FACING THE CHALLENGE OF NUMERACY IN ADULT EDUCATION

by
Forrest P. Chisman

September 13, 2011

Council for Advancement of Adult Literacy

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FOREWORD

FACING THE CHALLENGE OF NUMERACY IN ADULT EDUCATION is CAAL's final report on its two-year Adult Numeracy project. This topic is one of the most complex, neglected, and extremely important areas of adult education. We hope the report will generate further discussion of it and action.

Although we need much more research on adult numeracy, CAAL believes there is already a compelling case for shifting from traditional math instruction in adult education to instruction in a more comprehensive set of numeracy skills. We may not have the resources in the present economy to go charging down a new path in math education for adults, but we certainly need to start moving with deliberation down that path. If math abilities can be developed that more closely fit the requirements for college and for 21st century life and jobs, individual Americans and the national economy will gain enormously. If we fail to give adult numeracy its due, there are likely to be huge consequences in America's ability to remain globally competitive.

Facing the Challenge lays out the case for reform. It explains the differences between traditional math and "numeracy" and why we should care. It presents and analyzes the best ideas currently available for shifting from traditional math instruction to a more comprehensive numeracy curriculum. It looks, often for the first time, at the key challenges and issues we must face if we are to reform math education. For example, major attention is given to several disturbing articulation problems that exist between ABE preparation for the GED and between the GED and college placement tests based on COMPASS. The paucity of math instruction for adult ESL students with low levels of prior education, who make up the bulk of the adult ESL population, is another key area of concern. The report calls for changes in curriculum design, measures of assessment, teacher training and recruitment, and other elements of reform. And it asks the Office of Vocational and Adult Education of the U.S. Department of Education to take the lead role in providing national leadership.

Forrest P. Chisman, who directed CAAL's Adult Numeracy project, has directed a number of pioneering CAAL initiatives over the years. His analytical abilities, vast knowledge of adult education and human resource development, dedication, and professionalism are extraordinary.

In covering this ground, Dr. Chisman raises many fascinating and problematic issues, some of which are unresolvable at this stage. But despite the unknowns, we actually know a great deal about numeracy, and one thing is clear: there is a strong case for giving it a far higher priority in adult education than it has had. We hope the messages of **Facing the Challenge** will be heeded by policymakers, researchers, and practitioners alike.

Facing the Challenge is the second of two CAAL publications on Adult Numeracy. The other is a collection of background papers by four different authors, published in July 2011 in a volume titled **Adult Numeracy: A Reader**. (The authors are Lynda Ginsburg, Sue Southwood of the U.K., Bob Bickerton, and Steve Hinds.) It is available at the CAAL website (http://www.caalusa.org/Adult.pdf).

Finally, we are indebted to the numerous funding sources that have supported our work over the past three years. Without their help, this project and our program of roundtables would not have been possible. They are the Dollar General Corporation, The McGraw-Hill Companies, Inc., the Joyce Foundation, the Mott Foundation,Wal-Mart, and the Ostgrodd Foundation. Numerous individual donors have also provided significant support, including some members of the CAAL board and the late business leader Harold W. McGraw, Jr. who was a longtime friend to CAAL and who enthusiastically championed adult education and literacy for more than two decades.

Gail Spangenberg
President, CAAL

FACING THE CHALLENGE OF NUMERACY IN ADULT EDUCATION

PART A: SETTING THE STAGE

(1) INTRODUCTION

"Math instruction is the Achilles heel of adult education," according to one leader of this field. It may also be its best kept secret.

In some respects, mathematics plays an important role in basic skills programs. "Computation" is included in the definition of "literacy" in Title II of the 1998 Workforce Investment Act. It is one of the "adult education and literacy activities" that programs funded by that Act may provide, and the available evidence indicates that most ABE and ASE programs do in fact provide it in some form. In addition, each year states that receive funding under Title II are required by the U.S. Department of Education's National Reporting System (NRS) to measure both the math and literacy levels of students in "adult education and literacy" programs using approved standardized tests and to report to the federal government progress on the lowest of the two scores (math or language arts). Math is also a large component of the GED exam (the component on which most students score at the lowest levels) and hence of ASE programs that teach the knowledge and skills required to pass that exam.

The growing emphasis on preparing adult education students for transitions to postsecondary education has brought adult educators face to face with the fact that most postsecondary institutions require new students to take proficiency exams in both math and English (often standardized tests such as the COMPASS or AccuPlacer). Those who score below certain "cut scores" must enroll in developmental education courses before they can take regular college courses. Because GED graduates often fail to make the cut, "bridge" courses to improve math proficiency beyond the GED level have become a growing part of adult education. Finally, increasing interest in the use of adult education to improve employability and workforce quality has sensitized leaders to the fact that proficiency in math is one of the basic skills employers say they most need in their employees.

Considering the central importance of math instruction to adult education, it is surprising that this aspect of the field is rarely discussed by most adult educators, and very little is known about it. According to one authority, "the research base on this topic is very light,"[1] and only a few experts spend much time investigating it. At the most recent COABE meeting, there were only two sessions on math education; there was none at the most recent national TESOL meeting.

Although the National Science Foundation has made a few grants to study math education for adults, the U.S. Department of Education has invested very little in this area. A few states have curricular guidelines for math in ABE/ASE, but most do not. Both the NAAL and NALS national assessments of adult literacy included measures of "quantitative literacy." But these were primarily intended to test the ability to identify and solve elementary math problems embedded in various forms of text, rather than very extensive mathematical ability.[2]

International studies of adults' math proficiency show that the United States scores low compared to other nations in the developed world. And labor market projections indicate that a large percentage of the family-supporting jobs in our country, both now and in the future, require a higher level of math proficiency than most American adults have.[3]

Most importantly, the few experts who have reviewed math instruction in adult education have found it grossly deficient in almost every way—in curriculum, pedagogy, faculty expertise, assessment, and articulation, within adult education components and between adult education and postsecondary institutions or the workplace. Overall, they have concluded that math instruction in adult education (like most math instruction in the K-12 system) must become both more intensive and extensive. They have coined the term "numeracy" to designate the basic skills in math they believe must be taught. The nature of those skills and the meaning of this term will be discussed below.

Based on expert opinion, the conclusion is inescapable that our adult education system is doing a poor job of providing the math education that both adult learners and our national economy need. This should be headline news! Improving math education in basic skills programs should be one of the highest priorities of this field. Yet hardly anyone is taking steps to address it. In policy, research, rhetoric, and practice, adult education is still primarily what it is usually called in shorthand fashion—"literacy." Its major focus is on the "language arts" which include reading, writing, and ESL. Math is the poor cousin in the adult education family. This is not true everywhere in the world. In some countries (such as England), both policymakers and practitioners refer to adult education as "adult literacy and numeracy," and math is taught in separate classes by different teachers from language arts.[4] In the U.S., as indicated above, "computation" is considered an aspect of "literacy" and both are usually taught by the same teacher in the same class. These distinctions suggest how far we must go to meet the math needs of adult learners.

The purpose of this report is to help raise the visibility of numeracy in adult education and to stimulate thinking about how it might be improved—to expose the "Achilles heel" in the hope that it can be strengthened. It explains why math experts consider this aspect of the field so deficient, the challenges adult educators face in improving it, and some strategies that might be adopted to overcome them. The report is based partly on the discussion of participants in a

CAAL Roundtable meeting on numeracy in adult education convened in January 2011, and partly on a review of the literature on this subject and improving math in the K-12 system.

(2) CONTEXT

The central importance of mathematics as an academic discipline and a practical tool has been recognized in the West for thousands of years. Legend has it that the words "Let no one untrained in geometry enter" were inscribed over the gates to Plato's Academy (geometry being then considered the highest form of mathematics), and various forms of math were part of the "quadrivium" that formed the core of the medieval "schools"—and indeed of virtually all higher education in the West—well into the 19th century. Today math is taught in all school grades, and mathematical proficiency is universally required for college entry and many other purposes.

At the practical level, math reformers have been tireless in creating laundry lists of how math concepts and procedures are used in virtually all aspects of work and everyday life (from making change to driving a car to performing virtually any occupation). An example of one such list is "The Massachusetts Adult Basic Education Curriculum Framework for Mathematics and Numeracy."[5] This remarkable 100-page document lists several hundred "benchmarks" for mathematical proficiency and an even larger number of "Enabling Knowledge and Skills." Next to each one is a concrete example of "Where Adults Use It." Likewise, the research and literature associated with major initiatives such as SCANS and Equipped For the Future have documented the importance of math.

In short, there is, and has long been, a consensus that proficiency in mathematics is a "basic skill" of the greatest importance. Thus, it might be expected that questions of what should be taught in adult education and how best to teach it would have been settled long ago. But this is not the case.

To understand the problems of math instruction in adult education as well as what might be done about them, the context for the recent criticism of this aspect of our basic skills system must be understood. In large measure, it is an extension of a vigorous national discussion about how to improve math instruction in the K-12 system. That is, the ideas of experts who are concerned about numeracy in adult education largely mirror ideas developed and presently being implemented to improve math education in elementary and secondary education.

Improving K-12 math has been one of the largest, most debated, and arguably most effective aspects of "education reform" in the United States in recent decades. The major themes on which it has been based first gained widespread national attention in 1989 with the publication of a report by the National Council of Teachers of Mathematics (NCTM): Curriculum and Evaluation Standards for School Mathematics.[6] In subsequent years, the NCTM revised its

"standards," but its major themes have remained the same, and they have been echoed by a succession of other reports issued by the National Research Council and the U.S. Department of Education.[7] This body of work has been based on extensive research and deliberations by math educators, cognitive scientists, and mathematicians—the best minds that could be brought to the task—and it has led to at least some changes in K-12 math education in most states.

In 2010, an initiative sponsored by the National Governors' Association and the Council of Chief State School Officers issued a set of Common Core Standards for K-12 math education. These specify in detail what should be taught at each grade level.[8] The Core Standards are derived directly from the literature on math reform that has flowed from the 1989 NCTM report and they embody its major themes. To date, 48 states have "adopted" these standards, which means they have pledged to implement them by 2015. Because the core standards are not a fully developed curriculum, different states will implement them in somewhat different ways. But they are prescriptive enough that they should result in a thorough transformation of K-12 math education over the next few years.

These K-12 developments quickly drew the attention of at least some adult educators. In 1994, a group of 16 Massachusetts ABE/GED teachers investigated how the new ideas about K-12 math education might be applied in their classrooms. This led to the publication of the Massachusetts ABE Standards in 1995 and new work by the Massachusetts Department of Education to apply the findings. It also led to investigations of math education by adult educators in the state, and to the publication and refinement of the Massachusetts ABE Massachusetts Curriculum Framework (most recently revised in 2005).[9]

At about the same time, an adult numeracy conference sponsored by the U.S. Department of Education led to the creation of the Adult Numeracy Network (ANN)—a nationwide group of adult educators concerned about math education. With a grant from the National Institute of Literacy, this group conducted focus groups of learners, teachers, and other stakeholders to discuss the present state of and need for math instruction in adult education and considered how that instruction should fit within the frameworks created by the Massachusetts effort, SCANS, Equipped for the Future, and other efforts they considered relevant. In 1996, the ANN published A Framework for Adult Numeracy Standards.[10] This work has continued to provide a national forum for deliberations about curricular frameworks, best practices, conceptual development, and other activities to promote the improvement of mathematics in adult education, and it has been an important source of leadership in that cause.

There have been other initiatives by adult educators to advance numeracy instruction over the last few decades. Together with the Massachusetts and ANN activities, they have resulted in the creation of a small but active leadership group of math educators in the adult education field. Some of these leaders have a primary background in mathematics; others have backgrounds in

other fields. Collectively, they make up a cadre of numeracy advocates who have been pressing for reform of math instruction in adult education that will parallel reform in K-12.

Most importantly, the Massachusetts, ANN, and other activities, and the leaders who have been instrumental in bringing them about, have at least one important thing in common. By whatever road they have arrived at their diagnosis of the problems of adult education math instruction and their prescriptions for reform, they have adopted the same basic themes set forth in the 1989 NCTM report and the subsequent literature on K-12 math, culminating in the Common Core Standards. That is, the movement to improve math education in adult education has a common intellectual heritage with the movement for K-12 math reform and also continues to share the same intellectual framework. This is important, because the resources available for research and development in this area of adult education have been only a tiny fraction of those devoted to K-12. Numeracy advocates in the literacy field benefit from the fact that their fundamental ideas, as well as many of their more specific recommendations, are validated by major national efforts in school reform.

PART B. PROBLEMS WITH MATH EDUCATION

Why do math reformers in both K-12 and adult education believe that math instruction is deficient, and how do they think it should be improved? A full answer to this question is well beyond the scope of this report, but the following material sets forth the major themes that concern math reformers. Most readers doubtless have more personal experience with math education in K-12 than adult education. Thus, this section presents the main themes of K-12 math, and Part C (p. 11) extends them to adult basic skills programs.

Two questions are of paramount importance. What is wrong with the math education most of us have received (and that most school children continue to receive)? What should be done about it?

(1) CONTENT

Traditional school math curricula consists of arithmetic (addition, subtraction, multiplication, and division of whole numbers, fractions, and decimals) in the elementary grades, and algebra (often along with a brief detour through geometry) in the higher grades. Although math reform advocates describe this content in somewhat different terms, the traditional terminology will suffice for this report. They believe that students must become proficient in all of these areas of math and in the relationships between them. Importantly, they believe that each of these traditional subjects is built on certain core concepts (such as the properties of whole numbers, fractions, and functions). School math often fails to teach a mastery of these core concepts as well as it should, and it often fails to teach the relationships between the different parts of the curriculum in a logical and consistent way. As a result, students lack the foundation they need in elementary math concepts to move on to more advanced content (e.g., from arithmetic to algebra) or to apply one or more elements of math to real life.

Most importantly, advocates for change believe that there is more to math than the standard curriculum list suggests. They would include subjects such as the representation of mathematical concepts in charts and graphs, measurement, the presentation and interpretation of data, statistics, probability, and estimating the answers to math problems. And they would give more prominence to geometry than it presently receives. In school math curricula, these are often treated as sideline topics, but they are centrally important to understanding all aspects of mathematics—from the perspective of understanding math content and because they are the form in which people are most likely to meet math in the real world.

Most change advocates are concerned that traditional curricula fail to teach mastery of the full range of mathematics. This may seem a formidable task, but they believe it is less so than it appears. Some aspects of all the major areas of math can and should be taught to even the lowest

level learners—e.g., certain "algebraic concepts" can be taught in kindergarten. Understanding even elementary versions of all areas of math content is valuable in its own right, but it is most valuable for providing a ladder of knowledge and skills that helps students progress to increasingly complex topics.

(2) PROCEDURES

A member of the CAAL Roundtable observed that most people believe that math is the only subject about which students cannot ask "why." Math is a logical system based on certain rules. Thus, the answer to some "why" questions is simply, "because that's how math works." But reform-minded math educators think it is essential for students to ask and answer "why" questions about most aspects of mathematics—to develop what is often called a "conceptual understanding" of why all aspects of arithmetic, algebra, geometry, and all the other areas of math work the way they do. For example, at the most elementary level they should understand why 5+2 is the same as 2+5 or that multiplication is simply a series of additions (e.g., 3x5 simply entails counting to five and then continuing to count the same amount two more times).

The greatest concern of math reform advocates is that most instruction in this field consists of memorizing rote procedures for solving math problems. Large amounts of time are spent in memorizing multiplication tables or learning how to find the lowest common denominator of fractions. Most of this is wasted time. Not only do students quickly forget the procedural rules, but in the 21st century they not only do but should use hand-held calculators to perform most calculations in arithmetic and many in geometry and algebra.

Although it is important for students to be able to perform elementary mental arithmetic (such as adding two digit numbers) as a foundation for more easily mastering more complex forms of math (such as algebraic equations), the "drill and kill" of repeated practice with applying the same procedures to different sets of numbers or problems is counter-productive. It makes students hate math. In contrast, if they have a *conceptual understanding* of why procedures work the way they do, they are more likely to recall how to perform a particular procedure, know when to use it and what its results mean, and see how it can be used in other areas of math.

If they have a conceptual understanding of math, they can often invent some procedure for solving most math problems—because in most cases more than one procedure will work (contrary to what we were all taught in school). Once a person knows what a "lowest common denominator" is, why it matters, and how to use it, they can forget the term but recall when, where, and how the *concept* is useful for solving a math problem. *More than any other goal, the Common Core Standards and other math education thinking intend to shift the emphasis of the math classroom away from memorizing procedures and toward building a conceptual understanding of "why" different aspects of math work the way they do*.

(3) APPLICATIONS/COMMUNICATIONS

One reason change advocates oppose teaching rote procedures is that they believe the purpose of learning math is to acquire intellectual tools that can be applied in a great many contexts. As a result, they think that an essential but often neglected aspect of math education is helping students learn how to apply math where it is relevant to work and everyday life. People must learn to see the mathematical aspects of problems or situations they encounter and be just as fluent in applying math to dealing with their lives as they are in using language. To take a simple example, they should see determining the amount of carpeting they need to cover a hallway as calculating the area of a rectangle. Math education should include far more opportunities for students to apply various aspects of math in different situations than it presently does. It should help them to see the many applications of math as a familiar and useful set of tools they are comfortable using.

In fact, many advocating reform suggest a "student-centered inquiry" method of instruction that reverses how math is usually taught. In traditional classrooms, learners are presented with rules for solving certain types of mathematical problems and then asked to apply those rules to particular situations. In the "student-centered" method, learners are presented with a problem that requires the use of math, encouraged to generate their own solutions, and then asked to explain how they reached the solutions and what rules for similar situations this suggests. However it is implemented, the emphasis on applications is intended to show students the relevance of math and to foster "strategic competence"—"the ability to formulate, represent, and solve mathematical problems."[11] Math scholars believe this set of skills is essential, in part because problems that require math to solve them arise all the time in everyday life. Math education will have little benefit unless students learn to identify when and how math is required to solve a problem and know how to apply it.

Closely related to the emphasis on applications is an emphasis on communications. In many settings, particularly on the job, individuals must be able to understand how math can be used to solve problems and also how to explain to others the solutions they reach and how they reached them. To extend the example just mentioned, a carpet installer may have to explain to his/her supervisor why 100 square feet of carpet is needed, and he/she may have to represent graphically how the sections required would be cut from a roll so the right amount can be delivered to the worksite and waste can be minimized.

(4) NUMERACY

In sum, among the major problems leaders have identified in the K-12 system are that the scope of mathematics taught is too narrow, that there is too much emphasis on memorizing procedures and too little on conceptual understanding in its various forms, and that there is far too little

emphasis on learning how to apply math and communicate the meaning of mathematical findings. The various reports that have embodied the discussion of math education over the last decade as well as the Common Core Standards based on them are all attempts to identify and solve these and related problems. There is consensus that schools must adopt enlarged goals for math education—goals that are both broader and deeper than in the past.

The term "numeracy" has been adopted by at least some people to signify these more expansive goals. A definition of numeracy (in this case for adults) formulated by British scholar Diana Coben summarizes the goals of much of the contemporary movement for math reform. According to Coben: "To be numerate means to be confident, competent, and comfortable with one's judgment about whether to use mathematics in a particular situation, and if so what mathematics to use, how to use it, what degree of accuracy is appropriate, what the answer means in relation to the context, whether and how to communicate the answer appropriately, and what action if any to take as a result of the analysis."[12]

An important feature of Coben's definition is that the primary emphasis of most school math has been and remains on only one phrase in it—"how to use it" (procedures)—to the detriment of all the rest. Math scholars believe that the enormous value of mathematics for individuals and society cannot be realized unless and until traditional school math is replaced by teaching numeracy. They might differ with Coben on particular aspects of her definition, but in general, it captures the basic skills they believe should be taught.

(5) TEACHERS

The contemporary critique of math education is not limited to what should be taught, however. It also extends to who should do the teaching. Math reformers are as concerned with upgrading the proficiency of teachers as with upgrading the proficiency of students. Obviously, moving from a system of math education that emphasizes procedures and traditional subjects to one that includes a larger body of content together with conceptual understanding and applications requires a new set of skills on the part of teachers. At the very least, they must have an in-depth understanding of math. Teachers who lack an advanced conceptual understanding of math will find it impossible to convey a conceptual understanding to students. Moreover, teaching a more expansive math curriculum will require new approaches to pedagogy. The traditional system of math education relies heavily on textbooks, workbooks, and drills. As long as the goal is simply to memorize procedures, this system of instruction may allow most teachers to function fairly well. But if teaching numeracy is the goal, teachers must play a different and more active classroom role.

Math reformers believe that most K-12 teachers have neither the expertise in mathematics nor the pedagogical skills required. At present, elementary school teachers often receive little

training in math education and can be certified in many states without demonstrating proficiency in math or how to teach it. Even high school teachers, except the few who have specialized in math, seldom have the necessary depth of understanding. Math reformers believe that upgrading the math teaching force is a precondition for making the essential transition from traditional math education to numeracy instruction. Their suggestions for what K-12 math teachers must know and how they might learn it are as extensive as their suggestions for improving what students must learn. This will require a substantial investment in upgrading the skills of virtually all K-12 teachers involved in math education.

(6) ASSESSMENT

Math reformers place great emphasis on the need to improve assessments of student learning gains—both the assessments teachers should conduct on a continuing basis to ensure that individual students are making progress, and the statewide and national assessments of math abilities used to evaluate the effectiveness of schools, policies, and much else. Assessments are key to indicating what improvements must be made in instruction, curricula, teacher performance, resources, and all the other components of the educational system that support gains in education. In traditional math education, with its emphasis on memorizing procedures, assessment is a relatively straightforward matter (conceptually at least): students are assessed by standardized tests that require them to perform those procedures. With a greater emphasis on numeracy must come new forms of assessment. A larger body of content must be assessed and some means must be found to determine whether students are gaining a conceptual understanding of math and the ability to apply/communicate it in a variety of different ways. This aspect of math reform is to some extent a work in progress.

Math reformers think that traditional standardized tests do not adequately capture progress in numeracy. The Common Core Standards and the research behind them set goals rather than establish detailed teaching curricula. At the same time that these are being implemented as curricula by individual states and schools, new assessment measures must be developed that can measure learning gains in a variety of curricular frameworks.

At least some educators—primarily those who emphasize student-centered instruction—appear to be somewhat skeptical of standardized tests in any form. This is a longstanding concern in the assessment field, and it may be that math reform will result in assessment systems that rely more heavily on teacher judgments than math tests have in the past. For purposes of this report, the important point is that as the K-12 systems adopt new standards and curricula for math, they will also be adopting new assessment systems to measure progress toward improved numeracy.

PART C. TRANSLATING TO ADULT EDUCATION

(1) INTRODUCTION

Despite the admirable efforts of the Massachusetts Department of Education, the ANN, and others, there has been regrettably little systematic research on how math is taught in adult education programs. But the research that has been conducted by leadership individuals and institutions leads to the conclusion that math instruction for adults takes the same form as traditional K-12 math education in most cases. That is, it emphasizes memorizing procedures to the neglect of conceptual understanding and the ability to apply math.

This should come as no surprise. Traditional school math has been the norm in the United States. Adult education students are, by definition, people who did not master the K-12 curriculum, so it makes sense that adult programs should have established the goal of giving them a second chance to learn the math skills they did not acquire in school. But, whatever the past, the paradigm for math education has shifted. State K-12 systems are adopting the Common Core Standards for math in one form or another. It seems logical for adult educators to adopt these same standards for teaching adult students and to develop a teaching force and assessment system that can support them.

This is essentially what advocates of numeracy in adult education are proposing. When they say that math instruction in adult education is grossly inadequate, they cite the same themes identified by K-12 reformers, and they often cite the literature of K-12 math education to support their arguments. When they state their goals, they are largely the same as K-12 goals adapted to the adult education context.[13] This makes sense. Presumably the goal of K-12 math education is to prepare young people for the innumerable uses of math they will face in all aspects of their lives. Why should the goals of math instruction in adult education be less than that?

In fact, upgrading math instruction in adult education may be more urgent than in K-12. For young people, the need to use math well in many different contexts is in the future; they have many years to learn before the utility of math proficiency really matters to them. In contrast, in an immediate way, every day, adults are immersed in a math-rich world in which their proficiency affects their well being, the well being of those with whom they associate, and the national economy. There is no time to waste in upgrading their numeracy; a great deal is at stake for them and for society.

Adopting the Common Core Standards and all that goes with them as a new foundation for math in adult education will require a great deal of work in curriculum design, teacher preparation, and creating new assessment systems. But this only reinforces the imperative to make the necessary commitments and investments, and to do so soon.

However, if the adult education system is to go down this path it will have to overcome a number of problems that K-12 reformers do not face. Math reformers in adult education have focused much of their attention on these problems. It is a given that adult students differ from K-12 students in many ways and that all aspects of adult education—from pedagogy to program structure—must differ as well. Six major challenges were highlighted at CAAL's Numeracy Roundtable, and adult educators will have to grapple with them to move beyond traditional math into numeracy instruction.

(2) A NEW CURRICULUM

The challenge. Making the shift from traditional math instruction to numeracy instruction obviously entails moving the goal posts, in adult education as in the K-12 system. As noted, there has been remarkably little research on how math is taught in ABE and ASE classes, but the evidence available indicates that it is taught in most programs through drill and practice, using textbooks and workbooks produced by education publishers that almost exclusively emphasize memorization of arithmetic and algebraic procedures. Based on an analysis conducted for CAAL, it appears that levels of math student proficiency are measured by standardized tests that gauge the ability of students to perform these procedures. Moreover, the federal government requires that states and programs measure student progress in terms of the six Educational Functioning Levels of the NRS. Each of these levels has a descriptor of the entry-level skills that students placed in that level should have in "reading and writing" and "numeracy."[14] All of the descriptors for numeracy are stated in terms of procedures, and it is not until descriptors for entry into the ASE level (GED preparation) that algebra, geometry, charts and graphs, and other aspects of numeracy beyond arithmetic are mentioned at all.

Taken together, the workbooks and the tests used by adult education programs, along with the standards established by the NRS, define the parameters of the math curricula in adult education programs. Shifting to numeracy will require teaching more subject matter (for example, algebra, geometry, statistics, and the use of data at all levels of proficiency) and teaching it in more depth—moving beyond memorizing procedures to conceptual understanding and various aspects of applications and communication. It will also require assessment systems that capture student proficiency in these additional subject areas and across these additional dimensions—both for diagnosing the skills levels of individual students so that they can be placed in appropriate classes and for measuring learning gains. This combination of greater breadth and depth in instruction and assessment necessitates a wholly new math curriculum.

First steps: determining the curricula. What might a comprehensive numeracy curriculum for adult education look like? One Roundtable participant distinguished between "the intended curriculum" (the knowledge and skills students must master by some means), "the written curriculum" (the lesson plans and other guidance that define the sequence of instruction),

and "the implemented curriculum" (what is taught in the classroom and how). Based on the Roundtable discussion, it appears that more progress has been made in defining the intended and written curricula than in assessing how either might be implemented.

Roundtable participants cited The Massachusetts Adult Basic Education Curriculum Framework for Numeracy and Literacy, mentioned above, as an example of a comprehensive intended curriculum for numeracy in adult education. The Framework is a carefully reasoned curricular guideline that was created by an extensive planning process. It is divided into six levels, from "Beginning Adult Numeracy" through "ASE/Bridge to College." These levels are divided into four "Strands" (Number Sense; Patterns, Functions, and Algebra; Statistics and Probability; and Geometry and Measurement) and some aspect of all four Strands is taught at each level—even the Beginning level. Each Strand is then divided into "Benchmarks" that indicate the skills students should learn at each level within the Strand. Benchmarks are further specified in terms of the "Enabling Knowledge and Skills" students will need to achieve each Benchmark and "Examples of Where Adults Use the Benchmark." The result is a Framework that establishes very wide and deep guidelines for numeracy curricula. For example, Level 1 (Beginning Adult Numeracy) includes 40 Benchmarks and 72 Enabling Levels and Skills, and higher levels of proficiency include more.

As an example of a written curriculum, Roundtable participants referred to EMPower—a mathematics curriculum for adult education through the GED level developed with funding from the National Science Foundation by TERC, a non-profit educational services organization based in Cambridge, Massachusetts.[15] The EMPower curriculum is a series of eight books, each of which contains a sequence of lesson plans using a student-centered pedagogy. Most of the books contain nine "lessons" divided into three "activities" each. These books appear to cover most of the content areas discussed by numeracy advocates and aim to build conceptual understanding and facility in applying math. Strictly speaking, EMPower is not a fully comprehensive curriculum, because it is not designed to serve students below the Intermediate Low level of proficiency. Its primary focus is on math for life skills, and it does not contain units to prepare students for transition to college. EMPower's guidance for teachers states that the books can be used in different sequences. For example, students might begin with lessons on "Geometry and Measurement" and then move on to "Everyday Number Sense: Mental Math and Visual Models," or they might use the books in the opposite order. As a result of this flexibility, teachers can implement EMPower in different ways, and TERC is presently providing technical assistance in a number of states about how they might do so.

Issues. A full exposition of the Massachusetts Framework and EMPower is not given in this report. But even these brief descriptions indicate that both curricula are based on the same themes that have guided K-12 math reform and the Common Core Standards in the range of numeracy skills they encompass. Although it is beyond this report's scope to explain in detail

the written curricula for numeracy proposed by either K-12 or adult education reformers, CAAL's examination of both suggests that they are similar. The adult education curricula are not specified in terms of grade levels, they omit skills that kindergarten or pre-k children must acquire, and they use more adult examples of applications. But in most other respects, they appear to recommend learning essentially the same numeracy skills, and in roughly the same order, as recommended for K-12 numeracy curricula. As a result, it is not clear from the Roundtable discussion or materials available to CAAL how the Massachusetts Framework and EMPower are tailored to adults. This is because differences between numeracy instruction for adults and for children are most likely to be apparent at the level of the implemented curriculum—where the themes and sequence of instruction developed by these leadership efforts are translated into classroom instruction.

Based on comments by Roundtable participants, it appears that the Massachusetts Framework and EMPower are works in progress as implemented curricula. That is, both are being phased in by local programs. Nevertheless, they are valuable points of reference in defining what a comprehensive numeracy curriculum for adult education should be. And they raise important questions about how that curriculum should be developed. Must every state expend the resources required to develop its own version of these curricula, or should the states adopt a common intended and/or written curriculum for adult numeracy? And, if states should coalesce around a common curriculum, do either the Massachusetts Framework or EMPower—perhaps in some modified form—provide the core around which that curriculum should be based?

The CAAL Roundtable did not discuss these issues, but clearly they must be addressed if adult education is to make the shift from traditional math instruction to numeracy. Finally, both curricula provide a background for understanding some of the other issues related to making the change to numeracy instruction in adult education.

(3) STUDENT TIME ISSUES & BACKGROUND KNOWLEDGE

The challenge. The need for a new curricular framework in math is not unique to adult education. The Common Core Standards dictate a new K-12 curriculum as well. However, an important difference is that K-12 students have 13 years to move through any numeracy curriculum that is developed, and they are compelled to attend math classes on a regular basis. Even the most motivated adult education students are not likely to spend more than a few years attending classes, and classes rarely meet more than 3-4 hours per week. In addition, the responsibilities of adult life result in erratic attendance by most adult students. Moreover, K-12 numeracy curricula can assume that learning math is a sequential process—moving from more elementary to progressively higher levels of ability. Whereas, in contrast, most adults

begin numeracy instruction with some prior ability in math—gained from a combination of their K-12 experiences and their personal experiences living in a world where the need to use math is pervasive.

The challenge for adult educators, therefore, is to find a way to provide deeper and broader numeracy instruction in a time frame suited to adults and to take account of the uneven math abilities that adult learners bring with them when they first enter programs. Most numeracy advocates at the CAAL Roundtable said that they believe a comprehensive adult numeracy curriculum would require more instructional time than traditional math instruction, but they were uncertain how much more classroom time would be required or what problems, if any, this would pose for students.

To give an example, Roundtable participants examined a City University of New York numeracy course that prepares GED graduates for college math.[16] This highly successful course meets six hours per week during a semester. Thus, it devotes more instructional time per week to math alone than many adult education courses devote to both math and language arts. To give another example, a participant from Massachusetts indicated that ABE students who enroll in classes based on the state's numeracy Framework and a new English Language Arts Framework "will advance, on average, one 'grade level equivalent' in both ELA and Math in 120 to 140 hours."[17] Assuming that half the instructional time is required for numeracy, and bearing in mind that most NRS levels comprise about two grade-level equivalents, this estimate indicates that it would take Framework students about twice as many instructional hours as the City College program requires to progress one NRS level—about two semesters of classes meeting six hours per week.

Uncertainty. However, some Roundtable participants pointed out that the time needed for a student to cover more aspects of math in more depth may not be as great as these and some other estimates suggest. For example, they think that a lot of time is wasted in ABE programs through repeated use of drill and practice, and they suggested that students learn more quickly when they are more engaged in learning—when instruction focuses on conceptual understanding and various aspects of applications, and when prior math ability is factored in. Engaged students are less likely to drop out. And even if they do not master all aspects of numeracy, they will learn some math rather than give up on adult education altogether. The participants also believe that students' prior math abilities can be a strength on which numeracy teachers build. It can provide a foundation for developing conceptual understanding and contextual ability to apply procedures.

But firm evidence about the importance of these two issues in shifting to a numeracy curriculum is lacking. Efforts to introduce numeracy extensively into the adult education curriculum are less than a decade old, and, based on the Roundtable discussion, it appears that most programs around the country have not yet moved in this direction. We do not yet have a sufficiently large body of evidence on which to assess the challenges of instructional time and prior experience.

Building on the experience we have. It is clear that adult educators must bear these challenges in mind if they are to shift to fully developed systems of numeracy instruction. It could be that they will have to adapt the numeracy curricula developed thus far, or at least the means of implementation, to both the time constraints of adult learners and the prior math abilities they bring to their math learning. And, to the extent that time constraints are a problem, several Roundtable discussants think it may be better to teach a few areas of numeracy very well than to attempt to implement a comprehensive numeracy curriculum.

A realistic numeracy curriculum for adult education may look very different in many respects from the intended curricula, such as the Massachusetts Framework suggests. It may not incorporate all of the "strands," meet all the "benchmarks," or teach all of the "enabling knowledge and skills." In practice, initiatives such as the Massachusetts Framework may be precisely what the term "framework" indicates: a structure that supports numeracy instruction at various levels of depth and breadth. If so, this would not be grounds for criticizing the efforts of adult educators in Massachusetts or their counterparts elsewhere. On the contrary, a framework in this sense creates boundaries, possibilities, and standards for making the shift from traditional math instruction to teaching numeracy. It creates a common set of concrete goals toward which teachers, students, and administrators should work. In so doing, it enables a more unified effort by everyone than would otherwise be possible.

At the same time, Roundtable participants observed that the shift to numeracy might also require changes in the *structure* of adult education programs. It may be necessary, for example, to devote more of the available class time for basic skills to math, to introduce more "high intensity" classes (classes that meet more frequently than 3-4 hours per week), or even to adopt the British system of offering separate "literacy" and "numeracy" classes—allowing students to select how much time they want to invest in each of these areas of basic skills.

The discussants reached no conclusions about how to adapt numeracy instruction to the special needs and circumstances of adults. But they were clear that planning to meet this challenge must be a priority.

(4) ARTICULATION PROBLEMS

The challenge. A third major challenge adult educators face in shifting to a more comprehensive numeracy approach is articulation problems in the educational pathways basic skills students pursue. At present, the requirements of these pathways are poorly articulated and, in some cases, they are outside the control of the adult education field itself. Yet without improved articulation, they may be barriers to placing greater emphasis on numeracy.

The sequence. For native English speakers (ESL is discussed separately below), adult education has long been divided into two sequential components: adult basic education (ABE), which

primarily teaches the basic skills of reading, writing, and math up to what is usually regarded as the equivalent of the 8th grade level, and adult secondary education (ASE), which teaches these skills plus a rudimentary knowledge of science and social studies up to the level required to pass a high school completion or high school equivalency test (usually the GED). ABE is usually divided into four levels of increasingly higher proficiency. Students are placed in a level that corresponds to their skills based on standardized tests (most commonly the TABE and CASAS), and, if they persist in adult education, they progress up the sequence of levels based on improvements in their scores on these tests until they complete the ABE sequence. At that point, they transition to ASE for further improvement in basic skills plus instruction in the other subjects required for high school completion or equivalency tests.

Many adult educators are aware, however, that the basic skill levels required for high school completion or the GED are not sufficient for most students to make a smooth transition to postsecondary education. Most colleges require students who do take or register high enough scores on standard college admission tests (such as the SAT or ACT) to pass special basic skills tests in reading, writing, and math (usually the COMPASS or AccuPlacer) before they can enroll in credit-bearing courses. If students do not score highly enough, they are placed in developmental education classes—which delays their progress in college and which many never complete.

In recent years, adult educators and others have placed increasing emphasis on the economic benefits of ABE and ASE for low-skilled adults. Because the benefits of postsecondary education far outweigh the benefits of the traditional adult education system by itself, some programs have introduced "bridge" courses for GED graduates. These courses aim to help those who want to enroll in college score highly enough on college basic skills tests that they can avoid or minimize developmental education requirements. Bridge courses take many different forms, but collectively they have become a third tier of adult education (beyond ABE and ASE) in many programs.

Joining ABE and ASE. Stated in these familiar terms, adult education appears to be a fairly well articulated system. And, not including bridge courses, this is the system design reflected in the NRS.

From the perspective of math education, however, the elements of adult education are so poorly articulated that it is barely a system at all. Although there is no definitive study of how much and what kind of math is taught in ABE classes, research commissioned by CAAL shows, as indicated above, that it is primarily limited to arithmetic and taught by drill and practice instruction using workbooks.[18] Geometry, algebraic concepts, charts and graphs, and other higher elements of math are introduced only at the highest ABE level, and instruction in these

elements is limited. This presumption of what the core of ABE instruction should be is reflected in both the NRS descriptors for ABE levels and in the tests prescribed for NRS reporting, all of which primarily measure and report the ability to perform procedures using arithmetic.

Articulation problems arise if the purpose of ABE instruction is seen as preparing for ASE—a key aim of which is to prepare students for the GED test. This is because, according to analyses published by the GED Testing Service and the independent analysis commissioned by CAAL, the math portion of the GED is primarily a numeracy test.[19] That is, it not only covers most traditional math topics, but it also measures conceptual understanding and a fairly wide range of numeracy applications. The emphasis is more on conceptual understanding and applications than on procedures. This is why NRS descriptors for ASE math place more emphasis on numeracy than descriptors of ABE math do. But the difficulty with this instructional sequence is that it confines most aspects of numeracy instruction to the ASE level, placing an enormous burden on ASE teachers to teach virtually all of numeracy in the time students can devote to GED test preparation.

In fact, the burden may be so large that it cannot be carried. Analysis prepared for CAAL indicates that math is the subject on which most students score lowest on the GED exam. About 20 percent fail, and many students "cram" for the math portion of the exam by "plow[ing] through endless sample test items in review books."[20] There is no way to know whether they improve their proficiency in most areas of numeracy in ASE classes, because of another lapse in articulation: the measures of progress in ASE required by the NRS are standardized test scores that primarily measure the ability to perform procedures, but do not capture most aspects of numeracy.

In short, *the notion that adult education provides a logical path of instruction for students with any level of limited basic skills through GED completion is confounded by the lack of articulation between ABE and ASE—at least with regard to math*.

Transitions to college. The aspiration to use adult education and the GED as a pathway to postsecondary education is complicated by another articulation problem that is a mirror image of the ABE/ASE problem. An analysis of the COMPASS math test by the City University of New York researcher present at the CAAL Roundtable and circulated to participants indicates that this "gatekeeper" exam basically measures the ability of students to perform procedures in arithmetic and algebra.[21]

This means that students who have prepared for and succeed in passing the GED, which tests for numeracy, have not received the right kind of preparation to pass the COMPASS, which tests for traditional math and which colleges use for placement purposes. The CUNY researcher states that: "Because of poor exam alignment, we should not expect that GED math preparation alone

will also equip students to do well on the COMPASS exams.… GED math scores were found to only account for about 24% of the variability in students reaching math proficiency by the end of their first semester." [22]

Thus, even though students may benefit from gaining numeracy skills to pass the GED, this does not translate into improved ability to pass the COMPASS, a major gatekeeping test that determines whether they can enroll in college credit courses. In its present form, the GED is therefore apparently not a reliable pathway to college. Put another way, *a reason that too many students who study for the GED are placed in developmental courses is that ASE instruction is not articulated with the measure of math proficiency colleges use to determine placement*.

This articulation issue is deeply troubling for many reasons. First, a major reason that math personnel in both K-12 and adult education advocate for numeracy instruction is that they believe the range of skills encompassed by this enlarged notion of math instruction are those students need to succeed in college math and science courses, and to use math effectively in work and everyday life.

Second*, lack of articulation between the GED and the COMPASS calls into question what bridge courses should aim to do to help GED graduates make the transition to college—with regard to math at least*. Should they be cramming students to improve their ability with procedures so that they can pass gatekeeper tests? Or should they be teaching numeracy at levels required to pass the GED—a path that math educators believe will ultimately help students in their academic careers?

These questions are seldom asked. Many adult educators believe that one reason GED graduates have trouble making transitions to college is that they do not score high enough on the GED math test. In that case, the purpose of bridge courses should be to increase abilities in numeracy —the comprehensive set of math skills that the GED measures. It may be, however, that a major reason for transition problems is insufficient mastery of the procedural skills measured by gatekeeper tests. In that case, the immediate problem students face—avoiding developmental courses—can best be solved by bridge courses designed to increase procedural skills alone.

The author of the aforementioned CUNY study teaches a bridge course at the University. His approach is to teach a few topics in numeracy as thoroughly as possible, based on the belief expressed by some other numeracy advocates that ability to perform procedures usually accompanies numeracy instruction. He has so far succeeded in improving both numeracy and the percentage of students who score highly on the COMPASS exam. But this is only one instance, and discussion at the Roundtable suggests that *the design and purpose of bridge courses requires further examination to assure that they benefit students as much as possible*.

Third, obviously this problem of articulation should not exist. *In the short term, either colleges should adopt more comprehensive gatekeeper tests for math proficiency or the GED should be adapted to take account of college entry requirements*. The recently announced decision by the GED Testing Service to develop a new GED exam aligned with the Common Core Standards may provide the solution.[23] This is because colleges may well conclude that any students who meet those standards at the high school level (whether through standard high school attendance or an equivalency exam) have the math skills required for college work.

This development is somewhere in the future, however, and will require evaluation when it occurs. In the interim, discussion at the CAAL Roundtable suggests that adult educators, colleges, and the organizations that create high stakes tests should engage in deliberations about how to overcome the articulation problem between the GED and college entry requirements using the information and tests now available. *Several Roundtable members indicated that colleges in their areas are reluctant to engage in these deliberations.*

Misalignment of numeracy and the NRS. The problem of articulation between GED math and college requirements is the most dramatic articulation problem to be overcome if adult educators are to provide more effective pathways of opportunity to low-skilled adults. But lack of articulation between ABE and ASE is no less serious. Many numeracy advocates believe this can be overcome by teaching all aspects of numeracy to ABE students at all levels, and they have developed curricular guidelines on how this can be done. The Massachusetts Framework and EMPower are examples of such frameworks. Possibly, teaching all aspects of math to students at all proficiency levels would create a seamless continuum of math instruction from the lowest levels through ASE, and relieve the pressure on ASE courses to make up for the numeracy instruction ABE students have not received.

Progress in this direction is at variance with the requirements of the NRS, although this does not mean that the NRS prohibits programs from teaching numeracy at all levels. However, programs that pursue this route will be evaluated by student performance tests that are not designed to capture most of what they are teaching. At best, they must keep an eye over their shoulder to make sure that their students are progressing in both numeracy and mastery of particular procedures at each level that the NRS-sanctioned tests measure. This may hamper development of the most effective ABE numeracy curricula. At worst, the imperative to meet NRS standards may discourage programs from introducing numeracy at the ABE level at all.

The Massachusetts Department of Education has developed a numeracy assessment that measures student progress in programs that have implemented its Curriculum Framework and it has conducted analyses that show how scores on this assessment correlate with NRS requirements.[24] As a result, the state's assessment has been approved for use in NRS reporting. Important as this effort may be, it is not clear from information available to CAAL if the

Massachusetts assessment is valid for states that do not adopt the Massachusetts Framework. Because the assessment was developed in relation to the Framework, it appears that states that adopt other intended curricula for teaching numeracy at the ABE level and above would have to make their own investments in developing assessment systems and aligning them with the NRS.

Clearly, this is not a reasonable or cost effective way to solve the problem of aligning numeracy instruction with the NRS. If there must be a national assessment system for math in adult education, it should not be created one state at a time. *Adult educators must decide whether numeracy instruction should be incorporated into all levels of ABE, and if so, the NRS should work with states, teachers, and experts to replace or supplement the tests it presently prescribes with tests that measure progress in numeracy on a nationwide basis*.

Can this be accomplished without developing a national core curriculum for math in adult education that is similar to the core curriculum developed for K-12? Many Roundtable participants believe that it cannot. They think that the most cost-effective way to articulate adult education's various strands and to advance the shift to numeracy instruction nationwide is to launch a core curriculum initiative in this field that will parallel the initiative of K-12 educators. This suggestion will be discussed more fully below.

(4) ENGLISH LANGUAGE LEARNERS

The challenge. For decades, the American K-12 system was wracked by debates about how to teach academic subjects to children with limited English proficiency. In the end, a number of highly specialized and well-researched approaches have been adopted, and a cadre of teachers with specialized credentials has been trained to implement them. Regrettably, the adult education field has never addressed the issue of how to teach math or any other academic subject to adult ESL students. As a result, math instruction is not provided by ESL programs, and few have developed a systematic way to refer limited-English adults to other programs that could improve their math.

This is a major problem for adult education service provision regardless of what form math instruction takes. Roughly half of all adult education students are enrolled in ESL. The primary purpose of this service is to help students improve their ability to read, write, speak, and comprehend the English language. A secondary purpose is to help them acculturate to American society.

In other words, ESL instruction is almost exclusively instruction in language arts and it does not include a math component. As part of their acculturation goal, most ESL programs touch on topics related to math, such as making change using American currency and helping students

understand the vocabulary and symbols used to express mathematical operations in the United States. (For example, they explain that when Americans say "two times two" they are indicating multiplication.)[25] But they do very little to improve the math ability of students. This language arts emphasis is reflected in the fact that the NRS does not require ESL programs to test or report the math ability of their students. As a result, there is no direct measure of what their math problems may be.

However, according to ESL experts at the CAAL Roundtable, there is good reason to believe these problems are often severe. ESL programs serve immigrants with all levels of prior education. Some classrooms may include both college graduates and individuals with only a few years of former schooling. The only thing they have in common educationally is their desire to improve their English language abilities. Most highly educated ESL students probably have fairly good math skills. For them, the lack of math instruction is not a problem. But Roundtable participants believe that the vast majority of ESL students have less than a high school education and a large percentage have not completed grade school in their native countries. For these students, the lack of math instruction is a very serious problem. According to experts, this is because a major reason students enroll in ESL is to improve their economic prospects. To reach that goal, they certainly need to improve their English, but students with limited prior education also need to improve their math—for the same reasons that ABE/ASE students do.

It is understandable that math instruction is not part of the standard ESL curriculum. Teaching English requires a great deal of instructional time. Experts estimate that it takes on the order of 1000 hours of instruction for students with very low levels of English proficiency to reach levels where they can function effectively in American society.[26] Unfortunately, the vast majority of ESL students enter programs at very low proficiency levels. As a result, it may be that they are unwilling or unable to devote more time to adult education than the hours required to improve their language abilities. Likewise, ESL and math teachers require highly specialized and very different skill sets and training. It seems unrealistic to expect ESL teachers, probably the most professionalized members of the adult education faculty, to gain the expertise required to teach math as well.

What is more surprising is that neither the many ESL programs examined by CAAL in recent years nor any programs familiar to Roundtable participants provide for the math needs of ESL students at all.[27] This problem is rarely discussed or addressed. The question is, what can be done to help students with limited English proficiency and limited prior education attain the math skills they need to improve their economic prospects, and possibly even to transition to postsecondary education?

Strategies for progress. Insofar as adult education programs provide an answer, it is either to allow ESL students to move into ABE/ASE programs (usually at about the intermediate level of English language proficiency) or to provide supplemental math courses in which ESL students can enroll.[28] Based on the Roundtable discussion and research information available to CAAL, it is not known how common or effective either approach is. But fragmentary evidence suggests that at least some ESL students are motivated enough to devote the time required to enroll in supplementary math classes and that, when carefully implemented, blending ESL with ABE/ASE instruction can be effective.

Another approach is to enroll students whose native language is Spanish in classes that prepare them to pass the Spanish GED.[29] This test is a literal translation of the English language GED exam, and preparation for it would presumably include substantial math instruction. Again, there is little evidence of how effective this strategy is, and in particular if it poses barriers to students who want to transition to postsecondary education, where English language ability is required.

Issues and barriers. The lack of articulation between adult ESL and virtually all other aspects of adult education places the adult education field at a distinct disadvantage compared to K-12 when it comes to meeting the needs of ESL students. And because adult education has neglected this issue, it lacks the intellectual capital to address it that K-12 educators have accumulated over many years.

From the perspective of numeracy, this neglect should not continue. It is a disservice to ESL students to ignore their needs. There is no reason to expect that the ESL field is uniquely equipped to solve the problem, but someone must take responsibility for finding a solution. And it should not be assumed that solutions adopted by the K-12 system can be transplanted to adult education wholesale. Differences in the ways children of all ages and adults learn new languages as well as the greater instructional time available in school settings compared to basic skills classes suggest that adult educators will have to develop their own unique approaches.

Ultimately, providing numeracy instruction to adult ESL students will require the best efforts of everyone involved in adult education. It would be extremely helpful to have reliable data about the math abilities and prior education of ESL students. *To this end, the NRS could take a valuable first step by requiring a math assessment of these students and issuing a report on their educational backgrounds.* But any efforts by the NRS or others to map the math abilities of ESL students should account for the fact that math is often taught in very different ways in other countries than it is in the U.S. Thus, ESL students may have strengths in math that are not revealed by present NRS math assessments. Using numeracy assessments that cover all aspects of math proficiency would help develop understanding about how the math needs of ESL students can be met and how supplemental math instruction can be designed to build on their strengths.

A case could be made that providing math instruction to adult ESL students is the aspect of improving math instruction that most urgently needs attention. Low-skilled immigrants are becoming an increasingly large part of our prime age workforce. Their economic success or failure will have an important effect on our standard of living, on whether we can afford to support the retirement of the baby boom generation, and on many other headline issues. We cannot afford to treat math education, or anything else that will enlarge economic opportunity, as a niche issue.

(6) HOW MUCH IS ENOUGH?

The challenge. In shifting from traditional math instruction to teaching numeracy, policymakers and practitioners should be aware of several important issues that bear on their efforts to develop closer links between adult education and occupational training. An important reason for concern about the quality of math education is that so many employers, researchers, and policy leaders believe that too many American workers lack the math skills required for jobs and job training, and thus to ensure that our nation has a globally competitive economy. This problem is important in terms of workers' ability to perform necessary functions on the job, but also with regard to job training. In some ways, numeracy instruction is highly compatible with job training approaches that have been developed in recent years, but it also raises some questions about those approaches.

Common elements. Those who advocate for workforce development programs need to realize that a large number of low-skilled adults in the U.S. do not have high enough math skills to enter and succeed in training programs that will prepare them for current and emerging occupations, including areas where there is substantial demand for workers, such as technicians in health care or advanced manufacturing. This problem is particularly acute at a time of high unemployment, because low-skilled workers are more likely than other Americans to be unemployed or to be low-wage earners.

Leaders of adult education and workforce development have responded to this challenge by placing greater emphasis on the role of basic skills courses in preparing adults for job training and employment. In some cases, this consists simply of endorsing the importance of traditional basic skills instruction. But many professionals believe that even under the best circumstances increasing the basic skills of adult education students to the levels required for occupational programs takes longer than many students are willing or able to devote to adult education classes—especially students at lower proficiency levels who may need several years to reach the levels required for job training if enrolled in traditional classes.

As a result, adult and occupational educators have begun to collaborate in designing new programs that accelerate the development of both basic and occupational skills. Many of

these programs take the form of "concurrent" or "integrated" instruction in basic skills and occupational training. In this approach, students learn the technical content of a particular occupation and the basic skills required to master that content and meet the requirements of the occupation at the same time—often by alternating between occupational and basic skills classes. This kind of workforce development first received national attention as a result of programs developed by the Center for Employment Training (CET) in the late 1980's.[30] Today it is best known through the various VESL (Vocational ESL) programs and Washington State's I-BEST initiative. An increasing number of programs are adopting the concurrent approach in some way.[31] Growing interest in combining basic skills instruction with workforce development is one of the signature features of adult education in recent years and of important legislation pending in Congress.

Concurrent basic skills/occupational programs and numeracy instruction are compatible approaches to adult education in at least two important ways:

First, both emphasize the value of contextualized instruction. As discussed above, one of the defining characteristics of numeracy is teaching math by helping students explore the applications of mathematical procedures, concepts, and reasoning to real world problems. The basic skills instruction of concurrent programs is necessarily contextualized, because those programs teach the skills students need to pursue their occupational studies. In both numeracy instruction and concurrent occupational programs, students learn math by using it for practical purposes rather than by memorizing abstract procedures. This emphasis on "learning by doing"—often called "functional context" instruction—has been advocated by many adult education leaders for several decades.[32] They believe that if students can immediately see the relevance of the math or other basic skills they are learning they will not only learn faster but also be more motivated to persist in programs. Numeracy and concurrent occupational programs are applications of the functional context approach.

Second, both numeracy and concurrent occupational instruction incorporate a wider range of math content for adults at the lower levels of basic skills proficiency than is found in traditional adult education classes. Numeracy instruction incorporates virtually all forms of math for students at all proficiency levels, and integrated programs include whatever type of math students need to meet the requirements of a particular occupation. For example, if someone studying to become a medical technician needs to be able to read and explain charts and graphs or to understand certain algebraic concepts, contextualized programs will teach these aspects of math using as examples the tasks the student is learning to perform. These are aspects of math that most traditional adult education programs teach at only the highest levels of proficiency, and even at those levels they may not teach the concepts in a contextualized form.

Divergent Goals in Numeracy & Concurrent Education. Despite these common elements, however, the CAAL Roundtable discussion suggested a possible divergence of goals between numeracy and concurrent approaches to job training. This divergence may be more apparent than real, but it is apparent enough that a number of Roundtable members suggested that further explorations of both numeracy and job training programs would be beneficial.

What is the possible goal divergence? As stated at the outset, the goal of numeracy advocates is to improve the quality of math education by expanding the math curriculum beyond a primary emphasis on learning abstract procedures in arithmetic and (at the higher levels) algebra. The aim is to move toward a wider range of math topics as well as a better conceptual understanding of those topics and greater ability in applying them. Because students enter adult education classes with different levels of math proficiency, a better curriculum would necessarily be one that improves math instruction for students at all levels and allows them to advance to higher levels. But how far should they advance? Ideally, far enough that their math abilities do not pose problems in their work, further education, or everyday life. As already explained, most numeracy discussions posit a curriculum that reaches at least high school completion and many extend the curricular goal to college readiness. That is, most discussions of numeracy explore the requirements for a comprehensive numeracy curriculum.

The goal of concurrent occupational instruction is somewhat different. It is to provide low-skilled adults with the education and training they need to complete occupational courses and perform effectively on the job—as quickly as possible. The purpose of math education in these courses is to provide students with the math skills they need to achieve these goals in a particular occupation.

These goals may diverge if a particular occupation (or job program) does not require the full range of numeracy skills, or if it requires only a rudimentary level of some skills and a fairly high level of others. For example, it may be that nursing students do not need a very advanced understanding of geometry or algebra, but they do need a high level of ability in dealing with data and measurement. And it may be that they can do their jobs perfectly well if they have the rudimentary ability to perform arithmetic procedures. Should a concurrent nursing program devote time and resources to teaching nurses skills they may not need for immediate occupational purposes? That is, should it aspire to comprehensive numeracy instruction? This would seem to defeat the purpose of concurrent instruction.

In short, programs that attempt to accelerate basic skills instruction in the context of job training inevitably face the question of "how much is enough" with regard to the numeracy and other skills they teach. In math, they will not speed up progress unless they teach a less extensive set of numeracy skills than students would learn in a comprehensive numeracy curriculum. And

they may teach considerably less. Several Roundtable participants who have observed concurrent programs expressed the belief that although the programs teach selected math applications, they may not improve overall math proficiency.

Why does this divergence matter? There are several reasons. First, the math skills required by virtually all jobs are increasing and changing in nature, one reason that inadequate math ability in the United States has caused alarm. As a result, job training that prepares students only for the present math requirements of an occupation may well leave them unprepared to function effectively in that occupation in the future.

Second, many training programs for low-skilled adults prepare them for low-wage entry-level jobs. While these may offer students improved working conditions and income, they can become dead-end jobs unless students have the skills required to move up career ladders—which inevitably includes basic skills at a higher level than required by the job for which they were initially trained. As a result, concurrent training programs will have limited benefits unless they provide the basic skills that allow students to ascend career ladders—in the case of math, a higher level of numeracy than the jobs for which they are first trained.[33]

Third, teaching only the basic skills required for entry-level jobs or even jobs one or two steps higher in an occupational hierarchy also does not meet national manpower needs. To build a competitive economy, the U.S. will have to educate far more people at the Associate or Bachelor degree level in virtually all fields. If job training and adult education are to make a substantial contribution to meeting national manpower needs, they will have to prepare students with the basic skills needed to ascend career ladders to these levels.

Fourth, the recent economic downturn has underscored the fact that the American economy is undergoing major structural changes. Demand for workers is growing in some occupations and industry sectors and declining in others. An increasing number of workers must undergo retraining in fields far different from those in which they have been employed in the past. These workers will be at a disadvantage if their basic skills are limited to those required by their past job. As a result, organizations that provide educational services to the under-employed or unemployed should give workers a firm grounding in all aspects of numeracy and the basic skills. *They should offer upgrading that is transferable to new occupations and industries.*

In short, to meet the needs of students and the economy, the basic skills component of concurrent job training programs must be forward looking. It must anticipate the skills needs of occupations and provide the foundation for upward mobility and possibly retraining individuals in the future. Regrettably, neither Roundtable participants nor CAAL are aware of research on the types of math or other basic skills instruction such programs typically include. In reviewing a few programs in the ESL field, CAAL observed that their basic skills content was

based on a combination of auditing occupational courses and assessing the skills of incumbent workers in particular occupations.[34] If this is the prevailing practice in concurrent programs, the design would not appear to be forward looking enough. Graduates of job training programs would have to find some means of upgrading their basic skills in the years to come—and this need would become apparent at the worst possible time, when they discover that low skills make it hard for them to perform effectively on the job, to advance up career ladders, or to change occupations.

Solutions and issues. For many years, employers have been aware of limits in workers' basic skills proficiency. In some cases, they have contracted with adult education programs to provide specific skills for specific tasks—for example, how to use fractions in calculating the amount of different chemicals that should be combined in an industrial solution. This type of ad hoc incumbent worker training plugs small gaps in basic skills deficiencies. But it does not come to grips with the more comprehensive skills upgrading needed when occupations or industries undergo major structural change—such as the advent of statistical process control in many areas of manufacturing.

At the very least, the differing goals of numeracy instruction and job training should be a caution for the growing number of concurrent programs. These programs should assure that their numeracy and other basic skills components are thinking to the future. Roundtable participants offered no answers on how they can do this with any precision, and nothing they suggested indicates that the state of the art in adult education or job training allows either field to predict future skill needs for particular occupations.

Insofar as this problem is addressed now, it might be by requiring participants in concurrent programs to have fairly high levels of numeracy or other basic skills before they enter them. In fact, many programs observed by CAAL require enrollees to have at least an intermediate level of basic skills, and others require a GED.[35] With regard to math proficiency, students who are assessed at the intermediate level in traditional adult education courses would seldom have math skills beyond arithmetic. This entry-level requirement would seem to be too low. But students who have been enrolled in numeracy courses would have a fairly broad range of math skills at the intermediate level. In short, one way that job training programs can be more future-oriented is to assure that the students they enroll have had access to comprehensive numeracy curricula rather than traditional math instruction—prior to the time they enroll.

Adopting this approach would narrow the distinction between concurrent basic skills/ occupational training programs and "sequential" models for preparing low-skilled adults for job training, the model that has long been dominant in the United States. In sequential programs, students complete a comprehensive adult education curriculum *prior to* enrolling in occupational studies. In some sequential programs, students identify their occupational interests at an early

stage in their adult education studies, and teachers try to make use of materials and activities required by the target occupations as the context for the basic skills they are developing. But for very low-skilled adults, sequential programs require more instructional time than do concurrent programs, and students may lose motivation unless teachers and counselors ensure that the goal of occupational training remains clear. Nevertheless, students who complete sequential programs have the full set of basic skills they will need in their future careers. Strengthening the programs to increase retention and accelerate learning should, therefore, be a priority.

Multiple types of numeracy. Roundtable participants stressed repeatedly that we should possibly think in terms of multiple kinds of numeracy—for example, numeracy for academic studies, occupational training, everyday life, or parenting. But they did not explore these notions very deeply, and CAAL has found no literature that does. Certainly they require a thorough exploration, if for no reason other than that they raise the question of "how much is enough?"

As the discussion of job training illustrates, it is hard to know what form numeracy instruction should take unless its goals are carefully considered. If something less than a comprehensive numeracy curriculum is sufficient for certain purposes, then the math required for those purposes should be defined. It may be that there is no practical difference between various types of numeracy. It may be enough to say that numeracy, like every other skill, is a matter of more or less, and that less is required for some purposes than for others. If there is a practical difference, however, as there appears to be in some forms of job training, then this should be specified. Otherwise the success of the various enterprises to which numeracy might be applied will be in doubt. Based on the discussion at the CAAL Roundtable, this appears to be a set of issues with which numeracy advocates are only beginning to grapple in the context of adult education.

(7) TEACHER PREPARATION

The challenge. Roundtable participants devoted more time to the topic of preparing adult education teachers to move from traditional math instruction to numeracy than to any other. This is not surprising because it is mostly teachers who determine what the "implemented curriculum" (the instruction students actually receive in the classroom) will be in math or any other area of education. No matter how well-considered documents such as the Massachusetts Framework or EMPower may be, teachers have the responsibility for translating them into learning opportunities, and for customizing them to meet the distinctive needs of adult learners. As noted above, these curricular designs are in many ways similar to those adopted by the Common Core Curriculum for children.

A special need. Most of the concerns voiced about teacher preparation echoed those expressed by K-12 math scholars for many years, as summarized earlier in this report. Simply put, math reform advocates believe most school teachers have fairly low math abilities themselves and little insight into what numeracy entails, let alone how to teach it. Without a program to upgrade the math abilities of teachers and prepare them for numeracy instruction, there is little chance that numeracy curricula can be implemented at the classroom level in either K-12 or adult education.

Roundtable discussants think that the challenge of teacher preparation is more serious in adult education than in K-12. Although many adult educators are active or retired school teachers, the field has been fortunate in attracting many highly talented, dedicated people who have little or no formal training or prior educational background at all. Adult educators who are or have been elementary school teachers have at least some experience and often some academic training in teaching math—although that experience and training is often limited to drill and practice of procedures, and a good many lack this experience when they first enter the field.[36]

Barriers to progress. K-12 has attempted to address the problem of math teacher qualifications by encouraging more of them to take additional courses to qualify as "math specialists"—either at the BA or MA level or through in-service training. The pressure of No Child Left Behind to increase student math scores on standardized tests has resulted in a high demand for these teachers. In fact, math specialists in K-12 are often paid premium salaries and have no shortage of job offers. Based on accounts from Roundtable participants, they frequently serve as regular classroom teachers. But they sometimes also serve as *master teachers* who mentor their colleagues in improving this aspect of instruction—in much the same way that the growing cadre of "reading specialists" help their colleagues improve reading instruction.

Because few academic teacher preparation programs specialize in adult education—and few students enroll in those programs that exist—adult education has been unable to match K-12 initiatives in this respect. At best, it must compete for the limited number of K-12 math specialists. Because the terms of employment in adult education (rates of pay, availability of benefits, number of full-time positions, and even access to essential instructional materials) are less favorable than in K-12, Roundtable members think it would be difficult under present conditions to entice math specialists into adult education as either full- or part-time teachers.

Professional development. To the extent that adult education has been able to upgrade teachers' abilities to provide math instruction, it has been through in-service professional development classes or workshops.[37] The number of hours of professional development in math or math instruction available to adult education teachers seems to vary greatly among states and programs, as do the topics covered. Based on Roundtable accounts, it appears that a few days per year of professional development is all that most teachers get, and/or for which they

receive released time. Whatever level of professional math development is presently offered, Roundtable participants unanimously believe that it is inadequate to prepare the adult teaching force to provide comprehensive numeracy instruction.

However, this conclusion should not diminish the value of professional development for math instruction in adult education. The participants reported that even in limited amounts, it can help teachers understand that there is more to math education than teaching procedures. It can also provide them with at least some pedagogical tools, lesson plans, and other intellectual capital to broaden and deepen their instruction. And even limited professional development can encourage teachers to learn more in other ways—such as the literature and websites sponsored by the ANN and other groups and the extensive resources that have been created for math teachers in the K-12 field. Importantly, professional development can encourage teachers to learn by experimenting with numeracy instruction in their classrooms.

It is widely believe that students benefit from teachers who receive this kind of assistance. Thus, as a first step in moving from traditional math toward numeracy in adult education, most Roundtable participants advocated more and better professional math development programs that reach more teachers more effectively. Participants who have been involved in professional development activities report that teachers "vote with their feet" to endorse this conclusion. Seminars, workshops, and courses in math education for adult education teachers are well attended, and many attendees express the desire for more learning opportunities in this area of their work.

Math specialists/master teachers. While simply expanding existing forms of professional development in math education would be a worthwhile investment, the Roundtable discussants think it must be accompanied by more substantial investments of time and money in teacher training. One participant estimated that most teachers would require the equivalent of four three-credit academic courses to improve their math abilities to the level needed to teach numeracy effectively. This would take a large investment on the part of teachers, programs, or both. Realistically, the attainable goal may be to create a cadre of math specialists or master teachers in adult education similar to those being developed in K-12. The benefits of a master teacher in each program—someone who can mentor other staff members in building their skills for numeracy instruction—are illustrated by the CUNY program reviewed at the Roundtable.[38]

Roundtable participants also observed that investments are needed in other areas of teacher preparation. For example, one observed that just as we have no satisfactory way to assess students' numeracy abilities, we also presently have no good way to assess the math proficiency of teachers or their ability to provide effective numeracy instruction. Existing teacher assessments in math are keyed to traditional math instruction. If adult education and K-12 are to expect more from math teachers, the federal government or some other source(s)

of research and development funding will have to invest in the creation of new teacher math assessments that can verify when teachers have achieved the knowledge and skills they need.

A number of Roundtable participants suggested that *taking special steps to recruit more math specialists from the K-12 field should also be explored*. Although adult education programs cannot compete with school systems in many respects, they do offer teachers greater autonomy and variety in their work, and in the best of circumstances they provide more motivated students. Many K-12 teachers are frustrated by the demands that education policy have placed on them in recent years. It is possible that if adult education programs reached out to K-12 math specialists, some would be willing to exchange somewhat lower wages and benefits for greater professional satisfaction. This would probably require paying the math specialists a salary that compares with the best-paid adult educators. It might also require creating more full-time positions for these people generally, in effect creating a kind of "lead teachers" core. Together with enhanced professional development, investments in academic coursework to create a core of "lead teachers," and better use of technology, efforts to recruit K-12 specialists should be part of any comprehensive strategy to expand the instructional range of math teachers in adult education.

Role of Technology. Roundtable participants did not give much attention to the role of technology or distance learning in improving the proficiency of adult education teachers in math instruction. But a variety of recent research reports, including Reach Higher, America and The Power of Technology to Transform Adult Learning,[39] present a powerful case for such a role. The participants did observe that there is a large amount of math teacher training material available online from various sources. But they were not very familiar with its quality or how it can best be used. Because technology can offer cost-effective professional development services, clearly its potential role should be explored further.

Funding constraints. On the whole, the concerns of Roundtable participants about teacher quality in math were similar to concerns expressed in CAAL's 2010 Roundtable on Faculty and Staff Certification[40] and in other recent discussions of adult education teacher certification and credentialing. The core problem is that state and national policy provides too little funding for teacher training in any area of adult education, and funding constraints make it almost impossible to create conditions of employment that would attract adult education teachers and reward them for investing their own funds in needed further education. Roundtable participants, like other leaders in adult education, believe that these *funding restrictions are shortsighted in the extreme*. Without a greater investment in the adult education teaching force, it is hard to see how numeracy curricula or any other improvements can be implemented for adult basic skills services.

PART D: SUMMING UP

(1) EXPANDING THE MATH AGENDA

If discussions of numeracy in adult education achieve nothing else, they at least call attention to the importance of improving math instruction in basic skills programs. This is an exceptionally valuable contribution to both policy and practice, because examining the present state of math instruction and what must be done to improve it have never been priorities for most adult educators. Numeracy leaders have begun to expand the agenda of issues that must be addressed for the field to provide the service that low-skilled adults and the nation's economy require. Once math/numeracy is visibly on the table in deliberations about the future of adult education, it will become clear why it should be a priority, especially if understood in the enlarged sense advocated by leaders who embrace the concept of numeracy.

One reason that adult educators have marginalized the importance of math instruction may be that it conjures up memories of rote instruction in procedures during their school years from which they feel they have derived little benefit. But in expanding the scope of math education—in effect redefining it—numeracy advocates demonstrate that it includes a wide range of skills essential to most adults in everyday life and at work and that will be recognized as such if effectively taught.

(2) GED & ESL AS FORCES FOR CHANGE

In neglecting math education, adult educators have fallen behind their K-12 counterparts. Upgrading math in the K-12 system has been one of the highest priorities of school reform for several decades, and the Common Core Standards for math adopted by almost all states will result in numeracy instruction rather than traditional school math, becoming the norm for America's children. One consequence of this K-12 evolution is that the GED Testing Service recently announced that it will develop a new version of the GED aligned with the Common Core Standards.

This GED development in itself will force certain kinds of change. A significant percentage of ABE and ASE students enroll in basic skills classes to gain the knowledge and skills they need to obtain a high school equivalency certificate. Although articulation of adult education curricula with the existing GED test is far from perfect, development of a new GED based on the Common Core Standards will require a thorough review of the content and pedagogy of ABE and ASE. New math curricula will have to be developed that close the gap between the traditional math norm and numeracy proficiency that the new GED will require. Unless adult educators are

prepared to meet this challenge, they will be unable to deliver one of their signature services: preparation for high school equivalency exams.

In short, the creation of a new GED exam based on the Common Core Standards will make the nature and quality of math instruction in adult education a priority issue in the coming years, whether or not adult educators are influenced by the arguments of numeracy advocates today.

The growing importance of immigrants to the American workforce is also a force for change. This phenomenon means that adult educators cannot continue to neglect the math needs of ESL students without serious consequences. We will have to overcome the barriers to job training and postsecondary education that now exist for ESL populations, and that are caused by poor articulation between math instruction and the requirements of adult ESL education. In the decades to come, the nation will not be able to meet its need for high-skilled workers unless a significant percentage of ESL students are able to ascend career ladders in job training and postsecondary education. To do this, many will have to develop math (and other basic skills) as well as English language skills, and a major priority for adult educators must be to develop program models that make this possible.

(3) LEADERSHIP & PARTNERSHIP

Upgrading the quality of math instruction will require developing new curricula, assessments, staff development programs, and more. Reform-minded educators have made an important beginning in this process, but they have been hampered by a shortage of resources. Because math instruction has not been a priority for adult education, resources have never been earmarked for this purpose. To make matters worse, total funding for adult education at the federal level has been static for some years, and funding by many states has declined as a result of the economic downturn. Thus, there appears to be barely enough support to maintain the existing adult education system generally, let alone for program improvement on the scale needed for a shift to numeracy instruction. Clearly, we need to think innovatively and outside the box—and new forms of leadership and new partnerships will be needed.

Roundtable participants recommended that the U.S. Department of Education use some of its national leadership funds to partner with states to establish new models at the state and program levels. And they urged that this partnership include a close working relationship between adult education and K-12 agencies responsible for implementing the Common Core Curriculum for math. They recommended that adult educators become members of federal and state working groups engaged in K-12 reform, so that the agendas and needs of adult learners can be factored in. Because the goals of numeracy instruction for adults are similar to those of the Core Curriculum, this could be a reasonable and cost-effective way to move forward.

But proceeding in this way will be more than a matter of re-formatting K-12 materials. As discussed above, curricula, assessments, and staff training for improved math instruction in adult education will have to take account of important differences between improving the basic skills of adults and teaching children. Among these are limits on the time adults can devote to basic skills classes, the need to articulate their progress toward various goals, the background knowledge and experience they bring to learning, possibly conflicting priorities in job training programs, the apparent absence of a strong foundation in adult education for teaching math to ESL students, and lack of an infrastructure and incentives for major advances in teacher training.

Taking account of these and other challenges in partnerships to implement the Core Curriculum will require a substantial commitment of resources. Numeracy advocates believe that the federal government and states must make the trade-offs necessary to invest these resources if the needs of a large percentage of our population to improve their math skills are to be met, and if national employer needs are.

(4) THE RESEARCH IMPERATIVE

If adult educators are to progress in improving math instruction, whether in partnerships or not, they must develop a stronger knowledge base about this area of basic skills instruction. Because math has been such a low priority in adult education, many assumptions made by numeracy advocates are necessarily based on fragmentary evidence. Adult educators will be in a much stronger position to draw conclusions about curriculum, pedagogy, teacher preparation, and other elements of implementing a new approach to math instruction if they can gain a better understanding of key issues.

For example, detailed and systematic research is needed to determine more precisely the numeracy skills of ABE/ASE and ESL students, the form classroom instruction in math presently takes, the qualifications for numeracy instruction teachers have and need, and the form math instruction takes in various types of job training programs. There is no reason to doubt that numeracy advocates have drawn the right general conclusions about these and other topics. But public and private funders should invest in a research agenda to validate these conclusions and deepen understanding of the problems in math education and the form solutions should take.

National report cards would help. At the very least, the NRS should require states to report the proficiency and progress of ABE/ASE students in *both* literacy and math, not just the basic skill in which students score lowest, as at present. And the NRS should require reports on the math levels of ESL students. These should be published as national report cards on literacy and numeracy, respectively. Although NRS measures of math ability may be problematic, this change of reporting policy would be a low-cost way to construct at least a preliminary

topographical analysis of the need for math/numeracy instruction in adult education and how well it is being met. And it may emphasize the importance of such instruction to states and local programs.

Beyond this type of topographic research, significant investments are needed to address the many other issues raised by this report, which should be a high priority for both public and private funders. For example, there is a great need to develop assessment systems that will measure the numeracy of both students and teachers. We should try to find out what numeracy skills should and can be taught in different contexts (especially in the context of various forms of occupational training). We need to develop systems for teaching numeracy to adult ESL students, determine how best to use technology for teaching math and professional development of teachers, and, most fundamentally, conduct in-depth research on how numeracy instruction for adults must differ from that for children. There is also a need for both theoretical and action research on whether adult education should develop a numeracy core curriculum linked to the K-12 Common Core Curriculum, and if so what form that adult core should take.

(5) FINAL OBSERVATIONS

Some numeracy advocates are frustrated by the common practice of using the term "literacy" synonymously with adult education in both policy and professional discourse. They believe the United States should follow the example of at least some other countries by routinely using the phrase "literacy and numeracy" to describe its system for improving basic skills. They suggest that, though this would be largely symbolic, it would be a long overdue acknowledgement of the central importance of math instruction in adult education. CAAL believes the suggestion deserves serious consideration.

Demonstration projects. It seems evident that if partnerships for implementing the Core Curriculum cannot be implemented in the near term, the progress made by a few states, such as Massachusetts, could provide a foundation for moving ahead. As noted above, it may be that the most realistic strategy for improving math instruction in the near term is for the federal government to sponsor demonstration projects in some of these states, as a way to create fully implemented comprehensive numeracy curricula as well as assessment and staff development systems the adult education field now lacks. Large progress in a few states could provide models that other states will follow. Investments in demonstration projects are an established and familiar federal strategy, and the cost of investing in a few states that are already trying to upgrade math instruction and having at least some success should be possible within existing federal resources for adult education program improvement.

Someone must take charge. Finally, while participants in the CAAL Roundtable reached no consensus on the best approach for engineering national progress in math instruction in adult

education, they did agree that someone must take responsibility for overcoming the longstanding neglect of this issue. In light of the U.S. Department of Education's emphasis on improving math instruction in the K-12 system, they thought that the Department is the natural agency to assume the responsibility. CAAL suggests that the Office of Vocational and Adult Education pick up the baton for making improved numeracy instruction a priority in adult education.

APPENDIX A: ENDNOTES

[1] Lynda Ginsburg, "Adult Numeracy Demand & Provision," in Adult Numeracy: A Reader, p. 1, Council for Advancement of Adult Literacy, New York, 2011.

[2] This formulation is based on the "Glossary" of the NAAL reports, http: //nces.ed.gov/naal/index.asp.

[3] Lynda Ginsburg, op. cit.

[4] Sue Southwood, "Basic Skills in the United Kingdom: How it Has Evolved over the Past Decade," in Adult Numeracy: A Reader, Council for Advancement of Adult Literacy, New York, 2011.

[5] Massachusetts Adult Basic Education Curriculum Framework for Mathematics and Numeracy, Massachusetts Department of Education, Adult and Community Learning Services, (October, 2005), www.doe.mass.edu/acls/framework.

[6] Curriculum and Evaluation Standards for School Mathematics, National Council of Teachers of Mathematics, Reston, VA,1989. This seminal document does not appear to be available online but is still in print. Its revision in 2000, Principles and Standards for School Mathematics, is available from the Council's website at www.nctm.org.

[7] The most frequently cited documents are: (a) National Mathematics Advisory Panel, The Final Report of the National Mathematics Advisory Council (U.S. Department of Education, Washington, DC, 2008), http://www2.ed.gov/about/bdscomm/list/mathpanel/report/final-report.pdf. (b) Adding it up: Helping children learn mathematics, Jeremy Kilpatrick, Jane Swafford, & Bradford Findell, Eds., (National Mathematics Learning Study Committee, Center for Education, Division of Behavioral Sciences and Education, National Research Council, National Academy Press, Washington, DC, 2001), http://www.nap.edu/openbook.php?record_id=9822&page=1. (c) Quantitative Literacy: Why Numeracy Matters for schools and colleges, Bernard L. Madison and Lynn Arthur Steen (Eds.), Proceedings of the National Forum on Quantitative Literacy held at the National Academy of Sciences in Washington, DC, December 1-2, 2001, National Council on Education and the Disciplines, Princeton, NJ, 2003).

[8] Common Core State Standards for Mathematics, Center for Best Practices, National Governors Association and Council of Chief State School Officers, NGA, Washington, DC, 2010, http://www.corestandards.org/the-standards.

[9] Massachusetts Framework, op. cit. The discussion in this and the following paragraphs are largely based on the exceptionally useful introductory material in the Framework document, other Massachusetts' documents, the background material available on the Adult Numeracy Network website (www.aduldnumeracynetwork.org), and the CAAL Roundtable discussion.

[10] Available at www.adultnumeracynetwork.org.

[11] Adding it up: Helping children learn mathematics, op. cit, p. 124.

[12] Diana Coben, "Numeracy, Mathematics, and Adult Learning," Ido Gal (Ed.) in Adult Numeracy Development: Theory and Research Practice, Creskell, NJ, Hampton Press, 2000, p. 63.

[13] See, for example, Ginsberg, op. cit. See also Lynda Ginsburg, Myrna Manly, and Mary Jane Schmidt, The Components of Numeracy, National Center for Study of Adult Learning and Literacy, Cambridge, MA, 2006, www.ncsall.net/fileadmin/resources/research/op_**numeracy**.pdf. Also see other resources at the Adult Numeracy Network website (www.adultnumeracynetwork.org) and at Adults Learning Mathematics, the website of the international forum for scholars concerned with adult numeracy, www.alm-online.net.

[14] See "NRS Implementation Guidelines" at www.nrsweb.org, pp. 21-27.

[15] See http://empower.terc.edu.

[16] Described by Steve Hinds in "More than Rules: College Transition Math Teaching for GED Graduates at the City University of New York, "first published 2009, reprinted in Adult Numeracy: A Reader, Council for Advancement of Adult Literacy, NY, 2011, www.caalusa.org/Adult.pdf.

[17] Private communication from Bob Bickerton, Senior Associate Commissioner, Massachusetts Department of Education, June, 2011.

[18] See Ginsburg, op. cit., pp. 5-8.

[19] Ibid., p. 6.

[20] Ibid., p. 8.

[21] Steve Hinds in "More than Rules…", op. cit., pp. 19-26.

[22] Ibid., p. 9.

[23] See "ACE and Pearson Collaborate to Transform GED Test Aligned With Common Core Standards." The press release is available at www.acenet.edu/clll/ged/index.cfm.

[24] See Massachusetts Framework, op. cit.

[25] See, for example Tom Ciancone, Numeracy in the Adult ESL Classroom, Center for Applied Linguistics, Washington, DC, 1996, http://www.cal.org/caela/esl_resources/digests/Ciancone.html.

[26] For a quick reference on this and other basic facts about adult ESL mentioned in this report, see JoAnn Crandall and Ken Sheppard, Adult ESL and the Community College, Council for Advancement of Adult Literacy, NY, 2004, http://caalusa.org/eslreport.pdf.

[27] See CAAL's various ESL reports at www.caalusa.org/publications.

[28] For an example of the latter approach see Pamela Ferguson, "Yakima Community College," in Torchlights in ESL, Council for Advancement of Adult Literacy, NY, 2007, http://caalusa.org/torchlights.pdf.

[29] See Crandall and Sheppard, op. cit.

[30] One of the best discussions of the theory, practice, and history of this and other forms of functional context instruction is W. Norton Grubb, Judy Kalman, Maria Castellano, et al, in Readin', Writin', and 'Rithmetic One More Time: The Role of Remediation Within Vocational Education and Training Programs, National Center for Vocational Education, Berkeley, CA, 1991.

[31] For information on I-BEST see http://flightline.highline.edu/ibest/.

[32] See W. Norton Grubb et al., op. cit.

[33] For examples of this and other problems in the allied health field, see Forrest Chisman and Gail Spangenberg, To Reach the First Rung and Higher, Council for Advancement of Adult Literacy, NY, 2005, available at www.caalusa.org/firstrungandhigher.pdf.

[34] See Forrest Chisman and JoAnn Crandall, Passing the Torch: Strategies for Innovation in Adult ESL, Council for Advancement of Adult Literacy, NY, 2007), http://caalusa.org/eslpassingtorch226.pdf. Also see Chisman and Spangenberg, "To Reach the First Rung and Higher," op. cit.

[35] Ibid.

[36] For a discussion of this and other issues related to adult education math teachers see Bob Bickerton, "Policy To Improve Math Teaching and Learning in Adult Basic Education: A Perspective from Massachusetts," in Adult Numeracy: A Reader, Council for Advancement of Adult Literacy, NY, 2011), available at http://www.caalusa.org/Adult.pdf. See also Ginsburg, op. cit., pp. 13-16.

[37] On professional development, see Ginsburg, op. cit., pp. 15-16.

[38] See Steve Hinds in "More than Rules…", op. cit.

[39] Reach Higher, America, the final report of the National Commission on Adult Literacy (2008), and The Power of Technology to Transform Adult Learning: Expanding Access to Adult Education and Workforce Skills Through Distance Learning (2009) by Mary McCain, Council for Advancement of Adult Literacy, NY, are available, respectively, at http://www.nationalcommissiononadultliteracy.org/ReachHigherAmerica/ReachHigher.pdf, and www.caalusa.org/POWER_OF_TECH.pdf.

[40] See Forrest Chisman, Closing the Gap: The Challenge of Certification and Credentialing in Adult Education, Forrest Chisman, Council for Advancement of Adult Literacy, NY, 2011, http://www.caalusa.org/Closing.pdf.

APPENDIX B:
NUMERACY ROUNDTABLE PARTICIPANTS

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