine areas of algebra that instructors should emphasize.
- A task force of California teachers and administrators developed six core mathematical concepts for students that also serve as the basis of CAHSEE and should underlie algebra instruction:
  - Basic skills
  - Formulas
  - Ratios and proportions
  - Exponents and powers



- Percentages
- Graphing
- Instructors are encouraged to emphasize nine areas of algebra:
  - Simplifying and evaluating algebraic expressions
  - Solving one-variable linear equations and inequalities
  - Multiplying monomials and binomials and factoring polynomials
  - Graphing linear equations
  - Solving simultaneous equations graphically and algebraically
  - Using the Pythagorean Theorem and approximating square roots
  - Solving quadratic equations
  - Using right triangle trigonometry
  - Determining the probability of an event's occurrence

## **Instructional Materials**

Facilitators' guides include transparency masters, handout masters, facilitator's notes, and a list of recommended mathematics and algebra Web sites and other online resources.

## **Strategies**

- At the TOT workshop, trainers model how to facilitate workshops and emphasize collaborative learning.
- At the instructor workshops, facilitators model strategies. The revised workshops will place more of an emphasis on interactive training and dialogue, such as questioning strategies, small-group activities, and sharing ideas.

## **F. Assessment and Findings**

- Trainers from the TOT workshop provided feedback on areas of the workshop to revise. Trainers also completed evaluation forms. Strategies that worked well at the TOT workshop included the organization and clarity of researched-based teaching strategies and the tricks and shortcuts on how to effectively present workshops.
- Participants at instructor workshops complete evaluation forms about the quality of the trainer and the training. Participants at workshops held in 2005–2006 liked the interaction with other participants, the opportunities to learn from peers, the

mnemonics, the Internet resources, and the handouts containing an algebra refresher and an exercise template.

## **G. Strategies for Sustaining the Initiative**

- Continue to hold CALPRO trainings on all topics, including algebra, at every PDC.
- Hold a CALPRO-wide reunion meeting to provide further professional development for instructors. At this reunion, participants will have the opportunity to gain additional training and post questions and solutions to different problems on facilitation skills.
- Revise the instructor workshop based on information received by participating at the GED Mathematics Training Institute held by the U.S. Department of Education. The revised instructor workshop is currently being reviewed by an external consultant.
- Ensure high-quality training for all participants through numeracy networking groups at regional PDCs.

## ILLINOIS ADULT LEARNING RESOURCE CENTER PROFESSIONAL DEVELOPMENT IN NUMERACY

### A. Background

The Illinois Adult Learning Resource Center (ALRC), which serves Northern Illinois, is connected to a statewide network that includes the Southern and Central Illinois Service Centers and the Center for Adult Learning Leadership. The Illinois ALRC is funded by the Illinois Community College Board and by Federal Leadership dollars.

The Illinois ALRC has been operating since 1971. Judith Diamond is the primary staff member who develops and delivers professional development in the teaching of mathematics to adults, but the service center also connects practitioners to conferences, institutes, and presentations by nationally known speakers.

### B. Goals

- Provide staff development to the entire spectrum of adult education mathematics instructors
- Make instructors aware of the research and materials available in the field
- Provide instructors with methods of presenting concepts, investing students in mathematics learning, and helping students transfer learning into real-world contexts

### C. Participants and Incentives

- Workshops, courses, institutes and presentations are open to all. However, Judith Diamond has selected instructors to pilot a mathematics software program, serve on a mathematics standards committee, and contribute to *Math Thoughts*, a quarterly newsletter that is written by adult education mathematics instructors in Illinois, Indiana, and Wisconsin. She has also selected programs to participate in an Extending Mathematical Power (EMPower) study developed by TERC and published by Key Curriculum Press.
- Participants are adult education instructors from community colleges, public schools, adult education programs, correctional institutions, and community-based organizations. No one has to be a mathematics instructor to participate in mathematics professional development activities.
- Incentives are determined by the participants' programs. Starting in fall 2006, adult educators in Illinois have to attend 6 hours of professional development per year. The need to fill the requirement may compel more instructors to participate in numeracy professional development at the Illinois ALRC.

- The number of participants depends on the type of professional development delivered. The Illinois ALRC has a database of 128 instructors who have signed up to be notified when the Illinois ALRC hosts an activity related to mathematics, whether it is online, in their classrooms, or in workshops. Judith Diamond contacts participants when she wants information or wants to try something out in a mathematics classroom.
- In addition, the Illinois ALRC has a general database of almost 4,000 instructors, many of whom are mathematics instructors and have attended professional development in mathematics. Approximately 70% of instructors who attend one mathematics workshop come back for another. Some instructors have been attending for more than 10 years. Judith Diamond views the Illinois ALRC's professional development in math as both "one-shot" for many and ongoing for many.

## D. Delivery Model

As a literacy resource center, the Illinois ALRC offers a variety of types of professional development. Workshops and courses range from 1 hour to multiple days to several weeks.

- From January 2005 to June 2006, the Illinois ALRC offered eight onsite mathematics workshops (requested and given at a specific adult education program) ranging from one session lasting 1–3 hours to two sessions lasting 2 hours; seven regional mathematics workshops lasting 4 hours each; and four online mathematics courses lasting 1 hour each.
- In spring and summer 2006, the Illinois ALRC offered a 1-day mathematics institute, a 1-day mathematics practicum, and a 2-day workshop on the Mathematical Achievement Through Problem-Solving Curriculum.
- New teacher orientations on GED mathematics and ABE (adult basic education) mathematics are each given twice a year. Approximately 13–25 teachers attend an orientation.
- The Illinois ALRC brings in nationally known speakers on mathematics and the GED and advertises adult education conferences.
- The Illinois ALRC publishes *Math Thoughts*, a quarterly newsletter that is written by adult education mathematics instructors in Illinois, Indiana, and Wisconsin. The newsletter, which has been published for 3–4 years, has a mailing list of thousands of people.
- The Illinois ALRC also reviews mathematics Web sites and software, and Judith Diamond fields questions and requests for consultations several times per week.

## **E. Instructional Components**

### **Content**

- Instructors or administrators may request consultations or customized professional development on mathematics topics that interest them. Otherwise, participants' interest, local needs, and national initiatives determine the content of the Illinois ALRC's professional development. Questions fielded cover such topics as requirements to teach mathematics, materials to use, and how to structure a class.
- Content in onsite, regional, and online professional development offered from 2005 to 2006 included the following topics: teaching GED mathematics; teaching visual fractions; incorporating financial literacy into ESL (English as a second language) lessons; introducing students to algebra; integrating mathematics, science, and social studies in GED instruction; implementing the Mathematical Achievement Through Problem-Solving Curriculum; and using Excel to help learners develop financial literacy. Professional development workshops on classroom management, strategies for multilevel classrooms, an introduction to the GED, and the "nitty-gritty of teaching adults" discussed mathematics but did not focus on it.

### **Instructional Materials**

Workshops do not focus on specific texts or publishers, but they may illustrate concepts by showing pages from attributed texts.

### **Strategies**

- Workshops make time for reflection and networking. Facilitators bring in research from the field. Groups contrast teaching philosophies and determine which philosophies the participants use, examining whether participants support the philosophy or use it because they are used to it.
- In onsite workshops, Judith Diamond often teaches a class while a group of participants watch. After class, the group discusses what they saw. Other groups work on modifying activities, integrating mathematics into other content areas, and making their own materials.

## **F. Assessment and Findings**

Several evaluations are given:

- Pre- and post workshop self-evaluations of skills and knowledge are given for workshops lasting 3 or more hours.
- An additional evaluation form asks participants to rate the presenter's knowledge of the subject; the presentation of the materials; the value of the presentation; the

balance of presentation, group work, and application; the clarity of applications for teaching and learning; and the effectiveness of handouts and visual aids. The evaluation form also asks participants to discuss whether expectations were met, what they liked, what they would improve, and what they will take back to their jobs.

- A third evaluation is sometimes given in which participants discuss what they have learned that they would like to incorporate into their philosophy, activities, and materials.

## **G. Strategies for Sustaining the Initiative**

- Ensure that state staff recognize the importance of the initiative and can advocate for continued funding
- Continue to make professional development in mathematics a part of the Illinois ALRC's activities

## **MASSACHUSETTS SYSTEM FOR ADULT BASIC EDUCATION SUPPORT ADULT BASIC EDUCATION MATH INITIATIVE**

### **A. Background**

The Massachusetts System for Adult Basic Education Support (SABES) Adult Basic Education (ABE) Math Initiative, which is funded by the Massachusetts Department of Education, is a 3-year initiative (Fiscal Years [FYs] 2006–2008) that is implemented by the state’s professional development resource center—the Massachusetts SABES. The initiative was designed by representatives from SABES, the Massachusetts Department of Education, and TERC, and trainers are both internal and external to SABES. The initiative is being implemented in all five regions of the state.

### **B. Goal**

Improve Massachusetts’ ABE mathematics instruction by training instructors to be practitioner-leaders in adult numeracy professional development

### **C. Participation and Incentives**

- Ten mathematics instructors (two per region) are selected to be practitioner-leaders each year based on their efforts and experience in mathematics education.
- Practitioner-leaders are paid for their participation. The professional development they deliver in their region is open to all instructors in the respective regions.

### **D. Delivery Model**

- The practitioner-leaders meet three to four times per year to partake in professional development and to plan short- and long-term activities for teachers in their region, ranging from a 1-day “math circus” to five 3-hour workshops delivered over the course of 6 months.
- Ongoing support is provided to the practitioner-leaders through communication with the trainers.

### **E. Instructional Components**

#### **Content**

- The practitioner-leaders participate in and plan courses and workshops for teachers in their regions. Content in FY 2006 focused on data and algebra, which are two strands of the Massachusetts ABE Curriculum Framework for Mathematics and Numeracy. Content in FY 2007 focuses on all four strands of the Curriculum Framework: algebra, data, geometry, and numbers.

- Participants have learned how to facilitate the analysis of student work and have revised the content of numeracy courses to ensure that they are linked to the state's content standards.

## **Instructional Materials**

The variety of texts and materials used includes Extending Mathematical Power (EMPower) texts, journals of the National Council of Teachers of Mathematics, videotapes, calculators, and the Annenberg Web site.

## **Strategies**

Trainers and practitioner-leaders model different ways to solve problems and use collaborative learning.

## **F. Assessment and Findings**

- Workshop evaluations are conducted.
- SABES staff conduct interviews with individuals and groups of participants to determine the impact of the professional development on instructors and to see whether programs are making changes as a result of their instructors' participation, such as offering more hours of instruction or using a greater diversity of materials.

## **G. Strategies for Sustaining the Initiative**

- Seek additional funding
- Increase the capacity in the state by encouraging programs to send more instructors, set up more vehicles in which instructors can publish their thoughts about mathematics, and create self-sustaining mathematics practitioner-leaders



## MAINE CENTER FOR ADULT LEARNING AND LITERACY PROFESSIONAL DEVELOPMENT IN NUMERACY

### A. Background

The Maine Center for Adult Learning and Literacy (CALL) is directed by Evelyn Beaulieu and has been operating for more than 25 years. Housed at the University of Maine, CALL has a yearly contract with the Adult Education Team of the Maine Department of Education, and CALL is Maine's adult education professional development project and state literacy resource center. CALL implements a variety of numeracy professional development and training for adult basic education (ABE) instructors, including online courses and workshops contracted from external professional development trainers.

### B. Goal

Provide research-based, high-quality, standards-based professional development in mathematics and numeracy to ABE instructors.

### C. Participants and Incentives

- ABE mathematics instructors volunteer to participate and are offered continuing education units for their participation.
- Twenty-six instructors participated in the online course about the mathematics standard of Equipped for the Future (EFF); 25 participated in the Extending Mathematical Power (EMPower) workshops; and more than 100 have participated in other trainings throughout the year.

### D. Delivery Model

Professional development is delivered through online courses; workshops provided by external consultants, such as TERC; and onsite trainings combined with an online course.

### E. Instructional Components

#### Content

The content used in the training depends on the goals and type of the workshop:

- *Use Math to Solve Problems and Communicate* involves a 4-day training and 4- to 6-week online course about the mathematics standard of EFF that covers number sense, algebraic reasoning, geometry, measurement, and data and statistics
- A variety of 1–2 day workshops include:

- *Math for Adult Education Teachers*: patterns, functions and relations, geometry, and measurement
- *Math—EMPower Math: Focus on Data & Graphs and Geometry & Measurement*: collecting, organizing, analyzing, and displaying data, perimeter, area, and volume of basic shapes
- *Math—Instructional Ideas for College Transitions Teachers*: strategies to help instructors prepare students for transition to college
- *Math—Using Authentic Materials*: using the teaching/learning cycle to frame mathematics activities, teaching mathematics strategies, using authentic materials to integrate mathematics with other content areas

## **Instructional Materials**

Instructional materials include *EMPower* workbooks and *College Transitions and Math for All*.

## **Strategies**

Instructional strategies promote student-centered instruction and high classroom interaction among participants.

## **F. Assessment and Findings**

Participants complete an end-of-workshop evaluation regarding their satisfaction with the training; the evaluation is shared with facilitators. According to the project director, workshop evaluations have yielded positive feedback from participants.

## **G. Strategies for Sustaining the Initiative**

Three strategies are in place to sustain numeracy professional development at CALL:

- Bring more mathematics instructors together through networking in 2007
- Continue online work, distance learning courses, and using study circles as mini-experiments and the Annenberg mathematics component
- Keep providing adult numeracy training
- Start a Maine chapter of the Adult Numeracy Network

## **MAINE: ANNENBERG'S LEARNING MATH SERIES**

### **A. Background**

Annenberg's Learning Math Series was implemented by the Portland Adult Education Center in Maine from September 2005 to June 2006. The series was directed by Pam Meader through the Portland Adult Education Center, the adult learning division of the Portland, Maine public school system.

Annenberg's Learning Math Series was aimed at providing new approaches for preparing students for the mathematics portion of the GED. Because several topics in the Annenberg Learning Math Series (designed for learners in grades K–8) address ABE numeracy topics, the director modified the materials for ABE numeracy instructor professional development.

### **B. Goals**

- Help teachers gain a better understanding of mathematics content
- Provide engaging explorations of mathematics using video, interactive activities, and problem-solving
- Encourage teachers to view mathematics as more than a rote set of rules and procedures

### **C. Participants and Incentives**

- Five instructors from various backgrounds voluntarily participated in the 2005–06 sessions through notification of program staff. Instructor backgrounds included adult basic education, adult higher education, and college preparation. A few participants had degrees in engineering, mathematics, and elementary education.
- As incentives, all participants were paid an hourly stipend for their time and received continuing education units and a certificate of completion from Annenberg.

### **D. Delivery Model**

- Participants met for ten 2-1/2 hour sessions to discuss particular lessons for that day. Participants who were not able to attend a session could download the content from a Web site.
- Follow-up online discussions were held at the course's conclusion regarding the implementation or activities in the curriculum.

## **E. Instructional Components**

### **Content**

- The series included algebra, data analysis, geometry, measurement, and number sense. These topic areas are aligned with the standards of the National Council of Mathematics Teachers (NCTM) and also follow the Adult Numeracy Network (ANN's) teaching and learning principles.
- The content included modified K–8 materials and was based on five standards of NCTM:
  - Communication—Topics covered included effective questioning, helping students understand precise language, using assignments, and presentations to clarify and deepen student's thinking. Session also included content and activities to help instructors better assess their personal and informal mathematics communication.
  - Problem Solving—Explores problem solving as a key means to introducing new materials and building conceptual understanding in students. Topics included problem selection and how to help students develop a problem-solving disposition.
  - Reasoning and Proof—Investigates how reasoning and proof provide the foundations of mathematics, at all levels and in a broad context. Topics included ways to integrate the concept of deductive proof and reasoning into instruction, particularly beyond geometry; how to help students understand how mathematical arguments work; and the meaning of such concepts as deduction, induction, validity, and conjecture.
  - Representation—Topics included how to help students understand and move fluently among representations, refining informal models, and understanding when and why to move to standard representations.
  - Connections—Explores the interrelated nature of mathematics. Topics included information on how to connect concepts within mathematics to related science, engineering technology, and nontechnical topics; and included exercises designed to help participants see how mathematics builds as a coherent, connected whole, from both grade to grade and across subject areas.

### **Instructional Materials**

Materials included interactive software videos and supplements downloaded from Annenberg's Web site. Real-world examples were offered during activities and homework sessions.

## **Strategies**

Instructional strategies included teacher reflection, collaboration, group work, homework with answers keys, and discussions about a few of the strategies that were modeled by trainers in order to foster teacher learning. Also, hands-on activities were designed to deepen learner understanding in mathematics.

## **F. Assessment and Findings**

Annenberg designed and provided evaluation forms and questionnaires to monitor the implementation of content and instructional processes in the classroom. The questionnaire data contained anecdotes and observations. Informal observations were also conducted by the trainer to gain a sense of the impact of the professional development on the participants. A formal assessment wasn't conducted by the implementing agency, and the questionnaires completed by teachers were for Annenberg's use.

## **G. Strategies for Sustaining the Initiative**

Share materials with other ABE providers and trainers and encourage them to use the materials because they are free of cost

## **NEW YORK CITY MATH EXCHANGE GROUP**

### **A. Background**

The New York City Math Exchange Group (MEG) is a group of adult education teachers who have been meeting monthly for the past 15 years. MEG was originally supported by Georgia Salley and Cathy Wilkerson of the New York Community Development Agency, but operates without a formal director or implementing agency.

Now an autonomous entity, MEG is open to anyone who teaches in the New York City metropolitan area. MEG operates on the theory that adult education teachers do not have advanced training in mathematics and need to develop their knowledge of mathematics content and of progressive instructional approaches. MEG understands that many teachers bring the alienating experiences of their own mathematics educations into their classrooms and that many teachers tend to teach mathematics the way it was taught to them.

### **B. Goals**

- Deepen teachers' mathematics content and pedagogical knowledge and help teachers feel more comfortable teaching mathematics
- Help teachers apply their knowledge about good literacy practices—such as incorporating cooperative learning, problem-solving, and critical thinking—to their mathematics classroom

### **C. Participation and Incentives**

- Teachers learn of the MEG initiative at workshops, through word of mouth, and through recommendations from adult education program managers.
- Attendance is voluntary and can be short or long term. Anyone who is interested in improving his/her knowledge of mathematics is welcome to attend.
- Participants represent workforce training, adult basic education (ABE), workplace education, adult secondary education (ASE) (preparation for the GED), teachers of English for speakers of other languages, and family literacy.
- For the early workshops, a few teachers received small (less than \$100) stipends to participate. Currently, all participation is voluntary, and teachers receive release time from their organizations to attend monthly meetings.
- An average of 12–16 people attend each monthly meeting.

## D. Delivery Model

- Study circles are scheduled monthly during the school year at adult education programs throughout New York City. Professional development is consistent and ongoing through the monthly meetings. At a typical meeting, one or two members assume a leadership role by preparing a set of problems, questions, and/or readings for attendees to study and discuss.
- Participants are sent monthly newsletters and meeting minutes via e-mail.
- MEG has delivered several 4-week institutes at the Literacy Assistance Center and has also delivered workshops at public libraries; the Literacy Assistance Center; the Department of Youth and Community Development; City University of New York; Begin Employment, Gain Independence Now (BEGIN); community-based organizations; and mathematics and adult mathematics conferences (Adults Learning Mathematics, Adult Numeracy Network, National Council of Teachers of Mathematics [NCTM]).

## E. Instructional Components

### Content

The NCTM standards are the underlying influence on MEG's content and methodology. At the outset, MEG intended to explore the applicability of the NCTM standards to the teaching of mathematics to adults in ABE/ASE/GED settings.

### Instructional Materials

- Materials have been drawn from a variety of commercial sources, including *Math Matters*; the NCTM *Navigations* series; the NCTM *Standards*; and books written by Marilyn Burns, James Hiebert, Liping Ma, and Frank Smith.
- During the past year, participants have drawn extensively from reports and articles that concern the aftermath of Hurricane Katrina. Teachers are encouraged to examine mathematics in the real world and then move to abstract concepts that they represent.
- Graphing calculators are used when appropriate.

### Strategies

- MEG believes problem solving is central to mathematics instruction, and learning is organized around this principle.
- Strategies modeled by trainers to foster teachers' learning include teacher reflection and discussion; general learning theories, as well as those specific to adults; and active problem-based learning through collaboration.

- MEG meetings mirror adult mathematics classrooms. Attendees talk about the fact the mathematics is not always easy and that there is a need for perseverance in problem solving.
- Participants are initiated into the discourse of problem solving. It is a crucial part of the MEG philosophy that teachers work on real-life problems.
- At each meeting, a member or team of members present and guide a discussion about a mathematics question or problem appropriate to adult education classes. Teachers then reflect on how they solved a particular problem, discuss the mathematics involved, and consider the application to particular levels and classes of learners.

## **F. Assessment and Findings**

- No scientific evaluation has been conducted on MEG.
- The following excerpt was taken from an essay about the work MEG is doing: “How do we evaluate MEG’s experience thus far? What impact have we had? We can certainly point to some successes. We have created a small but active community of math learners and teachers. We know and understand a lot more math than we did when we began. We have been able to serve as a resource for particular teachers and program, trying to provide richer, more challenging math education . . . Our resources are meager and the task is overwhelming. We are well aware that standards-based, engaging math instruction remains the rare exception” (Brover, Deagan, & Farina, 2000, ¶18).

## **G. Strategies for Sustaining the Initiative**

- Gain commitment from local program administrators. MEG hosts an annual meeting in which topics and activities are planned. To extend this outreach, it would be necessary for local education agencies to release a core group of people who could spearhead the professional development activities.
- Consider the geographical area. A long-term commitment is needed to sustain an initiative like MEG, which is more suitable to geographical areas with relatively dense populations. Attendees must be able to travel to the meetings in a reasonable amount of time.
- Consider some form of distance learning. MEG has discussed the use of Web-based bulletin boards.



## **OREGON OCEAN SCIENCES AND MATH COLLABORATIVE PROJECT**

### **A. Background**

The Oregon Ocean Sciences and Math Collaborative Project has been developed and implemented by a collaborative effort among the Oregon Department of Community Colleges and Workforce Development, the Oregon State University College of Oceanic and Atmospheric Sciences, the Hatfield Marine Science Center, and the Oregon Sea Grant. The project has run for 2 years (2004–2005 and 2005–2006) and will continue until 2008.

The project involves the collaboration of oceanographers and adult basic education (ABE) numeracy instructors in research activities and expeditions designed to help instructors identify and integrate ocean sciences into the mathematics/numeracy curriculum. The initiative is funded by the aforementioned agencies and was designed by representatives from those agencies, including Susan Cowles (Oregon Department of Community Colleges and Workforce Development), Dr. Robert Collier and Dr. Marta Torres (Oregon State University College of Oceanic and Atmospheric Sciences), and Jon Luke (Oregon Sea Grant).

### **B. Goal**

The goal of this initiative is to help adult education teachers integrate ocean sciences into the science, math, and critical-thinking curricula and into the professional development activities of the Oregon System of Adult Education and Workforce Development.

### **C. Participants and Incentives**

- Each year, 14 teachers are selected by their respective programs and are required to complete an application form and secure their program director's approval and recommendation to participate in the initiative.
- Participants teach in workforce training, workplace education (cannery workers), ABE, adult secondary education (ASE) (preparation for the GED), English as a second language, family literacy, and Tribal education (Confederated Tribes of the Siletz Indians) programs administered through the Oregon Department of Community Colleges and Workforce Development.
- Each participant receives a stipend, curriculum materials, "hands-on science" activities and materials, and science kits with CDs of all print materials, DVDs, videos, and calculators. They also receive transportation reimbursement. All food and lodging expenses are born by the project sponsors.

## **D. Delivery Model**

- Each group of participants attends one 3-day institute. Participants and oceanographers collaborate through electronic communication during intervals between the institutes.
- Oceanographers visit project-related ABE numeracy classrooms, and instructors collaborate with oceanographers on research expeditions to the Eastern Pacific Ocean, the Sea of Cortez, Monterey Bay, the Western Pacific/Mariana Arc, and the Drake Passage.
- Technology is used extensively during the professional development, including streaming videos, audio, and demonstration computers. Also, during the expeditions, instructors identify content from oceanography that could be related to adult numeracy and develop mathematical/numeracy problems that are posted to a Web site to be archived and shared with ABE students on land.

## **E. Instructional Components**

### **Content**

- The content is specifically related to oceanographic themes, and topic areas include the physical ocean; ocean currents; global warming; aquatic invasive species; hydrothermal vents; plate tectonics; human impact on the ocean; ocean impact on humans; climate and weather; water cycle; jobs and careers; estuaries; and the use of technology in science, such as the use of acoustics to track mammals and undersea earthquakes.
- Planners and participants developed and adapted curricula that link ocean sciences, mathematics, technology, critical thinking, and communication skills and engaged students in critical thinking, science, and mathematics learning activities.

### **Instructional Materials**

- On a Web site provided by the National Institute for Literacy, teachers document their trips to sea, develop daily science and mathematics questions for students, and disseminate ocean science curricula. Participants received CDs of all print materials, DVDs, videos, and calculators.
- Texts include Ocean Currents, Global Warming and the Greenhouse Effect, Family Science, Oceans Around Us, Math Behind the Science, the National Geographic Series Decoding Data, Puzzling Out Patterns, Thinking it Through, and an online teachers guide. Scientists also supplied free videos on aquatic and invasive species.

## **Strategies**

Strategies modeled by trainers include active learning, collaborative learning, and project-based learning, and teachers were encouraged to use those strategies with their own students.

## **F. Assessment and Findings**

- Assessment of the training involves mostly anecdotal feedback from students about trainer performance. Survey data were also collected from instructors through evaluation forms and used in formative and summative assessments. Comparisons of survey data were made as continual monitoring was provided during training.
- Participants reported gains in knowledge about the ocean and its impact on the economy and environment of Oregon, as well as its role in the Earth's ecosystem. This resulted in similar gains by learners in their programs as the instructors integrated ocean sciences into their adult education programs. All respondents reported gains in their confidence and ability to teach ocean science; an increase in the frequency with which they taught science and in their use of hands-on science activities; changes in the ways they structured classes, planned curricula, and used resources and facilities; a dramatic increase in the use of technology; and positive changes in their students as a result of using the technology.

## **G. Strategies for Sustaining the Initiative**

- Continue informal mentoring during the 2006–2007 school year while continuing to implement the initiative in 2007–2008.
- Build participation capacity by training participants to become trainers and mentoring teachers in subsequent years. Participants from the 1st year of the initiative were invited to attend the institutes in the 2nd year and mentor new teachers.
- Maintain partnerships with various institutions to sustain the initiative.

# **OREGON AND WASHINGTON STATE: THE MATH LEARNING CENTER'S PROFESSIONAL DEVELOPMENT ON VISUAL MATH**

## **A. Background**

- The Math Learning Center (MLC) has helped teachers improve the teaching and learning of mathematics for more than 30 years. The organization has received funds from Murdock Charitable Trust, the National Science Foundation, the U.S. Department of Energy, and through contracted services from school districts. From 1984 to 1990, the MLC in Salem, Oregon, conducted professional development and developed curricula on visual thinking in the teaching and learning of mathematics.
- MLC provides professional development in mathematics to teachers at all levels, some of whom teach adult basic education (ABE) mathematics through strategies that are reflective of standards and principles of the National Council of Teachers of Mathematics (NCTM).
- MLC collaborated with the Oregon State Department of Community Colleges and Work Development to provide training to ABE mathematics teachers in Visual Math. The initiative implemented in Oregon was designed and directed from a curriculum derived from visual thinking models by Eugene Maier. Susan Cowles and Dianne Ferris provided the training to ABE teachers.

## **B. Goals**

The goals of MLC's professional development on Visual Math include the following:

- Model quality practice for participants and engage participants in Visual Math activities with manipulatives to broaden their methods of computing mathematics
- Promote the incorporation of visual thinking into the teaching and learning of mathematics through curriculum development and professional development
- Incorporate the use of visual thinking into the teaching and learning of mathematics thorough teacher and curriculum development

## **C. Participants and Incentives**

- In Oregon, the majority of participants were ABE teachers who either volunteered or were nominated to attend the workshops. The Oregon model was tailored specifically for ABE and adult secondary education teachers, including English for speakers of other languages and correctional education instructors. In Washington, approximately 20–30 participants attended the workshops on Visual Math I, II, III, which are

designed for mathematics teachers at all levels, including those who teach ABE mathematics.

- Incentives depended on the program or school district and may have included stipends. Participants received workshop materials, and, depending on the workshop, some participants were eligible for post baccalaureate credit through Portland State University.

## **D. Delivery Model**

- Professional development was offered throughout Oregon and Washington. In Oregon, the initiative was offered statewide from 1996 to 2002 as full, 3-day workshops. In Washington, workshops are conducted across the state in a variety of formats, from 3-day to 5-day workshops.
- Since 1990, professional development on Visual Math has been offered to adult educators at colleges, meetings, conferences, and institutes in the form of workshops that range from 3- to 10-hours long. MLC also offered a distance-learning course for teachers in a remote region of Eastern Oregon.
- Support, such as follow-up activities provided after the professional development, depended on the school district or program.

## **E. Instructional Components**

### **Content**

- Content was designed for teachers whose students had varying backgrounds and abilities, including those who had been judged as unsuccessful in mathematics. It is also valuable for special education teachers, teachers of English language learners, and those who work with talented and gifted students.
- “Each of the three courses in the Visual Math series contains dozens of lessons and a complete year-long plan with regular homework assignments, embedded assessment, and practical suggestions for implementation.”<sup>18</sup> The content strategies are reflective of the goals of the principles and standards of NCTM.
- Workshops were offered in six areas: Visual Math I, Visual Math II, Visual Math III, Math and the Mind’s Eye, Algebra Through Visual Patterns, and Bridges in Mathematics. The content was often supplemented with discussions of pedagogy in relation to the philosophy of Visual Math. Over the years, the content of professional development has led to the development of curricula.

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<sup>18</sup> See MLC at <http://www.mathlearningcenter.org/curriculum/highschool/visual-math-components.asp>. Retrieved November 13, 2006.

- Workshops on Visual Math I and II introduced teachers to creative ways to teach patterns and algebraic thinking, shape and symmetry, measurement, and probability. Teachers explored hands-on activities that would encourage students to invent algorithms for computing with whole numbers, fractions, decimals, and percentages. Teachers investigated conceptual strategies for teaching factors, primes, and averages. All strategies reflected the spirit and goals of the principles and standards of NCTM.
- Workshops on Visual Math III introduced teachers to ways to teach arithmetic sequences, symmetry, isometries, linear and quadratic functions, graphing, and data variability and spread. Participants explored strategies for helping students invent algorithms that extended models of integer and fraction operations to operations with algebraic functions.
- Workshops on Math and the Mind’s Eye provided training on a supplemental curriculum of 14 themed units that used visual thinking to teach concepts in middle- and high-school mathematics. Each unit contained 5–10 lessons. Some units have been used by ABE instructors.
- Workshops on Algebra Through Visual Patterns provided training on an introductory algebra curriculum.
- Workshops on Bridges in Mathematics provided training on a K–5 curriculum.

## Instructional Materials

- Texts and materials included:
  - Visual Math I—Starting Points for Implementing Visual Mathematics, Visual Mathematics, Course 1
  - Visual Math II—Starting Points for Implementing Visual Mathematics, Visual Mathematics, Course II
  - Visual Math III—Starting Points for Implementing Visual Mathematics, Visual Mathematics, Course III
  - Math and the Mind’s Eye Units
- Pattern blocks and mathematics manipulatives were also used as accompanying materials
- Once curriculum materials had been developed, participants in the Visual Math I, II, and III workshops received a teacher resource guide, *Starting Points for Implementing Visual Mathematics*, and Visual Mathematics I, II, or III teacher’s guide and student activities packet.

- In some workshops, participants used graphing calculators.

## **Strategies**

- Strategies modeled by trainers to foster teachers' learning included: collaborative learning, open-ended questions and exploration, sharing, problem-solving to show various methods of reaching the same answer.
- These same strategies were modeled by trainers for teachers to use in the classroom. Trainers also modeled mathematics manipulatives and project-based learning.
- Hands-on manipulatives and basic instructional technology were used in the deliverance of the professional development.
- Activities provided are accessible to learners at various levels of understanding, allowing for differentiation of learning and instruction.
- Trainers focused on helping teachers develop their mathematics content knowledge and become aware of the multiple ways to solve problems and think about concepts. Trainers also modeled the strategies that teachers would use in the classroom.

## **F. Assessment and Findings**

- In the ABE trainings in Oregon, teacher anecdotes and feedback along with evaluation and survey data were implemented. Workshop evaluations, including anecdotal information, were collected to gain an idea of teacher satisfaction with the training. Findings showed that the Visual Math materials are applicable to ABE mathematics classrooms.
- Because MLC's goal is to build capacity among mathematics teachers, it emphasizes the use of classroom teachers to teach other teachers, which is well received by school districts.

## **G. Strategies for Sustaining the Initiative**

- Oregon has no plans to sustain the initiative.
- MLC is currently developing materials and professional development for K–12 and other adult learners.

## **PENNSYLVANIA: MAKING MATH REAL**

### **A. Background**

The Making Math Real (MMR) initiative, directed by Ellen McDevitt and coordinated by Ellen McDevitt and Sue Snider of the Greater Pittsburgh Literacy Council, was delivered to Pennsylvania adult educators from 2000 to 2004. Funded by the Pennsylvania Department of Education's Bureau of Adult Basic and Literacy Education, the initiative was awarded \$50,000 for the 1st year. The grant was renewed each year for three successive years, for \$55,000 in year 2, \$60,000 in year 3, and \$25,000 in year 4.

MMR institutes were conducted by external trainers with expertise in specific content areas. State trainers and former institute participants also led sessions. Various initiatives of the Pennsylvania Department of Education's Bureau of Adult Basic and Literacy Education (e.g., family literacy, workforce, learning disabilities, Equipped for the Future [EFF], and technology) provided a framework and content for the initiative. MMR staff also sent out a needs analysis based on themes that compose the Framework for Adult Numeracy Standards developed by the Adult Numeracy Network (ANN). According to the needs assessment, participants preferred learning about GED mathematics when the new GED was to be released; otherwise, participants preferred learning about algebra and geometry.

### **B. Goals**

Goals for the first 3 years of MMR institutes and reunion meetings were to do the following:

- Develop a cohort of numeracy practitioners in the state who are interested in changing and improving their practices and sharing their expertise with others
- Deliver information and methodologies on the best practices for teaching mathematics to adults
- Allow participants to demonstrate their understanding of four principles:
  - Mathematics is everywhere, and classroom mathematics cannot be taught in a vacuum.
  - Instructors and tutors cannot teach as they were taught because our learners didn't get it when it was taught that way in school.
  - Practitioners need to adapt the problem-solving methodology to their own environments, decreasing their reliance on cookie-cutter workbooks.
  - Everyone can "do mathematics"; there is no room in a global economy for the artificial designation of "being a mathematics person" or "not being a mathematics person."



Goals for the 4th year of MMR were all of the above plus the following:

- Help practitioners develop and field-test lessons that use instructional strategies reflecting best practices in numeracy
- Create a set of field-tested lessons with narratives that can be distributed to other numeracy practitioners

## **C. Participants and Incentives**

- To recruit participants and advertise the initiative, MMR staff and returning participants gave presentations at conferences or participated in panel discussions. Staff also posted flyers at professional development centers.
- Participants interested in attending the institute were required to complete an application that included questions on the characteristics of a good adult mathematics teacher, reasons for attending, and the importance of one of the seven themes of ANN's Framework for Adult Numeracy Standards. MMR staff reviewed applications and invited selected participants to attend. Participants returning for the 2002, 2003, and 2004 institutes had to submit a lesson plan, answer questions on how they changed their practices, and whether they had seen any changes in their learners. In addition, participants in the 2002 and 2003 parallel institutes had to submit an activity that they had tried in their classrooms that demonstrated a change in practice and was based on what they had learned at previous institutes.
- Participants were teachers of ABE, GED, correctional education, and family literacy and had to be teaching or planning to teach mathematics to adults. In year 4, administrators who thought they might be teaching mathematics also attended the institutes.
- Participants' programs paid release time, and participants received 14.5 hours of professional development credit for 3-day institutes and 5 hours of professional development credit for 1-day reunion meetings. However, local program administrators were often reluctant to allow staff to participate in more than one institute. The initiative paid the travel and lodging of participants who attended the 1-1/2 day workshop in year 4. Participants also received copies of the materials used at the institutes.
- The number of new and returning participants varied by year.
  - The first institute, from April 23–25, 2001, served 55 practitioners from 31 agencies. The first reunion meeting on October 19, 2001, had 21 participants.
  - The second institute, from May 1–3, 2002, served 48 practitioners from 29 agencies and contained a 1-day parallel institute for 21 returning participants. The second reunion meeting on October 21, 2002, had 25 participants.

- The third institute, from May 7–9, 2003, served 48 participants from 28 agencies and contained a 1-day parallel institute for 23 participants who had attended the first and/or second institutes.
- The fourth institute served 51 participants, but it was composed of two identical 1-day workshops (17 participants attended on October 23, 2003, and 12 participants attended on November 7, 2003) and a half-day workshop plus a full day of presentations at the ANN conference (22 participants attended from April 27–28, 2004).

## **D. Delivery Model**

- Three-day institutes were offered for both new and returning participants. During the 3-day institutes in 2002 and 2003, returning participants spent 1 day at a parallel institute to receive more intense professional development. Each presenter offered a 90-minute session twice to give participants opportunities to attend a greater number of sessions.
- One-day reunion meetings for returning participants are usually held in October.
- A modified institute model was offered in year 4, when funding was drastically cut back. A 1-day workshop for new and returning participants was offered at two different regions in Pennsylvania, to cut the costs of travel, lodging, and meals; and a 1-1/2 days of professional development were offered in Philadelphia. The half-day consisted of workshops with several ANN presenters, and the full day involved ANN conference presentations. The project paid for the travel and lodging of the participants who attended the 1-1/2 day sessions.
- Participants were able to share information and ideas that they learned at institutes in other ways. Ellen McDevitt e-mailed participants every few weeks with information on new online resources and dates of mathematics conferences. Participants presented and discussed their work at poster sessions at successive institutes, gave presentations at conferences, and delivered workshops at their local programs using information and methods learned at the institute. Two participants led a session during the half-day workshop on April 27, 2004, and one presented at the ANN conference on April 28, 2004.

## **E. Instructional Components**

### **Content**

- Content was determined by a needs assessment sent to practitioners identified by regional professional development centers in the fall of 2000. Participants identified reasoning, data analysis, the GED mathematics test, making connections between concepts, and calculator use as areas for development. In addition, participants at

reunion meetings were able to give feedback on previous institutes and suggest changes to upcoming ones.

- When coordinators noticed that participants were having difficulty implementing changes beyond what they had learned at the institutes, they speculated that weak mathematics content knowledge was one reason. As a result, they decided that the fourth institute, composed partly of two 1-day workshops, should focus on a single topic. Coordinators surveyed participants from previous institutes on the three mathematics topics with which they felt least comfortable and chose algebra and equations.
- Experts in the field facilitated sessions on such topics as developing word problems, teaching fractions and percentages, enhancing mathematics instruction with visual thinking, using direct instruction to teach alternative mathematics techniques, using alternative forms of assessment, using the EFF mathematics standard to develop learning activities, using Extending Mathematical Power (EMPower) materials, using scientific calculators, exploring mathematics Web sites, teaching mathematics in the context of technology, integrating mathematics with other content areas, using mathematics in the workplace, incorporating mathematics into family literacy, understanding learning disabilities and “dyscalculia,” and preparing for the GED.
- At reunion meetings, participants shared stories about how they “made mathematics real” after the institutes, discussed ways to improve the institutes, planned for the next institutes, and did mathematics activities.

## **Instructional Materials**

- Participants received binders with background information, outlines of ways to extend MMR’s message to local program sites, and session activity sheets. Participants also received kits with calculators, rulers, and manipulatives. In addition, at the end of each 90-minute session, participants had to write a mathematics problem or learning activity to reflect the session’s content. These problems were compiled into a resource book, *Practitioner’s Handbook of Word Problems*, which was sent to each participant.
- Participants at reunion meetings were urged to share classroom activities and mathematics problems, and packets were made and distributed to all who attended. Similarly, the learning activities that applicants to the 2002 and 2003 parallel institutes were required to share were copied and distributed to all returning participants.
- Each group of participants who attended an institute was given an e-mail account that they and MMR staff used to disseminate notices of meetings and conferences and share classroom ideas and activities.

## **Strategies**

- The institutes emphasized collaboration among participants and reflection on different ways to solve problems.
- Each institute began with a 2-hour mathematics scavenger hunt in which teams of participants traveled to different sites in the city and solved multi-step mathematics problems related to the location, architecture, function, or shape of the structures. (Returning participants wrote their own scavenger hunt questions instead of participating in the hunts.) The mathematics scavenger hunts created cohesiveness among participants, set the tone for collaboration and exploration, and reinforced the idea that mathematics is everywhere.
- Presenters created an environment in which mistakes were part of the learning process and not a reason for embarrassment. Participants, as a result, felt more comfortable taking risks. When they were asked to explain how they arrived at a solution, participants felt that the mathematics they did know was validated.

## **F. Assessment and Findings**

- Participants filled out evaluations after each workshop session and after each institute.
- MMR informally monitored implementation by requiring participants to re-apply for institutes by describing changes in their practices, by requiring participants to create mathematics problems and activities for sessions they attended, and by requiring or encouraging participants to share mathematics problems or activities that they tried.
- MMR staff sent local program administrators post institute questionnaires to find out if administrators had noticed any changes in the practices of participants. After the April 2001 institute, administrators responded that practitioners were using materials and techniques from the institute and the changes were having positive effects on learners. Questionnaires were not sent after the May 2002 institute because classes were drawing to a close. Questionnaires sent after the May 2003 institute received 23 responses; 12 of the responding administrators had observed the teachers after the institute and had noticed positive changes in the teaching and the learners. Finally, questionnaires sent after the fourth institute—the fall 2003 and April 2004 workshops and ANN conference—confirmed that administrators saw changes in the practices of participants. However, it was noted that it was very difficult to get responses from administrators and that there needed to be consistent follow-up.

## **G. Strategies for Sustaining the Initiative**

- Secure buy-in and commitment from state and program administrators.
- Continue to publicize the initiative to keep up the level of awareness.

- Work with several participants to provide professional development at institutes and other mathematics conferences in the future and promote the initiative. After the 1st year, participants co presented with Ellen McDevitt at MMR institutes. In other years, participants attended Pennsylvania’s annual adult education conference and either served on panels or presented on how they used what they learned from MMR in their classrooms. These participants/presenters acted as informal recruiters for MMR.

## VIRGINIA: GED AS PROJECT

### A. Background

- *GED as Project: Pathways to Passing the GED* is a curriculum guide that is available in print or online. Funded by the Virginia Department of Education's Office of Adult Education and Literacy, the guide was initiated by the Workforce Improvement Network, a partnership between James Madison University and the Virginia Literacy Foundation, and completed by the Virginia Literacy Institute at Virginia Commonwealth University. It was developed and field-tested from 2001 to 2004.
- Dr. Diane Foucar-Szocki directed the Phase 1 and 2 development teams, which produced the volumes on introduction to the GED, mathematics, reading, and writing. Barbara Gibson directed the Phase 3 development team, which produced the volume on science and social studies. The project was funded for \$200,000 per year for 3 years by the Virginia Department of Education's Office of Adult Education and Literacy.
- The *GED as Project's* inquiry process framework has recently been incorporated into GED Fast Track classes, an instructional program developed as a result of the Race to GED, a statewide initiative to increase the number of Virginians who pass the GED each year.

### B. Goals

- Provide teachers with a resource that emphasizes higher order thinking skills, problem-solving, and application in GED mathematics classes
- Allow teachers to help learners understand the scope and complexity of the GED and begin to develop the skills necessary to achieve academic success

### C. Participants and Incentives

- Teachers were informed of the guide and the workshops through the Virginia Adult Learning Resource Center (ALRC). Teachers volunteered to participate in the workshops and institutes, received hard copies of the guides, and also learned how to download the guide and student lesson plans for free.
- Adult educators and administrators with diverse characteristics participated in workshops and institutes.
- No incentives were provided to attend workshops or use the guide. Individual programs, however, may decide to compensate or reimburse teachers who attend workshops.

- An average of 20 people participated in each workshop. Overall, 1,200 teachers and administrators attended the workshops and institutes, although this number includes repeat attendees.

## **D. Delivery Model**

Two 2–3-day institutes (2003 and 2004) and workshops covered the inquiry process and *GED as Project*.

## **E. Instructional Component**

### **Content**

- Content was determined by the 2002 GED and was based on the PA version of the official practice test.
- Volume 2, Math, has nine learning projects on the following topics: number line and informational graphing; rates; algebra (variables and using equations); data analysis (mean and median); fractions, proportions, and percentages; the coordinate plane, intercepts, and slopes; and geometry (area, perimeter, and volume; angles and triangles). Each learning project consists of 2–6 inquiry activities. The mathematics volume also contains sample individual action plans and a list of skills that one can assess for 25 different mathematics problems.

### **Instructional Materials**

- A curriculum guide and video clips of instruction are available online and on a CD-ROM. A 15–30-minute video was created for each volume and shown at initial workshops; clips on the Web site are excerpted from the videotape.
- Aside from the curriculum guide, which includes inquiry activities and action plans as handouts, GED calculators were used. The curriculum guide is also on a CD-ROM, for people who cannot easily access the Internet.

### **Strategies**

- Facilitators encouraged sharing and collaboration between participants, especially about participants' thought processes and ways of solving problems. Workshops included experiential, hands-on activities.
- Teachers learn how to facilitate discovery learning through the inquiry process and how to shift from a heavy reliance on direct instruction to a greater balance between guidance and instruction, structuring activities around students' strengths.

## **F. Assessment and Findings**

Workshop evaluations have been conducted. Staff has also solicited feedback from the Virginia ALRC Advisory Board.

## **G. Strategies for Sustaining the Initiative**

- Promote delivery in other states. Pennsylvania has started to offer courses and professional development on *GED as Project*.
- Make sure implementing agency can sustain commitment to initiative. The Web site has been transferred to Virginia Commonwealth University to sustain the initiative.



## VIRGINIA: MAKING MATH MEANINGFUL

### A. Background

- Making Math Meaningful (MMM) workshops were designed by Myrna Manly and sponsored by the Virginia Adult Learning Resource Center, which is funded by the Virginia Department of Education’s Office of Adult Education and Literacy. The workshops were implemented in Virginia from 2004 to 2005.
- The workshops were developed to strengthen teachers’ mathematics skills and methods for teaching GED mathematics, especially given the governor’s 2004 “Race to GED” initiative, which aims to increase the number of Virginians who pass the GED each year.

### B. Goals

- Help participants to recognize the importance of maintaining a cohesive curriculum while trying to erase skills gaps of individuals
- Teach participants strategies and techniques for encouraging students to reason independently about important mathematical concepts
- Encourage participants to focus on two fundamental strands—proportional reasoning and algebraic reasoning—and how to incorporate them early in adult basic education and build on them in GED preparation

### C. Participants and Incentives

- The workshops were advertised by the Virginia Adult Learning Resource Center (ALRC), and participants volunteered to attend.
- Characteristics of participants were diverse. Instructors were both new and seasoned.
- Incentives were free transportation, lunch, and copies of Manly’s *GED Math Problem Solver: Reasoning Skills for Application* and the *GED as Project* mathematics volume. Some programs paid teachers to attend, but most did not.
- More than 100 teachers participated in 2004–2005, with approximately 20–30 participants attending each workshop.

### D. Delivery Model

- Manly conducted one 3-hour workshop and three 6-hour workshops, each in a different region of Virginia.

- Follow-up sessions were provided at a state conference for teachers who had attended previous MMM workshops.

## **E. Instructional Components**

### **Content**

The workshops covered the inquiry process approach from *GED as Project*, the requirements of the GED, proportional reasoning and algebraic reasoning, and classroom activities that bridge teaching to the test and teaching for understanding.

### **Instructional Materials**

GED calculators, copies of the *GED Math Problem Solver: Reasoning Skills for Application*, and copies of the *GED as Project* math volume were used.

### **Strategies**

- Sharing and collaboration between participants were encouraged, especially regarding participants' thought processes and ways of solving problems. Student errors were used to structure activities and guide examples.
- The inquiry process approach, active learning, and cooperative learning were strategies modeled for teachers to use in their classrooms.

## **F. Assessment and Findings**

Workshop evaluations were conducted. The Virginia ALRC reports that regional workshops received high evaluation ratings. On a scale from 1 to 5, the average score for the workshops was 4.9. Staff also solicited informal feedback from program directors and the advisory board. Findings are not available.

## **G. Strategies for Sustaining the Initiative**

Make sure that trainer/designer continues to have venues to impact and reinforce quality methods of mathematics instruction. Manly became part of GED Content Standards development for the state and returned to serve as content expert for the Virginia Numeracy Project.

## **VIRGINIA NUMERACY PROJECT**

### **A. Background**

The Virginia Numeracy Project is implemented by the Virginia Adult Learning Resource Center (ALRC), which is funded by the Virginia Department of Education's Office of Adult Education and Literacy. Directed by Susan Holt, the Virginia Numeracy Project is one project in a four-part adult basic education (ABE) professional development initiative. The three other projects focus on professional judgment in the classroom, best practices in ABE, and reading.

The Virginia Numeracy Project began in 2006 by training seven adult educators to plan professional development for teachers in their regions. The seven trainers participated in a 2-day train-the-trainer workshop that was led by Myrna Manly, and the trainers subsequently provided numeracy professional development across the state.

### **B. Goals**

- Teach a conceptual approach to numeracy instruction that improves statistics of the National Reporting System for Adult Education, increases success rates on the GED, and retains learners
- Build state capacity to deliver professional development

### **C. Participants and Incentives**

Participation and incentives vary by program. Teachers may participate in workshops that the Virginia ALRC advertises in their areas, or program directors may contract with a trainer to lead professional development or a study circle for their programs. Participants are ABE and GED mathematics instructors.

### **D. Delivery Model**

- A 2-day train-the-trainer workshop for seven trainers occurred on March 23–24, 2006. The trainers meet every few months to plan professional development for their regions.
- Each trainer may facilitate any number of 4-hour or 7-hour workshops, depending on the need and requests in the region. Four-hour workshops provide instruction on one mathematics strand, and seven-hour workshops provide instruction on two strands. As of October 2006, 15 workshops will have been delivered. Eight more are scheduled through March 2007, as of the date of this report. Furthermore, the Virginia Department of Correctional Education has contracted with the Virginia ALRC for Fiscal Year 2006–2007 to deliver at least five trainings that are customized to the incarcerated learner.

- Program directors may request a trainer to lead a study circle with their teachers as follow-up. Study circles would meet for 1-1/2–2 hours each month for 2–3 months. Study circles are funded by the Virginia ALRC. The first study circle will be delivered in fall 2006.
- Program directors may contract independently with a trainer to conduct workshops.

## E. Instructional Components

### Content

The seven trainers developed content for regional workshops around the following conceptual strands: numbers and number sense, patterns and algebra, measurement and geometry, and data and statistics. The trainers teach one strand in a 4-hour workshop and two strands in a 7-hour workshop.

### Instructional Materials

Texts and materials range from Myrna Manly's *GED Math Problem Solver: Reasoning Skills for Application* to manipulatives. Each trainer has been provided with a large trainer kit that is filled with a variety of manipulatives ranging from manufactured plastic geoboards to such everyday household items as beans and straws.

### Strategies

Participants engage in experiential, hands-on activities and have opportunities to share and discuss their ideas.

## F. Assessment and Findings

- Trainers conduct two onsite evaluations during a workshop. The participants fill out a “next steps” card on which they capture ideas that they would like to implement upon returning to the classroom. This card is then mailed to participants 2 weeks after the workshop. The participants also complete a workshop evaluation at the end of each workshop.
- To assess the effectiveness of the training, an online survey is e-mailed to all participating teachers 2 months after each workshop. The survey asks questions about the relevancy of the workshop material to participants' classes; how participants have implemented what they learned; and what positive effect, if any, the new methods are having on students.
- Staff also solicited informal feedback from the advisory board and program directors.

## **G. Strategies for Sustaining the Initiative**

The initiative plans to incorporate the Virginia's new content standards into a training and follow-up professional development project.

## **EQUIPPED FOR THE FUTURE: USE MATH TO SOLVE PROBLEMS AND COMMUNICATE**

### **A. Background**

Professional development on the Equipped for the Future (EFF) Use Math to Solve Problems and Communicate standard and performance continuum is currently being implemented in four states and the District of Columbia by the EFF Center for Training and Technical Assistance at the University of Tennessee's Center for Literacy Studies. Diane Gardner directs the EFF initiative and the math component of EFF. Donna Curry designed the professional development, and Donna Curry and Aaron Kohring are the primary trainers.

The National Institute for Literacy (NIFL) funded EFF from 1994 to 2004. The majority of work on Use Math to Solve Problems and Communicate, however, occurred after NIFL's funding ended. Now, most of EFF's professional development is fee-for-service. Fees are based on the level of customization and the scope of work.

Oklahoma, Rhode Island, New Jersey, Washington State, and the District of Columbia are currently training teachers on the Use Math to Solve Problems and Communicate standard and performance continuum. New Jersey and Oklahoma, in particular, are working to integrate EFF into their statewide professional development systems. Maine, Tennessee, and Ohio are other states that have provided this training. This summary discusses Oklahoma's EFF initiative in more detail than other states because additional data were collected.

### **B. Goals**

- Deepen teachers' knowledge and application of the Use Math to Solve Problems and Communicate standard and performance continuum
- Help teachers plan standards-based lessons using the EFF Teaching/Learning cycle
- Broaden teachers' knowledge of mathematics and mathematics strategies to make "higher level" mathematics more accessible at lower levels (i.e., to teach all four mathematics strands across all levels)

### **C. Participants and Incentives**

- Selection of participants varies by state. In some states, teachers apply to participate or are self-selected. In Oklahoma, the state professional development coordinator selects pilot programs, and every teacher who attended the first year of EFF professional development, composed of an orientation and training on the reading standard, attended the second year, which focused on mathematics. Nine of 39 Oklahoma programs participated in the 2005–2006 mathematics workshops.

- Characteristics of participants are diverse. In Oklahoma, participants included directors and teachers from adult basic education, English as a second language, and family literacy programs.
- Incentives for participants vary by state. In Oklahoma, participants received release time, a stipend for attending, and a stipend for transportation.
- Numbers of participants vary by state. In Oklahoma, 33 participants from nine adult education programs participated.

## **D. Delivery Model**

- The duration and model of professional development varies by state. EFF offers workshops and classroom demonstrations with homework, online courses, conference calls, site visits, e-mail communication, and demonstration and modeling in the interim.
- The average model for professional development on the EFF standard is three 2-day workshops spread over 4–9 months and with assigned activities in the interim. EFF works with its partners and adapts the training schedule when needed. For example, the training has been offered as a series of three 1-day workshops and two 2-day workshops.
- EFF offers an online course on the mathematics standard and performance continuum as one of the optional interim activities of the training series. The course is 4 weeks in duration and requires 2–4 hours of work per week. The online course is an integral component of the year-long training offered to states. Although it was not designed as a stand-alone form of professional development, it can be offered as such.
- Maine offered three sessions of onsite professional development and an online course in 2004–2005. In 2006, Maine offered two 1-day sessions on using authentic materials to teach EFF mathematics.
- New Jersey offered four professional development sessions and an online course. The EFF facilitator also modeled how to integrate the EFF mathematics standard in the classroom. Additionally, New Jersey has asked EFF to help develop a four-module online orientation course in which EFF is integrated for new teachers.
- Oklahoma offered three 2-day workshops from October 2005 to April 2006. These workshops focused on teaching mathematics through the EFF standard and the newly developed curriculum framework, the latter of which EFF developed in partnership with Oklahoma. Between workshops, teachers developed mathematics activities based on the Teaching/Learning Cycle and the curriculum framework and received feedback by e-mail. A 2-day refresher workshop was held in July 2006 that covered the integration of the frameworks of the reading and mathematics curricula.

- Rhode Island offered three 1-day workshops, extending from November 2005 to March 2006. Through a field-led process that was spearheaded by EFF trainers, Rhode Island has adapted the EFF mathematics standard and will be piloting the standard in fall 2006.
- Tennessee has implemented training on the EFF mathematics standard over the course of 3 years. In year 1, the state offered three professional development sessions. In years 2 and 3, the state offered two sessions over the course of both years. Tennessee has also used online courses.
- Washington, DC, introduced the EFF mathematics standard through a series of three 1-day training sessions extending over a period of several months. The training was designed to provide opportunities for instructors to learn how to use authentic materials to teach all four mathematics strands across all levels of learners.
- The state of Washington has implemented training on the EFF mathematics standard over the past several years. EFF staff have delivered the online course to instructors and have offered sessions at the 2006 summer conference. EFF staff are currently negotiating with the state to provide professional development over the next several months on the EFF standards.

## **E. Instructional Components**

### **Content**

- The content of the mathematics professional development is customized to states' needs, and the trainers often include more instruction in mathematics content when they ascertain the levels of participants' skills and knowledge.
- The content draws on EFF research, the Use Math to Solve Problems and Communicate standard and performance continuum, the Teaching/Learning Cycle, standards of the National Council of Teachers of Mathematics, and the research upon which those standards are based.
- Donna Curry uses the performance continuum to help participants break away from the traditional mathematics sequence and show them that they should not wait to introduce students to number sense, algebra, geometry, and data and statistics.
- Oklahoma contracted with EFF to develop a mathematics curriculum framework. This framework was integrated into the professional development. The curriculum framework describes four mathematics strands—number sense, algebra, geometry, and data and statistics—and gives examples of how the strands are integrated at each level of performance on the continuum.
- The online course focuses on the Teaching/Learning Cycle in mathematics and is offered between sessions. Two courses are offered in each content area—one for



supervisors and administrators and one for teachers. Supervisors are asked to read articles, such as EFF Research to Practice notes, and discuss them with their teachers at weekly meetings. Supervisors are also asked to think about how to further integrate EFF into programs and classes. Teachers are asked to apply steps of the Teaching/Learning Cycle using the EFF mathematics standard and reflect on their practice.

## **Instructional Materials**

- Texts and materials vary across states but include EFF handouts, such as those on the Teaching/Learning Cycle, and authentic materials that teachers are asked to bring in. Teachers have opportunities within the training to be learners themselves. They use manipulatives and other concrete materials as high-level mathematics topics are modeled for use with students at very basic instructional levels.
- In Oklahoma, state staff purchased a complete set of Extending Mathematical Power (EMPower) materials for every EFF math participant—teachers and program directors alike—and distributed them during the second training session. Materials will also be purchased for future cohorts. The EMPower materials give the participants and practitioners something concrete to work with as they re-conceptualize how to teach mathematics to low-level learners. The EMPower materials also help them think about ways to use existing materials or create their own activities.

## **Strategies**

- Professional development is group-centered, interactive, participatory, and reflective. Facilitators model strategies and techniques during the sessions and in actual classrooms.
- EFF is founded on the concept that all adults have experience using mathematics, and before instruction begins, teachers should find out what strategies learners use when they are not “doing” school mathematics. The teacher then builds on that knowledge and experience. EFF is also based on the most recent research on how people learn in general and how students learn mathematics concepts in particular.

## **F. Assessment and Findings**

- EFF staff collected information from participants through pre- and post workshop surveys. In 2006–2007, the staff wants to conduct an additional survey several months after the professional development.
- Some states are also collecting data on the impact of EFF. EFF staff reported that Oklahoma has the most extensive data collection plan. The state has collected data from 2003–2004 and 2004–2005 and is comparing student retention and grade-level gains in EFF and non-EFF classrooms. (The data do not specify the content areas of

the classes.) Oklahoma has found a 4% increase in the number of students in EFF classes who completed a learning level and a 4% decrease in non-EFF classes. Oklahoma's data show that this 4% increase was accomplished in EFF classes in fewer contact hours, whereas non-EFF classes had a 12% increase in contact hours. Also, 38% fewer students dropped out of EFF classes before they completed a learning level. Finally, EFF classes reported a 25% increase in the number of students who were staying long enough to be appropriately post tested. Non-EFF classes only had an increase of 8% of students who stayed long enough to be post tested.

## **G. Strategies for Sustaining the Initiative**

- Develop interest and commitment at the top level, as exemplified by New Jersey and Oklahoma. In Oklahoma, state-level staff has attended every mathematics training session and has worked collaboratively with EFF and the national trainers.
- Think systematically about the big picture from the beginning of the initiative. Oklahoma wrote separate goals and objectives for adult learners, teachers, directors, and state-level staff. These goals and objectives have not changed. The staff has added program objectives as new standards have been implemented, and these new objectives have helped guide them.
- Listen to what teachers and directors say about professional development and make changes accordingly. Oklahoma added an EFF orientation that precedes the mathematics training and made other modifications based on participants' recommendations.
- Build state capacity to continue professional development. EFF will offer train-the-trainer opportunities to any state or program that is interested. In Oklahoma, for example, EFF will mentor and train three practitioners from the year 1 training cohort to become EFF specialists. Over time, EFF specialists may develop training materials, deliver training, provide technical assistance, and support other EFF state specialists, state staff, and practitioners.

## **EMPOWER CURRICULUM**

### **A. Background**

Extending Mathematical Power (EMPower) is a comprehensive curriculum developed by and implemented through TERC, a Cambridge, Massachusetts, nonprofit mathematics and science education organization. The curriculum, which was developed over the course of 5 years, is designed for out-of-school youth, adult learners, and other nontraditional students enrolled in adult basic education (ABE), pre-GED, GED/high school equivalency, and transitional courses to college. The instructional materials development project was funded by the National Science Foundation (ESI 9911410).

The curriculum design team includes co directors Mary Jane Schmitt and Myriam Steinback, along with Donna Curry, Tricia Donovan, Marlene Kliman, and Martha Merson—a collaborative group of teachers and researchers with expertise in adult mathematics education and K–12 mathematics reform. The design team provided training and ongoing support for pilot and field test teachers. Now that the curriculum is commercially available through Key Curriculum Press, the TERC team continues to provide teacher support through EMPower professional development workshops.

### **B. Goals**

- Fill the training needs for mathematics and numeracy in ABE.
- Help adults develop mathematical proficiency by combining the best teaching practices of the past two decades with insights culled from educational research and classroom practice. The curriculum focuses on mathematical reasoning, communication, and problem solving, with strategies and approaches designed to encourage classroom discourse and appeal to a broad spectrum of learning styles.

### **C. Participants and Incentives**

- There were 50 participants in the curriculum pilot training, primarily ABE teachers selected based on their ABE mathematics teaching background and experience.
- Instructors received a stipend and materials for participating in the curriculum implementation pilot training.

### **D. Delivery Model**

The format of the training initiative was a product development model, which included pilot testing of the EMPower curriculum. Participants were trained to use the EMPower curriculum, and e-mail communication was used in conjunction with institute materials.

## E. Instructional Components

### Content

- Staff held several focus groups with ABE and GED teachers and K–12 practitioners to examine how to integrate the standards of the National Council of Teachers of Mathematics into the curriculum.
- A needs assessment was conducted with participating agencies before implementation of the pilot to adapt to the professional development systems of the respective agencies.
- The content areas include number and operation sense (including proportional reasoning), patterns, functions and relations (algebraic thinking), geometry and measurement (geometric and spatial thinking), data, statistics, and graphs.

### Instructional Materials

Eight books for students and corresponding books for teachers were developed:

- *Over, Around, and Within: Geometry and Measurement*
- *Everyday Number Sense: Mental Math and Visual Models*
- *Using Benchmarks: Fractions, Decimals, and Percents*
- *Many Points Make a Point: Data and Graphs.*
- *Split It Up: More Fractions, Decimals, and Percents*
- *Seeking Patterns, Building Rules: Algebraic Thinking*
- *Keeping Things in Proportion: Reasoning With Ratios*
- *Operations Sense: Even More Fractions, Decimals, and Percents*

### Strategies

Strategies include active learning, collaborative learning, project-based learning, facilitating investigations, and problem solving. Teachers are encouraged to transfer techniques used during the training to their classrooms.

## F. Assessment and Findings

- Research assistants collected data through classroom visits, telephone interviews, and e-mails. Students were asked to complete questionnaires, and students' pre- and

posttest scores on the Test of Adult Basic Education were used as additional data sources.

- Assessment data revealed that a positive change was observed in the discourse among students in the classroom and in concept development. There was also a noted change in students' confidence level; results from the student questionnaire demonstrated that students liked mathematics more after their teachers participated in the training.

## **G. Strategies for Sustaining the Initiative**

- Expand the curriculum training to reach other adult education teachers. This has begun in two ways: through TERC's EMPOWER professional development workshops and to some extent through Project TIAN (Teachers Investigating Adult Numeracy). EMPOWER professional development workshops have been conducted in 2005 and 2006 in California, Maine, and Massachusetts. TERC plans to develop interactive activities on Web sites for teachers.
- Broaden the audience beyond adult education. The EMPOWER curriculum is being used with incarcerated youth at the Division of Youth Services programs in Massachusetts and will be piloted in 2007 with developmental community college classes in Cincinnati.
- Seek additional funding for both exploratory and impact research that can be used to continue to improve the initiative.

## **EMPOWER PROFESSIONAL DEVELOPMENT WORKSHOPS**

### **A. Background**

Extending Mathematical Power (EMPower) Professional Development Workshops are designed to provide numeracy professional development through the use of the EMPower curriculum developed by TERC, a Cambridge, Massachusetts, nonprofit mathematics and science education organization. The training is directed by Mary Jane Schmitt in collaboration with teacher leaders who receive training in the EMPower curriculum. The project is funded through a fee-for-service structure.

### **B. Goals**

- Support teachers and programs in using the EMPower curriculum
- Foster a shift in the practice of mathematics education to make mathematics accessible to students at all levels

### **C. Participants and Incentives**

- Participant selection for EMPower Professional Development Workshops depends on the needs of adult education programs. Publishers of the EMPower curriculum outreach to program prospects who show interest in training—including sending postcards to interested parties—and respective program directors make arrangements to implement the training, including selecting participants.
- Participants include teachers of adult basic education and some generalist teachers and others who teach mathematics, and participant characteristics vary from program to program.
- Depending on the program, participants receive teacher and student books along with specific curriculum-related materials.
- Participant numbers vary and depend on programmatic factors for individual programs. On average, 30 teachers participate per training.

### **D. Delivery Model**

One- or 2-day customizable, intensive workshops encourage communication about mathematics by integrating reflection on practice with hands-on mathematical investigations.

## **E. Instructional Components**

### **Content**

Content for the training depends on the needs of clients and may include any of the EMPOWER books listed in the EMPOWER curriculum initiative summary.

### **Instructional Materials**

The EMPOWER curriculum and books serve as the main instructional materials, and teachers also use calculators, spreadsheets, and the Internet to complement the training materials.

### **Strategies**

- Instructional strategies embedded in the EMPOWER curriculum include active learning, collaborative learning, and project-based learning, all of which are supported by research in mathematics education.
- Teachers are encouraged to use all strategies modeled by trainers in their classroom, such as asking good questions, being more of a facilitator than explainer, justifying reasoning, using and solving mathematics in context, and learning how to perform mathematic methods through solving mathematic problems.

## **F. Assessment and Findings**

A training evaluation is used to help determine the level of participant satisfaction at the end of the training. Results of the evaluation summaries are positive and suggest that teachers value the training.

## **G. Strategies for Sustaining the Initiative**

- Notify the field about the EMPOWER Curriculum
- Create more ways to collect information about the impact of the program, including strategies for following up after training

## **GED MATHEMATICS TRAINING INSTITUTE**

### **A. Background**

The GED Mathematics Training Institute, held August 22–24, 2006, in Arlington, Virginia, was coordinated by Kathy Chernus of MPR Associates and designed and implemented by Susan Pittman and Bonnie Vondracek of Vondracek Enterprises, Inc., MPR Associates, and a team of mathematics consultants, including Esther Leonelli, Myrna Manly, and Mary Jane Schmitt. The GED Mathematics Training Institute was funded by a grant from the U. S. Department of Education’s Office of Vocational and Adult Education (OVAE).

### **B. Goals**

- Prepare state-level staff to improve mathematics instruction for adult learners
- Provide trainers with the information and tools to conduct professional development for GED teachers and help GED teachers recognize and provide remediation for their students’ areas of difficulty

### **C. Participants and Incentives**

- Each state was asked to select two participants, one specializing in mathematics and the other specializing in professional development. The grant funded the mathematics specialist, and the state funded the professional development specialist.
- A total of 106 people attended the institute—presenters, guests, and 85 participants from states. Six states did not send participants; some states sent three.
- States determined whether participants received incentives or stipends. All participants received copies of the materials used at the institute.

### **D. Delivery Model**

Professional development was provided through a 2-day institute. Experts in specific content areas facilitated the sessions.

### **E. Instructional Components**

#### **Content**

- Content was determined through MPR Associates’ identification of skills deficits of GED candidates who failed to pass the mathematics exam.
- The institute provided an overview of the types of questions most frequently missed on the GED. It covered algebra, geometry and measurement (including the van Heile



theory of developing geometric reasoning), reading and interpreting graphs and tables, applying basic mathematics principles to calculation, and problem-solving and mathematical reasoning.

## **Instructional Materials**

Participants used GED calculators and received a 300-page manual, which was also saved on a CD-ROM, containing PowerPoint presentations with presenters' notes; lists of references and Web sites; calculators and manipulatives; GED mathematics test formulas; format grids; games; and information on developing lesson plans. Participants also received copies of the lesson plans from 15 groups.

## **Strategies**

- The institute included direct instruction and experiential, hands-on learning. There was a combination of large-group and small-group sessions. Participants worked in small groups on a variety of problems and planned lessons based on the institute's content.
- Facilitators modeled instructional strategies, anticipating that participants would use what they learned to provide professional development to GED teachers.

## **F. Assessment and Findings**

- Participants completed evaluations of the quality of the institute and the presentations.
- OVAE may informally assess impact and implementation by speaking with states at state directors' meetings or by conducting telephone interviews with randomly selected states.

## **G. Strategies for Sustaining the Initiative**

- Engage state directors in the development of a plan before and after the institute.
- Require each state to submit an implementation plan. The initial statement of work required participants to develop follow-up and outreach activities, and the U.S. Department of Education would use this plan to assess and monitor the impact of the institute. These activities were removed when funding was not provided for follow-up. However, participants were still provided with blank implementation plans, and they were requested to provide professional development to instructors in their home states. Some participants have informed MPR Associates of the ways in which they are implementing what they have learned.

## **PROFESSIONAL DEVELOPMENT KIT**

### **A. Background**

The Professional Development Kit (PDK), developed by the University of Pennsylvania's National Center on Adult Literacy (NCAL) and SRI International, was funded by the U.S. Department of Education's Office of Vocational and Adult Education. PDK was developed from 1999–2001 and revised through 2003, with pilot tests in Connecticut and New York and institutes in Michigan using the PDK resources for writing, reading disabilities, and integrating technology and numeracy. Limited information is available on this initiative.

The underlying concept of PDK is that teachers learn and grow primarily from examining their own and others' decisions in the classroom and from deconstructing students' trajectories. PDK is designed for teachers in adult basic education (ABE), GED, and English as a second language (ESL) programs and in reading, writing, and mathematics.

The pilot states, as well as other states and programs, used PDK to structure their professional development systems. For example, if a program delivered a workshop on improving instruction on fractions, facilitators could play a video clip from PDK's CD-ROM and discuss the teacher's instructional decisions and interactions with learners. Participants would then brainstorm possible activities related to fractions that could be used in their own classrooms and use the online teacher resource section to read pertinent research, develop and store action plans, keep journals, and log classroom research. Participants could also discuss and view the work of others on online bulletin boards.

### **B. Goals**

- Provide systematic and sustainable professional development for a diverse audience of adult educators
- Support and/or structure other professional development activities of states, programs, groups, and individuals
- Provide a model of teacher research and enable practitioners to analyze and reflect on their instructional practices and decision-making.

### **C. Participants and Incentives**

- States, regions, programs, and individuals could use PDK. When PDK was funded, all state directors received CD-ROMs that contained video content; others received CD-ROMs after attending conference presentations or by requesting copies. Once funding ceased, only online resources were available to the public.
- Participants in the pilot tests and Michigan institutes were selected in different ways. In Michigan, facilitators were recruited through invitations placed on the state's Web

site and listservs, and NCAL staff reviewed applications and selected potential facilitators, who ranged from administrators to doctoral students with teaching backgrounds to experienced teachers.

- Participants were ABE, ESL, and GED practitioners and staff development professionals. Nearly 200 teachers participated in Michigan's institutes on writing, reading disabilities, and integrating technology and numeracy.
- Information on the incentives that participants received or the exact number of participants is not known. Because there was no funding for implementation, it is impossible to know how many people have used the various components of PDK and for which purposes and content areas.

## **D. Delivery Model**

- During the funded development period, professional development was generally delivered via initial and summative face-to-face meetings, with teachers working on their research projects between meetings. PDK's CD-ROM and Web site resources were used to support, document, and share teacher research and provided a forum for participants to communicate and collaborate. PDK staff also provided coaching and mentoring to workshop and institute participants.
- The technology was designed to connect teachers to one another and give them access to other teachers' classrooms and the most current research. The CD-ROM contains more than 8 hours of video featuring ABE, ESL, and GED reading, writing, and mathematics classes. The Web site contains public and private bulletin boards, personal storage space, and an online library of research articles and handouts, such as action plans.
- The Michigan professional development institute on integrating technology and numeracy followed a different model from the train-the-trainer model of the other institutes. PDK staff decided to model the first half of the institute after the Making Math Real Institute in Pennsylvania. Researchers and teacher educators—such as Myrna Manly, Esther Leonelli, Susan Cowles, and Mary Jane Schmitt—provided 2-day workshops on a variety of topics. At the end of the 2 days, participants identified research questions that they could investigate in their own classrooms. Six to 8 weeks later, the participants convened for 2 days in smaller regional groups to present and discuss their findings with the group and with mathematics educator/PDK facilitator Lynda Ginsburg. Each group of teachers also engaged in and discussed additional pedagogical activities. In the interim, participants had conference calls and online discussions with their groups and with PDK facilitators.
- Although PDK is no longer funded and the Web site is no longer updated, it is still possible to use the Web site to read articles, store action plans, post work, and chat with others on the bulletin boards. The videotapes were saved on a CD-ROM instead

of the Web site because the computers owned by most users at the time were not capable of downloading video.

## **E. Instructional Components**

### **Content**

- PDK's topic areas within ABE, ESL, and GED reading, writing, and mathematics were selected in response to a national needs assessment that PDK sent to adult literacy and ESL practitioners from April, 30, 1999, to June 30, 1999. Feedback from focus groups and the pilot tests further defined PDK's topics.
- Viewers of the videotaped mathematics class, taught by Esther Leonelli, can watch the class discuss various approaches to a word problem and see how she handles assessment, motivation, a multilevel classroom, teacher roles, and questioning techniques.

### **Instructional Materials**

- Materials may have been provided in face-to-face workshops. Action plans, math-related articles, and links to other websites are still available on PDK's website.

### **Strategies**

- PDK believes that to be meaningful and effective, professional development must be connected to classroom instruction; extend over a period of time; and teachers must be able to try new things in the classroom, conduct research, and reflect on their practice. Lynda Ginsburg calls PDK a "grand instantiation of that perspective."
- In the videotaped mathematics class, Esther Leonelli models strategies that teachers can use in their classrooms, and she views herself as a learner in her classroom. She selects problems that relate to students' lives, poses open-ended questions to help students find solutions themselves, and supports each student's approach to problem-solving. She breaks students into small groups to accommodate the variety of levels in her classroom. She encourages her students to assess themselves and their understanding.

## **F. Assessment and Findings**

SRI International conducted formative evaluations in spring 2001 and a summative evaluation in summer 2001, both of which assessed the quality of the professional development and changes in teachers' practice. Interviews were also conducted with pilot-test teachers. Findings of the evaluations and interviews are unavailable.

## **G. Strategies for Sustaining the Initiative**

The delivery model was designed so that participants could use the available resources, create their own materials, and do their own research. Funding was not available to document who continues to use and implement PDK.

## **TEACHERS INVESTIGATING ADULT NUMERACY**

### **A. Background**

Teachers Investigating Adult Numeracy (TIAN) is a national, 4-year research and development initiative (2005–2009) to pilot and field-test a professional development model for mathematics teachers of adult basic education and adult secondary education. Funded by the National Science Foundation (ESI 0455610), TIAN is a joint initiative of the University of Tennessee’s Center for Literacy Studies and TERC. Principal investigators are Beth Bingman and Mary Jane Schmitt. The initiative was designed by Beth Bingman, Mary Jane Schmitt, and Donna Curry. Mary Jane Schmitt and Donna Curry lead the institutes.

The initiative is organized into several phases. In year 1 (2005–2006), Massachusetts and Ohio participated in TIAN’s pilot study. In year 2 (2006–2007), Arizona, Kansas, Louisiana, and Rhode Island will participate in TIAN’s field test. Follow-up data will be gathered from the pilot and field-test states in year 2 and year 3 (2007–2008) via interviews and pre- and post observations. Four participants from the pilot sites have been selected to be trained to help facilitate institutes in the field-test sites. In year 4 (2008–2009), follow-up data will continue to be gathered, and reports, including teacher case studies, will be developed.

### **B. Goals**

- Deepen teachers’ mathematical content knowledge and pedagogical knowledge
- Increase teachers’ understanding and use of state mathematics content standards
- Build states’ capacity to support professional development in mathematics

### **C. Participants and Incentives**

- TIAN staff posted notices on e-mail lists and helped states develop a generic letter to send to program directors and teachers. Programs advertised the initiative to teachers.
- States apply to participate in the pilot study and field tests. The application process requires that states secure 20 teachers who teach mathematics to attend the institutes, be able to pay for teachers’ stipends and other expenses, have mathematics standards or be developing them, and have a professional development system in place to foster systemic change. The TIAN team meets with applicants to judge how well the initiative would fit into their future plans.
- States select teachers in different ways, and participation is voluntary. Some states choose teachers from every region; other states choose the best candidates and worry less about ensuring representation from all regions. Teachers bring a diverse range of mathematics experience and program areas. Representatives from state and regional professional development centers also receive the professional development.

- All participants receive stipends for their participation during and between the institutes and for their involvement in the data collection. States provide other incentives, such as certificates for hours of training (Ohio) and participation points (Massachusetts). In the pilot study, TIAN paid stipends for participation and stipends for data collection. In the field tests, the states pay the stipends for participation, and TIAN pays the stipends for data collection. Participants also receive materials from the Extending Mathematical Power (EMPower) curriculum.
- Twenty teachers and 2–3 professional development staff participate from each state.

## **D. Delivery Model**

- Participants attend three intensive, 2-day institutes over the course of 1 year.
- In the time between the institutes, participants try out lessons and activities in their classrooms.
- Between institutes, for a total of four times during the year, participants meet or have conference calls with other teachers in their region to discuss their classroom investigations, talk about articles on mathematics research, and try out activities and problems. These subgroup meetings are not facilitated by TIAN staff, but each subgroup must submit meeting notes to its trainer. In some states, professional development staff attend regional meetings but do not lead them.
- Participants communicate via e-mail with their trainers and each other.

## **E. Instructional Components**

### **Content**

- The first institute focused on data analysis. The second focused on algebraic thinking. The third institute focused on proportional reasoning and number sense. Data and algebra were chosen because the GED places more emphasis on them, students tend to score poorly on them, they are often topics reserved for students who have mastered fractions, and teachers are less comfortable with them. In addition, TIAN recognizes that the ability to analyze data impacts all disciplines. TIAN also wants teachers to integrate algebra into their instruction because it is seen as a gatekeeper subject.
- In the institutes, the subgroup meetings, and teachers' own classroom investigations, participants develop their understanding of their states' mathematical content standards. They discuss how to connect the standards to other disciplines, how to adjust their instruction so that it covers all aspects of the standards, and how to make the standards relevant to the needs of their students.

- In the institutes, the subgroup meetings, and teachers' own classroom investigations, participants hone their ability to analyze student work and integrate real-life situations into their instruction.
- Teachers are encouraged to use the content from the professional development in their own classrooms.

## **Instructional Materials**

Each participant receives 10 student workbooks and teacher books for the data and algebra components of the EMPower curriculum. Teachers are encouraged to try between 6 and 10 lessons from EMPower.

Participants also watch videos, use calculators, bring in examples of student work, use authentic materials, and work with their states' content standards documents. Participants in field-test sites will be able to post student work on a Web site.

## **Strategies**

- The initiative treats participants as mathematics learners, using teacher inquiry and reflective learning to engage them.
- Facilitators model how to analyze student work, integrate real-life situations into mathematics content, build on students' strengths and ways of solving problems, and emphasize multiple ways to solve mathematics problems. Facilitators also model how to deliver instructional strategies in the classroom.
- During the institutes, participants work in small groups for most of the time. The initiative encourages teachers to organize their classes into small groups and move away from students working in isolation.

## **F. Assessment and Findings**

- The initiative assesses change in participants' content knowledge, pedagogical practice, and knowledge of mathematical content standards through data collected from pre- and post institute assessments of participants' content and pedagogical knowledge, pre- and post institute questionnaires about participants' mathematics background and experience, and work samples submitted by participants between institutes.
- Implementation data were gathered through classroom observations of 10 teachers from each pilot state. Observations were conducted before and after the initiative, and TIAN will continue to observe and interview three teachers from each pilot state over the next 2 years. Field-test states are also planning observations (five per state).



- TIAN collects examples of student work and achievement data on such tests as the Test of Adult Basic Education (TABE) and Comprehensive Adult Student Assessment System (CASAS). Test scores are collected before and after the students' teachers participate in the initiative. However, transient students make this a challenge.
- At the time of this report, the results of the assessments were not available.

## **G. Strategies for Sustaining the Initiative**

- Develop state and regional staff who attend institutes and can support and advocate for TIAN
- Work with states to train participants to lead regional groups and institutes and extend TIAN into other states
- Provide more information to local programs to foster buy-in
- Maintain momentum and sustain learning through interim meetings and informal peer coaching

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**APPENDIX C**

**GUIDED QUESTIONS**

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## **INFORMATION FOR VERIFICATION**

### **Initiative Directors, Developers, and Trainers**

**Note:** Project staff will verify accuracy of information collected from extant materials, when those materials are available. Some of these questions may not be applicable to all numeracy professional development initiatives and will need to be tailored to the specific initiative.

#### **A. Background Information: Verify Initiative Name, Director/Designer and Contact Information**

1. What is the name of the numeracy professional development initiative?
2. Who directs the initiative?
3. Who designed the initiative?
4. Is this a statewide or local-level professional development initiative?
5. What are/were the goals and objectives of the initiative?
6. Who provided the professional development (e.g., internal staff or external consultants)? (PROBE: If external consultants, how were they chosen? What expertise/experience did the trainers (internal and external) have in numeracy?)

#### **B. Costs**

1. How was the numeracy professional development funded? Who funded the professional development?
2. How much money was allocated? (PROBE: How much did the initiative actually cost? How were funds spent (e.g., stipends, substitutes for teachers, materials?)

#### **C. Participants**

1. How did teachers find out about the initiative?
2. How were participants recruited? (PROBE: Was there a target population? If so, what was the target population? What were some of the recruitment strategies used? Why were these selected?)
3. How were participants selected? (PROBE: Were there criteria for selection? Was participation voluntary or mandatory? What commitments did participants make to the program? What was the rationale behind your approach to selection?)

4. What were the characteristics of participants (e.g., program area {ABE, ESL, workplace, family literacy} mathematical backgrounds, instructional levels)?
5. What incentives, if any, were offered to participants (e.g., release time, certification, stipend, CEUs)? (PROBE: If you have chosen any of these options, what was the rationale? How was the option implemented?)
6. How many staff participated? (PROBE: How many did you expect to participate? If fewer, why were there fewer participants than anticipated?)
7. Can you share a list of participants with us so that we may follow-up with a very small sample?

## **D. Type and Duration of Professional Development**

1. How was the professional development delivered (e.g., workshops, online courses, institutes, study circles)? (PROBE: Why were these approaches selected? How is it different from earlier numeracy professional development in your state/program? Why were these changes made? What needs to be in place (e.g., organizational structures, resources) to support this delivery model?)
2. What was the length and duration of the professional development (e.g., over what period of time, what years, how many times did participants meet)? (PROBE: Why did you choose these options? If ongoing, what needed to be in place to support the professional development activities?)
3. What support, if any, was provided after the professional development (e.g., mentoring or coaching, follow-up workshops, networking sessions)? (PROBE: What was the rationale behind these options? How well did this work?)
4. In what ways, if any, was technology used to prepare and support participants before, during, and after the professional development (e.g., materials distributed to participants prior to the professional development, incorporated in the professional development)? (PROBE: Why did you choose to use technology? How well did the use of technology work with participants? What difficulties, if any, arose?)
5. In what ways, if any, was the numeracy professional development integrated into the state or local program's ongoing professional development activities? (PROBE: What factors facilitated an integrated systemic approach? Hindered integration?)

## **E. Instructional Content and Materials**

1. How was the content of the professional development determined (e.g., types of needs assessments designed, mandate from state for professional development)? What was the mathematical content? (PROBE: Was the content aligned with national or state mathematics standards (e.g., NCTM, AMATYC, EFF, ANN)?)

2. What other content was provided? (PROBE: How adults learn? Pedagogical content?)
3. What texts and materials were used to teach this content? (PROBE: Why were these texts/materials selected? In what ways, if any, did the content and materials reflect authentic numeracy situations? How did the professional development encourage participants to connect to the real-world purposes for which adults use math?)
4. In what ways was technology used to teach numeracy (e.g., graphing calculators, videos, test simulation software, drill and practice software)?
5. How did the program customize the content and materials for diverse participants (e.g., different levels of knowledge of math, different comfort levels with math)?
6. Did the program address the social variables that affect quantitative skill acquisition in adults? (PROBE: If yes, how?)
7. What was the content that teachers were instructed to provide to adult students to increase numeracy skills?
8. What curriculum, texts, and materials were provided for teachers to use when teaching this content in their own classrooms? (PROBE: Why were these chosen? How is it different from what currently exists? What guidance was provided to help teachers modify these materials for a diverse learner population?)
9. What strategies and tools were provided to help teachers assess their students' understanding of mathematical concepts and processes? (PROBE: Why were these strategies and tools selected?)

## **F. Teaching and Learning Strategies**

1. What strategies were used to foster participant learning? (PROBE: What opportunities were there for active learning? For collaborative learning? Project-based learning? For being math doers and learners first and then reflecting on how to teach in the classroom? Mentoring or coaching? Why were these activities selected? Please provide examples of these activities.)
2. What strategies were modeled for teachers to emulate when teaching mathematics to adult students? (PROBE: Why were these strategies chosen? How were these strategies to be used with different adult learner populations (e.g., ELA, special education)? How do these strategies reflect the research on how adults learn (e.g., multiple problem-solving strategies, collaborative learning, access to prior knowledge and/or misunderstanding?)

## **G. Program Assessments and Findings**

1. Did the implementing agency monitor and evaluate the implementation of the content and instructional processes in participants' classes? (PROBE: If so, how did they

monitor and evaluate implementation? What instruments were used? Who was involved? What were the findings? What factors did teachers report that facilitated implementation? What barriers to implementation did they experience?)

2. How did the implementing agency monitor and evaluate the impact of professional development on participants' knowledge, behaviors, and instructional practices in the classroom? (PROBE: What was the rationale in choosing these strategies? Who conducted the evaluation? What instruments were used? How much time elapsed before evaluating the results?)
3. What data did you collect (e.g., evaluations or summaries of the program)? (PROBE: Can you share these summaries with us?)
4. What were the results of the evaluation?

## **H. Summary**

1. Overall, what worked well in this professional development initiative? What were the benefits of the initiative?
2. What changes would you make in the way the professional development was delivered? (PROBE: Why would you make these changes? What is necessary to have in place to support these changes?)
3. What, if any, are the long-range plans for developing further or extending this numeracy professional development initiative? What do we have to do to sustain these types of initiatives? (PROBE: What policies, resources, or organizational structures need to be in place to support these plans?)

## INITIATIVE PARTICIPANTS

**Note:** Some of these questions may not be applicable to all numeracy professional development initiatives and will need to be tailored to the specific initiative.

Name: \_\_\_\_\_ Date(s) of Attendance: \_\_\_\_\_  
Date: \_\_\_\_\_ Numeracy Initiative: \_\_\_\_\_  
Program Area (e.g., GED, ABE, correctional education): \_\_\_\_\_  
Years Teaching: \_\_\_\_\_

### A. Prior Knowledge

1. Can you give us a general overview of your prior experience and training as a mathematics/numeracy teacher?
2. Can you give us a general overview of how you taught math prior to your training?

### B. New Knowledge

1. Behavioral Changes
  - a. Has this initiative changed your perception about how adults learn numeracy? If yes, can you please explain?
  - b. Has this initiative had any impact on your own feelings about math?
2. New Strategies Learned
  - a. What are some of the techniques and strategies you've learned in the numeracy training?
3. Use of New Knowledge
  - a. Do you currently use the information you learned in the training? If so, how?
  - b. What are some strategies that are working for you in your classroom?
4. Utility of New Knowledge
  - a. How are students responding to the new strategies? Are they more or less engaged in the learning? More comfortable with math?
  - b. What feedback, if any have you received from students? What have you observed?
  - c. If other training like this is offered, will you attend?

5. Implementation Challenges of New Knowledge

- a. Have you faced any challenges in implementing, in your classroom, the strategies and techniques you learned in the training?
  - If yes, how so?
  - Was help provided/Is help being provided to you to help you implement the techniques and strategies in your classroom?

**C. Other Forms of Professional Development Received at the Same Time**

1. Have you received any other type of professional development prior to, at the same time as, or after this training? (i.e., reading on your own, websites, online courses, journals, teacher workgroups, teacher collaboration, conferences, meetings etc.) Please explain.
2. Do you feel that such professional development helped you in any way? Do you feel that it somehow aided your ability to understand some of the concepts in the training?

**D. Continuation of Learning**

1. What more would you like to learn to help to improve your own math skills and knowledge?
2. What more would you like to learn to improve your teaching of math?
3. Do you know of any other numeracy professional development initiatives in your state, district, or region?

**E. Delivery of Professional Development**

1. What worked well in the way the professional development was delivered?
2. What would you change or improve, if anything, in the way the professional development was offered? In the content of the professional development?

**F. Open Sharing**

1. Is there anything else you'd like to share with us about your experience in the training?



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**APPENDIX D**

**EXCERPT OF PATTERN CODES**

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## EXCERPT OF PATTERN CODES

After AIR researchers reviewed and compared the numeracy initiatives to one another, we used three methods to identify themes in the data: pattern coding, inductive coding, and ontological coding. We then combined and re-categorized each set of codes. The table below, an excerpt from the pattern codes, lists the codes for the category of “content” (i.e., the numeracy content that the initiatives covered).

Pre-Identified Thematic Referent: Content <sup>19</sup>			
Emerged Code	Code Definition	Code Description	Initiative(s)
Alg	Algebra	Algebra content included algebraic patterns, variables, expressions, and sequences; functions, equations, and inequalities; polynomials; and exponents and roots.	AR ALRC Numeracy Project, AR ANC, Annenberg, CALPRO, EFF Math, EMPower Curriculum, EMPower Workshops, GED as Project, GED Training Institute, IL ALRC, MA SABES ABE Math, Maine CALL, Making Math Meaningful, Making Math Real, TIAN, VA Numeracy Project, Visual Math
ASW	Analyze Student Work	Content involved in the analysis of student work was unspecified.	MA SABES ABE Math, TIAN
Coll/Wrk	College/Work	College/work content included ways to prepare students for college, jobs, and careers.	Maine CALL, Oregon Ocean Sciences and Math Project
D&G	Data and Graphing	Data content included collecting, analyzing, displaying, and graphing data; understanding coordinate planes, intercepts, and slopes; calculating averages, means and medians; and developing graphic literacy.	AR ANC, Annenberg, CALPRO, EFF Math, EMPower Curriculum, EMPower Workshops, MA SABES ABE Math, Maine CALL, Making Math Real, TIAN, GED as Project, GED Math Institute, VA Numeracy Project, Visual Math
FL	Financial Literacy	Financial literacy content was unspecified.	IL ALRC
Geo	Geometry	Geometry content included understanding angles, isometries, circles, quadrilaterals, triangles, polygons, and 3-D objects; calculating perimeter, area, and volume; using the Pythagorean theorem; and writing proofs.	AR ALRC Numeracy Project, AR ANC, Annenberg, CALPRO, EFF Math, EMPower Curriculum, EMPower Workshops, Maine CALL, MA SABES ABE Math, GED as Project, GED Math Institute, VA Numeracy Project, Visual Math
Int	Integration	Content was integrated with other contexts (e.g., workplace, family literacy) and disciplines (e.g., social studies, science, technology).	IL ALRC, Making Math Real, TIAN, Maine CALL, Oregon Ocean Sciences and Math Project, Annenberg,
LD	Learning disabilities	Learning disabilities content included dyscalculia.	Making Math Real
M-L	Multi-Level	Content included strategies for managing classrooms with students of multiple levels.	IL ALRC, PDK
Msrmt	Measurement	Measurement content was unspecified.	AR ANC, Annenberg, EMPower Curriculum, EMPower Workshops, GED Math Institute, Maine CALL, VA Numeracy Project, Visual Math

<sup>19</sup> “Content” is a theme that was identified prior to the collection and evaluation of the data; the table shows how we managed the coding of the data for further analysis.

Pre-Identified Thematic Referent: Content			
Emerged Code	Code Definition	Code Description	Initiative(s)
NS	Number Sense	Number sense content involved teaching arithmetic/operation sense; the number line, integers, whole numbers; ratio, proportion, percents, fractions, and decimals; and factors and prime numbers.	AR ANC, Annenberg, CALPRO, EFF Math, EMPower Curriculum, EMPower Workshops, Maine CALL, MA SABES ABE Math, Making Math Real, Making Math Meaningful, VA Numeracy Project, TIAN, GED as Project, Visual Math
Pat	Patterns	Patterns content was unspecified.	Maine CALL, EMPower Curriculum, EMPower Workshops, VA Numeracy Project, Visual Math
Prob	Probability	Probability content was unspecified.	CALPRO, Visual Math
PS-R	Problem Solving and Reasoning	Problem solving strategies and reasoning skills included ways to deepen students' thinking such as induction and deduction.	Annenberg, AR ANC, GED Math Institute, PDK, Making Math Real
SS	Study Skills	Study skills content included strategies for taking tests and overcoming math anxiety.	CALPRO
Stat	Statistics	Statistics content was unspecified.	EFF Math, EMPower Curriculum, EMPower Workshops, Maine CALL, VA Numeracy Project
Trig	Trigonometry	Trigonometry content consisted of right-triangle trigonometry.	CALPRO
VM	Visual Math	Visual math content included visual patterns, models, and thinking.	AR ALRC Numeracy Project, EMPower Curriculum, EMPower Workshops, IL ALRC, Making Math Real, Visual Math

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**APPENDIX E**

**ANALYSIS OF PARTICIPANT  
DATA**

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## **APPENDIX E**

### **ANALYSIS OF PARTICIPANT DATA**

AIR staff interviewed 36 instructors who had participated in the initiatives. For nine of the initiatives, we interviewed three instructors per initiative. For the rest of the initiatives, we interviewed between 0 and 2 instructors.

#### **A. Program Areas**

The respondents came from diverse program areas: adult basic education (ABE), GED, English as a second language (ESL), family literacy, and correctional education, with the majority coming from ABE and GED. Family literacy and correctional education instructors had the least representation of all respondents.

#### **B. Years of Teaching**

The respondents' experiences ranged from 0–10+ years, with the majority (16) of respondents having more than 10 years of experience teaching in adult education.

Some respondents mentioned that they came from a K–12 background and had between 3 and 12 years of teaching experience there. Three respondents had 3–5 years of experience, and three respondents had 6–12 years of experience.

Some respondents provided the number of years they taught mathematics; the majority (5) of those who did had 10+ years of experience. Only one respondent mentioned that he/she had between 0 and 2 years of experience teaching mathematics.

#### **C. Have Respondents Received Prior Training as a Mathematics Teacher?**

Of the 36 respondents,

- Twenty-eight reported that they had taught mathematics before and/or had teaching certifications or credentials.
- Eight reported that they had little experience teaching mathematics to adults.
- Seven reported that they were highly experienced in the field of adult numeracy (e.g., they had delivered professional development to others or had helped develop state mathematics standards).
- One reported that he/she was poor at mathematics and had reservations about learning it.

## D. How Had Respondents Taught Mathematics Before the Training?

Participant	Respondent Used Textbooks and Workbooks	Instruction Was Student-Centered (Sensitive to Students' Background Knowledge and Relevant to Their Lives)	Respondent Used Manipulatives and Realia	Instruction Was Teacher-Directed (e.g., "Chalk and Talk," "Hands-Off, Lecturing Style")	Mixed
1			•		
2	•			•	
3					
4	•				
5	•				
6		•			
7					•
8		•			
9	•				
10					
11	•				
12		•	•		
13	•				
14	•	•	•		
15					
16	•				
17		•	•		
18	•	•	•	•	
19	•		•		
20		•			
21				•	
22		•			
23					•
24					•
25	•	•		•	
26					•
27	•				•
28		•			
29	•				
30				•	

Participant	Respondent Used Textbooks and Workbooks	Instruction Was Student-Centered (Sensitive to Students' Background Knowledge and Relevant to Their Lives)	Respondent Used Manipulatives and Realia	Instruction Was Teacher-Directed (e.g., "Chalk and Talk," "Hands-Off, Lecturing Style")	Mixed
31				•	
32		•	•		
33	•				•
34			•		
35		•			
36		•		•	
TOTAL	14	13	8	7	6

### E. Had Respondents Made any Classroom Changes Subsequent to Their Training or Do They Claim to Have Learned Anything in the Training?

Respondents claimed to have gained knowledge about content or teaching methods, have an increased interest in or value for them, and/or have placed more emphasis on them. Twenty-two respondents said that they use more manipulatives and hands-on activities, and 19 respondents reported that the professional development reinforced what they already knew or felt about mathematics.

	Changes in Behavior/Strategy Learned	Number of Respondents
1	Teacher uses more manipulatives and hands-on activities.	22
2	Teacher reports that the professional development reaffirmed or reinforced his/her knowledge, teaching, or liking of mathematics.	19
3	Teacher learned new content, teaching methods, and resources for teaching.	16
4	Teacher puts more emphasis on building students' problem-solving skills and discussing multiple ways to solve problems.	14
5	Teacher is more aware of the prevalence of mathematics in everyday life, tries to make instruction more relevant to students' lives, and uses more realia.	12
6	Teacher uses more variations on whole-class or individual work, such as pairs or small groups.	8
7	Teacher reports that his/her own confidence has increased or that he/she now feels comfortable not knowing everything.	7
8	Teacher's instruction is more student-centered (e.g., teacher facilitates students' discovery of mathematics concepts; instruction validates the mathematics background students enter with).	6
9	Teacher teaches content in a nonlinear fashion, integrating topics instead of teaching them one-by-one.	4

	Changes in Behavior/Strategy Learned	Number of Respondents
10	Teacher reports that the class works specific to the initiative (e.g., EFF's Teaching and Learning Cycle; GED as Project's problem-solving template).	3
11	Teacher has learned ways to accommodate for differences in learning styles.	2
12	Teacher has learned to incorporate technology in the classroom.	2
13	Teacher has learned to better empathize with students.	2

## F. Are Respondents Using the new Knowledge They Learned in the Training?

Twenty-four respondents said that they were currently using the new knowledge they had learned from the training in the classroom. Nine respondents claimed that they were not implementing the new knowledge from the training in their classroom for a variety of reasons: at the time of the interview, classes had not yet started; they work with students at a level inappropriate for the initiative's content; they are no longer teaching; or, as staff developers or administrators, they do not teach.

## G. Have Respondents Noticed any Changes in Student Behavior and Attitude Toward the Training?

Respondents noticed that students were more comfortable in seven different areas displayed below. Fourteen respondents mentioned that some students were resistant to some or all of the new approaches. On the other hand, 12 respondents noticed that students were more comfortable with and/or interested in mathematics, and 11 respondents found that students bought in to the new techniques.

Participant	Some Students Are Resistant to New Strategies	Students Feel More Comfortable With and/or Interested in Mathematics	Students Have Bought Into the new Approaches	Students Are Making Connections Between Numeracy and Their own Lives	Teacher Has Used Strategies in Other Environments (e.g., to Middle School or High School Students)	Students Test Scores Have Increased	Respondent Has Not Seen any Change in his/her Students
1			•				
2	•		•				
3		•			•		
4		•			•	•	
5	•		•				
6	•						
7			•				•



Participant	Some Students Are Resistant to New Strategies	Students Feel More Comfortable With and/or Interested in Mathematics	Students Have Bought Into the new Approaches	Students Are Making Connections Between Numeracy and Their own Lives	Teacher Has Used Strategies in Other Environments (e.g., to Middle School or High School Students)	Students Test Scores Have Increased	Respondent Has Not Seen any Change in his/her Students
8			•			•	
9		•					
10		•				•	
11			•				
12	•			•			
13			•				
14							
15							
16							
17	•			•			
18							
19							
20	•						
21	•	•					
22				•	•		
23							
24							•
25	•						
26		•					
27	•	•					
28	•		•				
29	•		•				
30	•		•				
31		•					
32	•	•			•	•	
33		•	•	•			
34		•		•			
35							
36	•	•					
TOTAL	14	12	11	5	4	4	2

## H. Have Respondents Faced any Challenges in Implementing Their new Knowledge and Skills in the Classroom?

Respondents identified 14 challenges that they face in their classrooms implementing the new techniques and skills they learned. The majority of respondents (14) indicated that student resistance posed a challenge to the implementation of new techniques. Six respondents reported facing no challenges, and six respondents claimed that they needed more planning time. Four respondents said that the amount of material to cover was overwhelming and pacing their instruction was difficult.

	Types of Challenges	Number of Respondents
1	Students resist new techniques.	14
2	No challenges faced.	6
3	Instructors need more planning time.	6
4	Instructors need more time to implement techniques in class.	4
5	Environment of classroom or program prevents teacher from implementing new techniques.	4
6	Open enrollment makes it difficult to progress through the curriculum.	2
7	Manipulatives are expensive.	2
8	Techniques are not working with students who have learning disabilities or are ESL learners.	2
9	Grouping students is challenging because classes are small and/or mixed-level.	2
10	Using manipulatives is challenging.	2
11	Modifying the materials to suit the needs of the students is challenging.	2
12	Materials must be translated into Spanish.	1
13	Relinquishing authority to implement student-centered learning is somewhat challenging.	1
14	Helping students with different approaches to problem solving is challenging.	1

## I. Did Respondents Receive any Help to Implement new Knowledge and Skills Learned in the Training?

Six respondents reported that they had received help, either in the form of materials and supplies, support or coaching from the trainers, extra planning time, or meetings with other Respondents in their program. Three respondents reported that they had not received help. One reported not knowing where to seek help and said that adult education is “sink or swim.”

## J. What More Did Respondents Say They Would Like to Learn to Help Them Improve Their Mathematics Skills and Knowledge?

Respondents identified 16 areas in which they wanted to improve and topics about which they wanted to learn. The greatest numbers of respondents indicated that they wanted to learn more about mathematics anxiety (5), wanted to learn more ways to teach mathematics (5), and wanted to become more confident about teaching algebra and other topics (5).

	Specific Needs Identified	Number of Respondents
1	Learn more about mathematics anxiety	5
2	Learn more (unspecified) ways to teach mathematics	5
3	Become more confident teaching algebra and other concepts	5
4	Learn to teach different levels of mathematics	4
5	Learn more about manipulatives	3
6	Learn more initiative-specific strategies	2
7	Don't feel the need to learn anything new for now	2
8	Learn more about adult learning theory	2
9	Read more research	2
10	Learn more about how to help students with learning disabilities	2
11	Learn more activities that make mathematics relevant to real life	2
12	Need updated, comprehensive textbook for students	1
13	Receive more support planning lessons	1
14	Improve computer skills	1
15	Learn about the Japanese Lesson Study model	1
16	Learn more hands-on techniques for teaching mathematics	1

## K. What Did Respondents Say Worked Well in the way That the Professional Development Was Offered/What Did Respondents Like About the Training?

Respondents identified 11 features of the training that they liked. The majority of respondents enjoyed learning from other adult educators, working in groups, and networking with each other. Eleven respondents mentioned that they liked the trainers (e.g., they felt that the trainers had good ideas, lots of experience, and were engaging). Ten respondents mentioned that they liked the content and approaches that were covered. Seven respondents said that they enjoyed learning actively by playing the role of the learner.

	Strengths of the Training	Number of Respondents
1	Time spent networking, sharing, and working in groups with other participants.	18
2	Trainers/facilitators	11
3	Content and approaches covered	11
4	Presentation quality (e.g., trainers explained the techniques well; presentation was well-organized)	6
5	Opportunities for active, hands-on learning (unspecified)	5
6	Opportunities to play the role of learner	5
7	Intensity	3
8	Materials	3
9	Feedback from trainers	2
10	Duration	2
11	Use of technology	1

## L. What Did Respondents Say They Would Change/Improve in the way the Professional Development Was Offered?

Respondents identified 15 features of the training that they would change or improve. The majority of respondents (12) said that they wished that the training had been longer. Six respondents said that they would not change anything. Five would like to see the training targeted to help students who are learning disabled, nonnative speakers, or are still learning lower levels of mathematics.

	Features to Change or Improve	Number of Respondents
1	Longer duration/more time for professional development	12
2	No changes recommended	6
3	More emphasis on materials for a different audience of adult learners (e.g., adults who are learning disabled, nonnative speakers, or at a lower level of mathematics)	5
4	Change specific to the initiative	5
5	Shorter materials or content	2
6	Slower pace	2
7	More emphasis on using technology in the classroom	2
8	A refresher on the professional development	2
9	More discussion among participants	2
10	More topics covered	2
11	More feedback and follow-up from trainers	1
12	Less time should elapse between sessions	1
13	More hands-on learning	1
14	More funding and recognition for initiative	1
15	More people participating in the initiative	1